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Engineering News-Record

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A JOURNAL OF CIVIL ENGINEERING AND CONSTRUCTION

ISSUED WEEKLY

VOLUME LXXXVIII

January 1 to June 30, 1922

182695
23.7.23.

McGRAW-HILL COMPANY, INC.
10TH AVENUE AT 36TH STREET
NEW YORK

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ENGINEERING NEWS-RECORD

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A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. Mehren
Editor

Volume 88 — NEW YORK, JANUARY 5, 1922 — Number 1

Engineering News-Record is a consolidation of *Engineering News* and *Engineering Record*, effected in 1917.

Engineering News was founded in 1874 by George H. Frost, as the *Engineer and Surveyor*, which title subsequently became the *Engineer, Architect and Surveyor*, then *Engineering News and American Railway Journal* and finally, *Engineering News*, under the successive editorships of D. McN. Stauffer, Arthur M. Wellington and Charles Whiting Baker.

Engineering Record was established in 1877 by Henry C. Meyer as the *Plumber and Sanitary Engineer*. The name was subsequently changed to the *Sanitary Engineer, Engineering and Building Record* and, finally, to *Engineering Record*. During his ownership of the paper, Mr. Meyer was directly responsible for the editorial policy. John M. Goodell became editor in 1902, and was succeeded by E. J. Mehren.

The Contractor was consolidated with *Engineering News-Record* in 1918.

The staff of *Engineering News-Record* consists of

New York: E. J. Mehren, *Editor;* F. C. Wight, *Managing Editor;* M. N. Baker, F. E. Schmitt, R. K. Tomlin, Jr., C. S. Hill and J. W. Shaver.

Chicago: W. W. DeBerard, E. E. R. Tratman.

San Francisco: N. A. Bowers.

Spirit of This Issue

BUSINESS is like a ship. At times it is in much-traveled waters; at others in uncharted seas. Again it is favored by fair weather, and then assailed by mighty storms. In familiar waters and on fair days the sailor's task is easy. A normal amount of watchfulness is sufficient to bring the ship unharmed to port. If the weather is unpropitious, greater precautions are necessary, while if a hurricane comes in uncharted waters, every art and all the knowledge of the seaman are called into play. No opportunity is lost to determine the direction in which safety lies.

The ship of business has recently been in uncharted seas, with a hurricane blowing. Not only the captains but all of the crew have been tensed with anxiety. Whither were they going in the hurried run for safety? What shoals lay in the course? What favorable signs were there of safe harbor or of abatement of weather? —These are the questions not merely of the navigating officers, but of the technical staff and the common sailors, many of whom hitherto have not concerned themselves with navigating problems.

Such being the situation there has been a great and rapid growth of interest in the log and in the charts of business. To satisfy this interest, *Engineering News-Record* has been developing in recent years the records of the construction industry. These will be found, brought up to present date, in the early part of this issue and constitute the distinguishing feature of this the first number of the new year. Normally these statistics are found near the end of each issue, under the heading, "Business Side of Construction."

It is our belief that a comprehension by the three branches of the industry—engineering, contracting and manufacturing—of where the industry stands will help in determining sound policy. Each branch has its own special point of view. One reads caution into the figures; another sees much of optimism. Put together the sentiment welds into that of the entire field. It is important, therefore, that the several views be based on fact. Even then there is plenty of room for variation in interpretation and for going astray. It was in the hope that fact could be made to supplant guesswork that the various records, analysis and index numbers were established. Their hearty welcome by the field shows that they were sorely needed.

That the construction industry may not want for charts, where charts are available, is the spirit in which the *News-Record* has undertaken these contributions.

Much in Small Compass

IN LAYING out its program of business information for weekly publication *Engineering News-Record* has kept in mind that conciseness was desirable. In this the first issue, however, a certain amount of expansion was necessary. It is easy to fill page after page with figures; it is not easy to get at their essence and present it in a few words. Often the truth cannot be fully comprehended unless the underlying data are at hand for use in verification. That is particularly true in scientific studies. But in business matters the summaries or conclusions generally suffice.

Bearing this in mind we have condensed everything to the utmost. The index numbers in a few figures show the whole state of the industry. The "Trend of Business" column packs a solid week's reading into a few paragraphs. Representative bond issues only are listed, since these, selected from a large geographic range, accurately portray the market for public securities. The weekly price and wage reports are sufficient to indicate the trends and the "markets" in the chief building materials, leaving to the first issue of the month the complete listing of prices and of wage rates. Other statistics and business facts are similarly treated. Thus a picture of the situation can quickly be secured—which is what the average reader wants. Specialized magazines and books on finance are available to supply the demands of those who want a knowledge of detail.

What the Figures Show

IT IS not the intention to detail here the indications of the figures presented elsewhere in this issue. They are so clear that they need but little interpretation.

It is worth noting, though, that of the figures which tell the story best, the index figures. The cost index dropped from 231 in January to 168 in December, while the activity for the year (the volume index) is shown to be 88 as against 91 for 1920. Moreover, the cost index was steadily downward.

Probably the most surprising feature of these figures is that the volume of work placed under contract was within 3 points of what it was in 1920—a remarkable showing in view of the widespread and serious depression. Compared with other industries construction had a good year. It was spotty, it is true. The activity in some lines made up for the inactivity in others.

In the price quotation the most significant feature is the drop of steel to the 1913 level. Structural material at Pittsburgh is now quoted at $1.50, which is also the average for the year 1913. It is interesting to note that the other two major materials have not receded so far. Cement f.o.b. Chicago is now $1.97 as against $1.19 in 1913. Lumber, Southern pine, New York base, is now $49, as against $28.50 in 1913.

Labor, likewise, is still well above the 1913 level. For common labor the average for the country, computed by *Engineering News-Record* for 20 cities, is 45 cents, compared with 17, the common-labor wage in the steel industry in 1913.

In the drops for the year steel again leads, the present quotation as against those for December, 1920 being as follows: Steel, $1.50 as against $3 last year; cement, $1.97 as against $2.37; lumber, $49 as against $64; labor, 45 cents as against 60.

The deflation in prices, then, is similar in the construction field to that in the business world at large. It is spotty. Declines have been greater in some directions than in others.

The tendency will doubtless be still downward, but at a slow rate.

Big Projects Past and Prospective

THE FIGURES quoted and referred to in the preceding comment tell in cold fashion the story of the construction year. It is always satisfying, however, to visualize the big accomplishments singly. Unfortunately the instances of great accomplishment in 1921 are very few.

Most notable is the virtual completion of the Miami Conservancy Work. The great job is not done, but the dams are up and in functioning condition. In the next place must come the turning of water through the first of the record-breaking wheels of the great Chippawa power development of the Ontario hydro-electric system. Last, the Delaware River bridge project at Philadelphia was made a certainty by the completion of the preliminaries and the receiving of bids for the main piers.

On one project—the Hudson River vehicular tunnel—a most lamentable delay must be recorded. The work on the under-water section might, but for petty obstruction, be now well under way. Happily, right at the close of the year, the atmosphere cleared and an active continuance of work seems assured.

In work by classes, small housing, highways and miscellaneous public works call for passing mention. In these lay the greater part of the volume of construction in 1921.

As to the coming year, reverting first to groups of projects, it is probable that the three first mentioned will again be in the lead. The demand for small housing is still unsatisfied, the labor situation and the money market both promise to be somewhat easier, so that there is no discouragement of the demand in sight. As for roads and general public works the easing of the bond market gives promise of great activity.

Of big projects immediately in sight there are none so far as assurance of immediate construction is concerned except the new Cleveland passenger terminal. But there are three in the project stage that are notable. They are all of the grand type, requiring broad vision to conceive and detailed engineering talent and large money expenditure to execute. Not one of the three will probably be actually started in 1922, but each one will occupy the thoughts of many engineers whose duty now is not so much to work out the physical details as to convince the legislative mind and the voter of the fundamental necessities. Any one of the three, once started, will rank with the great engineering works of the century and as such the coming year may be noteworthy as the one when they were initiated. The development of the St. Lawrence for power and navigation, the control of the Colorado for irrigation, power and flood prevention and the unification of the port facilities of New York by railway, tunnel, bridge and warehouse construction, all lie ahead of us. Fewer engineers will be connected with them than with such commonplace necessities as curb setting or track layout, but they are concentrated and stupendous efforts toward diverting the powers of nature to the use of mankind and as such they will redound to the credit of engineers.

One more prospect needs to be mentioned in closing—the possibility, if railroad prosperity increases, of resumption of active railroad work. Much is needed. The new Cleveland passenger terminal, previously mentioned, is a case in point. A return of the railroads to the construction market would be an important factor in increasing the activity of engineers, contractors and manufacturers.

What of the Future

AFTER a survey of the past—briefly referred to above and well covered in various sections of this issue—we come to the ever-fascinating question, "What of the Future?"

It divides itself naturally into two heads: What of business generally? What the prospects of construction?

As always there are both favorable and unfavorable factors.

By far the most favorable feature for general business is the return of confidence, a necessary basis for vigorous trade activity. Many factors have contributed to this much desired end—the excellent banking situation, the slower rate of price declines, the partial recoveries in many business lines and the improving international situation. The last is a factor that deserves heavy evaluation. The certainty of arms reduction, the Four-Power treaty regarding the Pacific, the expected settlement of the Irish difficulty, the general improvement (except in fiscal systems) in the central countries of Europe have had a powerful influence on the popular mind.

The banking situation, particularly, is good. Loans are in moderate amount only and the potentiality for credit expansion within sound limits is very great. Money for investment is in liberal volume, as the rise in bond prices strikingly shows.

Of unfavorable factors there are many. Export demand has fallen off. Taxes are still high, though the new tax bill gives a greater measure of relief than is generally believed. The tariff is in an unsettled condition, making for uncertainty at a time when there is great fear of an invasion of cheap European goods.

Most potent of all the adverse factors is the plain fact that the public is not buying beyond necessities. Here again two situations are to be recognized—that of the farmers, and the state of mind of the city folk. The former have had a bad year. Farm-product prices have been lower than the cost of production. The farmer's buying power has been curtailed, and this, spread over a large area, has a serious effect on trade, for the farm population forms 45 per cent of the whole.

As to the city population, allowance must be made for unemployment and for wage reductions. But other factors are really more important. Prices are still believed to be high; the people have learned that they can get along without many things and are voluntarily accepting a lower standard of living; there is widespread resentment against profiteering, particularly by retailers and by labor, and a desire by withholding purchasing to punish those believed to be guilty. If anyone doubts the actuality of these buying deterrents, let him ask a dozen housewives and a dozen homeowners whether they are holding back purchases for home refurnishing and house renovation, repair and painting.

With these factors existing and operating, what of the coming year?

If one tried an accurate weighing and balancing, we are inclined to believe that he would look for a slow year. However, if the situation be appraised broadly, we believe that much weight must be given to relatively intangible, but, to us, potent factors—the upward trend of the last four months and the striking recovery of confidence. These potent factors combined with the encouragement of business afforded by the financial situation are likely to revive industrial expansion and certainly will encourage new commercial enterprises. These alone promise a recuperating year, with gradually increasing business activity, but not a boom. There is likelihood that the public's pressure for lower prices, for reduction of the spread between production cost and retail price, for the deflation of wages commensurate with deflation in prices will continue. Meanwhile buying is likely to pick up only slowly. Farm buying can hardly be expected until summer. With the public purchasing conservatively activity will depend upon operating and maintenance factors. Years of big business are made by expansion. Happily the basis is sound. Confidence has returned.

Construction Outlook

IN THE construction field the outlook is rather more encouraging than for business as a whole. This is due to the excellence of the bond situation, favoring security sales by governmental authorities, and to the still unsatisfied demand for housing—a demand forced by necessity.

Except for the curtailment that may come from refusal of citizens to stand further tax burdens there is no serious adverse factor in sight in public-works construction.

In building work labor is still high, so are many materials. Nevertheless prices and wages even higher than at present failed to be a serious deterrent to house building in 1921. With the more favorable factors in the general business situation, with wage reductions such as were consequent upon the Landis award at Chicago and the mitigation of the execrable working agreements both in Chicago and in Eastern cities, which are bound to follow the awakening of public indignation against these abuses, the volume of building should exceed that of last year.

Still, there is no reason for wild optimism in the construction industry. On the other hand there is no reason for pessimism. Expectation of steady improvement seems to be warranted by present conditions and the reasonable prospect of effective action by the public against building-labor and building-material abuses.

Changing View on Labor Solution

OF IMPORTANCE in the future adjustment of industrial relations is the present attitude toward the American Federation of Labor. The favor which it enjoyed before the war has largely disappeared. The former sympathy which seemed to be growing has been lost. The middle classes, who have had to submit to salary reductions and have suffered because of strikes, resent labor's tactics in trying to maintain its war scales.

The enthusiasm for the so-called "American plan," the growth of "open shop" sentiment, the public approval at Chicago of the Citizens' Committee for enforcing the Landis award, and the support at New York of the Lockwood Committee's determination to put a stop, by legislative action if necessary, to labor abuses are all indications of this increasing lack of sympathy with the Federation's methods.

While before and during the war there was a feeling that satisfactory industrial relationships could be worked out by having the employers work sympathetically with the Federation, to the end that there would develop there a diplomatic leadership, the view now is that there is little hope of displacing the fighting group, and that employers had better look to developing a personal relationship with their employees. The establishment of plant employee organizations, without affiliations with the Federation, has been growing apace, based upon the theory of former days that the employer is the natural leader of his men.

Large labor bodies would lose their reason for being if the employers would take the leadership of their men and justify that leadership by frankness and fair dealing. In this direction a satisfactory industrial order could be worked out without having our country go through the throes that have afflicted England. By progress in this new direction, it is quite likely that the Federation may be brought to see the light, that intelligence may supersede force, and that the Federation may come at a later date to deserve public confidence. Just now the leadership is so selfish that the paramount right of the public is not recognized.

Whatever the attitude of the public over a long period

of years may be, this much is certain, that the resort now to serious strikes to maintain the war labor scales has not the sympathy of the public. In fact, the public is determined that the wage level shall be lowered. That attitude might not have developed had the Federation preached efficiency and urged that each man render a service adequate to the war wage. The golden opportunity was lost. Even now a change in front would save much, but such counsels fall on deaf ears.

Railroad Revival

ONE of the most remarkable business features of the year was the financial progress of the railroads. Against a deficit in 1920 they will show a net operating income for last year of about $550,000,000. This is truly a heroic result in the face of declining revenues. For the first ten months of the year the gross revenue was $4,672,000,000 as against $5,082,000,000 in 1920. The showing was made, therefore, by reduction in operating expenses. These totaled $3,880,000,000 for the first ten months, against $4,808,000,000 for the same period of 1920. The largest item in this expense reduction was in payroll, but there have been in addition heavy temporary savings through the deferring of maintenance.

But even the net of $550,000,000 is only about half the net earnings intended by the Transportation Act. The act contemplated a return of 6 per cent; the net for 1921 is about 3 per cent. That was not sufficient, for the railroads as a whole, to cover interest on the bonded debt and other fixed charges.

While, therefore, there is reason for congratulation upon the progress that has been made, the railroads are not yet "out of the woods." Nor is it certain that their rate of progress will continue. With further business revival, traffic should increase. However, there is strong pressure for rate reductions. If these can be kept within safe limits—where they will be offset by wage reductions and traffic increases—the progress will go unhalted. Too drastic rate reduction, however, would be unfortunate for the railways and unwise for the country. A prosperous railway system will contribute much to general prosperity.

The railroad companies themselves recognize the need for lower rate reductions and have coupled their most recent request for lower wages with a promise to pass the savings to the public in the form of rate decreases. Judging by the summer decision of the Railway Labor Board and the later rulings abolishing certain wasteful working agreements and changing over-time rules for the maintenance-of-way forces it is apparent that that body, too, appreciates the necessity of bringing railway wages into harmony with the general wage deflation.

If these wage reductions can be made to accompany rate reductions and business at the same time increases last year's favorable progress may be continued.

Scandals in the Building Industry

DURING the whole of last year the country was treated to a succession of exposures of malpractice in the building industry. Materials men and labor unions had their rings whose ultimate result was to levy an undue toll on the public. In consequence there has been a great popular indignation against the whole building industry and not merely against those who were guilty of the collusive practices. Contractors as well as the materials men and the labor unions have come in for condemnation. Not only that, but the stage has been well set for the enactment of restrictive legislation.

We had hoped that contractors would play a large part in bringing to book those who had been responsible for the scandals. In that we have been disappointed. No single group is more aware of what is going on than the contractors. Had they the courage they could, we believe, so command public support as to prevent a repetition of the practices exposed.

On account of the inaction exhibited by the contractors, however, we are inclined to believe that they cannot be expected to take the leadership in fighting these practices. The public must turn to civic organizations, chambers of commerce or to emergency committees such as the Chicago organization of citizens for enforcing the Landis award. In New York, the Lockwood Committee is apparently going to fulfill the same function, and, in fact, has threatened to appeal to the Legislature for restrictive measures to curb the bad practices of the unions. The engineers can help to activate the civic body. Nor do we despair entirely of the contractors. They have fallen down woefully, but many of them, once the opposition is aroused, can be counted upon as valuable helpers to a citizens' vigilance committee.

Certain it is that the revelations in New York and Chicago point to the necessity in every community of investigating the building situation. We know from long experience that the building trades have carried things with a high hand and that building materials distributors get together with greater ease than almost any other class of commercial men. Scandals similar to those disclosed in New York and Chicago are awaiting disclosure in many of the large cities. For the stabilization of building, for the winning of public confidence and the warding off of legislation which may seriously cripple the industry, vigorous action is needed. Delay will only result in explosions that are destructive of public confidence.

The local engineering societies and courageous contractors have a duty to start the wheels of inquiry into motion.

Society Action and Inaction

DURING 1921 society activities absorbed far less of the engineer's time and attention than in the two years just preceding. Then there was agitation in the American Society of Civil Engineers, the organization of the Federated American Engineering Societies and the close scrutiny of the aims, methods and membership of the American Association of Engineers. Now there is a settling down to work, a maturing after the organizing and expansion throes.

In the American Society of Civil Engineers the new regime has been in power a year. That is not enough time to achieve notable results. There has been a consciousness among the members that there was striving at a certain measure of new activity, but the impress is not a strong one. This much, though, is certain: the membership wants a vigorous program of technical activities, and will loyally support sound leadership in that direction. This attitude is a great improvement

over the temper of the years of internal contention. The bickerings seem to have passed. The way is prepared for sound technical functioning if the leadership is forthcoming.

In the activities of the Federated American Engineering Societies likewise, there has been little to stir the blood; and this is said with full realization that the "Waste in Industry" report was produced. That was a worthy work, but either because of its character or because of failure in salesmanship it did not strongly grip the individual engineer. Possibly the subject was too old for enthusiasm. Keen technical interest in industrial waste elimination wore off when the scientific management boom collapsed after its brief flurry of ten years ago. Such studies now are, to the engineering mind, part of the regular routine of industrial management.

In the minds of engineers generally there stands to the credit of the Federation, beside the waste report, only the continuation of the campaign for a Department of Public Works. That, however, was an inheritance and the Federation is not, and should not be, given full credit for it. None of the other activities of the Federation has made any impression.

The Federation is under immediate obligation to find itself and to accomplish results that will favorably impress the entire profession. Failing to do this it will lose support—for directorates will act in accordance with the views of their members. The Federation faces a test year. It had the waste survey to buoy it up in 1921. Unless it soon finds an activity or a group of activities far more gripping than the waste survey, we look for considerable disaffection, with inevitable change of scope or of organization.

Quite in contrast with the quiet functioning of the organizations mentioned has been the vigorous activity of the American Association of Engineers. With a program that lent itself well to publicity, because of its incidence upon public affairs, it has impressed itself on its membership as resourceful, vigorous and effective. It has been constantly alert. Headquarters have stimulated the local chapters and clubs; the latter, in turn, have pressed large problems upon the parent organization. All in all the impression made is that of an organization pulsing with life, alert to its opportunities, pushing onward with vigor.

Possibly the most significant fact in the year's record is that, despite the increase in dues the slump in membership has not been large. On Dec. 1, 1921, the membership was 22,299 (of which 3,000 were students). This represents a loss of only 1,700 in the year, truly a remarkable showing and one that is contrary to the predictions freely made when the dues were advanced. Apparently the younger members of the profession have felt it well worth while to carry on the association's activities.

Should the A. A. E. continue its vigorous functioning it will furnish a desirable spur to the other two organizations. Along their special lines there is opportunity for work fully as vigorous, though in the case of the American Society of Civil Engineers not as spectacular. Technical work has not as strong an appeal as the rendering of personal or public services. Nevertheless, both the Am. Soc. C. E., and the Federation have much to learn from the vigorous activity of the A. A. E.

A.G.C. Makes Excellent Progress

IN ANOTHER field of communal work vitally affecting construction—that of organized contracting—there has been signal progress. The Associated General Contractors, a war-born organization, has more than justified the enthusiasm with which at the beginning of last year we welcomed its growing power.

It increased its membership last year by 50 per cent, but more than that it has displayed a remarkable ability to sense how it can serve contracting and an equal capability in execution. There has been scarcely an activity in which contracting has been affected in which the A. G. C. has not borne a worthy part. In some movements, like the Unemployment Conference, it has been a valuable and prominent worker; in others, like the fall letting of highway contracts and the proposed standardization of contract documents, it has taken the laboring oar and has been largely responsible for getting the activity under way. It has worked with the railway executives on railway rates; it has called unfair trade practices to the attention of the manufacturers in question; it has been vigilant on legislation affecting construction; it has started to accumulate and disseminate figures that will help the individual contractor conduct his work with a better understanding of business and financial conditions.

Like the A. A. E. it has proceeded on the policy that strength in its subsidiary organizations is an important factor in the strength of the central body; therefore, the relations between headquarters and local associations has been a close one. Where locals were lacking they were organized; weak locals were strengthened by advice and encouragement. As a result, the whole organization is pulsating and vigorous, and the central body has been able to carry into effect, through the locals, the ideas to which the entire group is committed.

This is a welcome situation and promises well for the future improvement of the standards of contracting. That the room for improvement was large, and is still large, is freely admitted. It is fortunate that the association is in the hands of strong leaders. The objects to be accomplished are beyond the ability of any but a vigorous management. That the association has, and continued success, therefore, seems assured.

Controversy Over Practice by Corporations

THE OUTSTANDING professional question before engineers during the year was the controversy over permitting corporations and mixed partnerships to practice engineering. While little has been said about the matter for some months, the controversy is not settled. Both the American Society of Civil Engineers and the Federated American Engineering Societies have committees considering the subject. Both of them are to report this month, and it is not impossible that the controversy may then break out anew.

When the public discussion of the matter ceased neither side had fully convinced the other. If anything, the drift was in the corporation ranks and toward the views of those who contended that the practice of engineering should be restricted to individual registered engineers and to partnerships and corporations composed wholly of engineers. The fundamental arguments

certainly favor those who take the strict professional viewpoint. Moreover, theirs is by all odds the safest course. Those who defend the opposite point of view fall back on the claim that in practice no serious harm has been done the engineering profession by the mixture of professional practice with business. This claim, of course, is most vigorously disputed and both sides make strong cases, one for the lapse in professional attitude on the part of corporations and the other for lapses of individuals. When the case is considered in the light of experience, it is apparent that the character of individuals is the determining factor in their conduct and, therefore, the argument gets nowhere when each side is intent upon exposing the moral delinquencies in the opponent's camp.

The controversy has, we believe, been of value in bringing to the fore the question whether engineers are really concerned in creating a professional status for their calling. It has encouraged an inquiry into fundamentals, which is always valuable. It has emphasized the need for greater communal concern regarding the conduct of individual practitioners, and has brought a realization that it is within the power of engineering organizations to determine what their standing before the public shall be. As a result of the controversy it is now keenly appreciated that engineers have been very indifferent to the conduct of their fellows whether practicing as individuals, partnerships, or corporations. If a strengthening of the sense of the moral responsibility of engineering societies to the public has been brought about, this alone will have made the controversy over the registration of corporations a decided contribution toward professional advancement.

Water-Power Development Lagging

DESPITE hopes entertained a year ago water-power development continues to lag behind its possibilities. High costs of construction (two to four times as great as for steam-developed electricity) continue to be almost prohibitive except where coal is not in competition. It would take many years of operating savings to offset the additional tax that excessive first costs would impress. The tabulation on another page shows that some sizable projects have been undertaken, but that practically all are in the West where water-power is practically the only power possible and where its horsepower cost is relatively low. In the East the new plants are mostly enlargements of existing systems, where the demand requires immediate increased capacity.

Although eighteen months have elapsed since the signing of the federal water-power act, the developments under that act are disappointingly small. As noted in the Federal Water Power Commission's report, sixteen or more million horsepower are represented in the preliminary applications. Only about 500,000 hp., however, are represented in actual construction and by far the greater part of that is at Niagara Falls which would have gone ahead anyhow. Here again the main deterrent is no doubt the high cost of construction coupled with the high rate of money in the early part of the year. The latter condition is somewhat ameliorated but the former still seriously affects hydro-electric construction, especially that which must operate under such rigid government supervision as will the federal-grant plants.

This latter restriction is being made much of by the public-utility interests. They claim that the commission's regulations as to depreciation reserves practically prohibit development under the law. The question is confused but seems to be more a matter of possibilities than actualities, for by far the larger part of the proposed developments must submit to regulations of state boards rather than the federal commission. The powers of the federal commission, however, in this respect are vague and need court interpretation or amendment. Some other features, too, need clarification, among which is the definition of "navigable water," so that the line between state and federal power control will be clearly defined. At the same time the commission needs to be given a more definite status than is afforded by part-time work of three members of the Cabinet. It has a most important function in the government and should be equipped with a permanent and independent personnel so that its policies and acts may be fairly consistent.

Flood Protection a Pressing Problem

WITH multiplied argument the past year has reinforced the belief of those who have predicted great responsibilities for the civil engineer in flood protection. The past three months witnessed the virtual completion—for purposes of practical protection against great disasters at any rate—of the huge regional protection project worked out for the Miami Valley, in southwestern Ohio. The retarding-basin dams of the system are completed, and only finishing operations and some additional channel improvement remain. More modest in its proportions, but yet noteworthy in flood history, is the Mill Creek improvement in Erie which has recently been finished. Thus two potential sources of destruction have been put under control, out of the scores and hundreds which the country contains. Of these others, however, three streams, a thousand miles apart, sent down devasting floods over Pueblo, San Antonio and Phœnix. Two of these communities at least were well enough aware of their danger that they had previously contemplated the construction of protective works; in fact, urgent warning of coming flood damage had been given by engineers within a year or two. Here, then, we face an impressive demonstration of the urgency of the flood problem for every valley city. All three communities have moved promptly to develop plans and start construction on flood protection, and it may be expected that these works will get under way within the coming year. With these new object lessons before them, citizen as well as engineer will attain to a higher appreciation of flood-protection.

The Municipal Financing Problem

THE record-breaking billion-dollar municipal bond sales in the United States during 1921, reported with other pertinent data elsewhere in this issue, raise questions that are not discussed in that article. Chief among these is the effect of such huge issues upon municipal tax and debt limits. This must be considered in the light of the construction that was deferred by the war and must be carried out now at increased cost. The high interest rates on mounting debts and the high operating costs in the whole municipal field must press hard upon the rigid limits on taxation and debt under

which most cities work. Reduced to 1913 buying power terms, the bond sales of 1921 were the equivalent of a half-billion instead of a billion dollars. The same factor must be borne in mind in considering that the actual sales for the five years 1916-20 totaled 1,337 millions compared with the 1913 sales of 403 millions, and that 2,015 million dollars would have been required for the five years on the 1913 price base to keep pace with the sales of that year. This gives a shortage of 678 millions for the five years, with no allowance for growth in population and other conditions demanding increased bond issues.

It is easy to say that the taxpayers of the country cannot stand the combined strain of catching up and of meeting higher construction and capital charges. Before reaching any such conclusion one should consider such things as what the real increases are in per capita debt compared with per capita wealth; what portion of the bonds go for revenue producing services and how extensively both bond issues and taxes are being affected by mere shifts from private to public agencies of the numerous services incident to city life. Many other data, not now available—particularly not in comparable form—are needed before sound conclusions as to tax and bond burdens can be drawn. But the data are not likely to be forthcoming soon. Meanwhile municipal financing problems press for solution.

For the immediate future the chief hope lies in the more careful framing of municipal budgets. If this is to be of the greatest possible helpfulness, our cities and towns must go beyond a yearly budget—although such a budget properly framed would be an innovation and great advance for many cities. Far-reaching municipal programs, carefully framed by engineers, financiers and representatives of all the people and their needs, must become the rule instead of the exception. These programs should forecast their effect upon the net debt of the city and upon the tax rate. Such programs would cover three and ultimately five to ten years. They would consider expenditures in the light of relative needs and values and should schedule them for immediate, early and future incurrence, according to relative importance and the state of the public purse. The value of this is not evident to the average city councilman but needs no explanation to the engineer. There is work here for not only municipal engineers but for all public-spirited members of the profession.

The Trend of Highway Thought

ANY APPRAISAL of accomplishment in the highway field during the past year would fall far short of being a true picture if it were limited to an inventory of physical progress—the mileage of roads constructed and maintained, the volume of materials used and the sums actually spent or made available. A few years ago such an analysis would have been satisfying. Today other factors—the new thinking along research and economic lines—must have a place in any retrospect or prospect of highway activities.

The state highway engineer, especially, is revising his conception of his duties and from the problems of design and construction, important as they are, is turning to studies of traffic and to its influence on future highway development. This is particularly noticeable in the Eastern States, where the remarkable increase in the volume and tonnage of commercial vehicle traffic has placed upon the state highway departments responsibilities unknown a decade ago. The research developments, too, lie to an important extent in the domain of traffic economics, as distinguished from structural design—though obviously all highway research is activated by an economic motive.

State highway officials are now keenly aware of the paucity of information upon which to formulate economically sound road policies. The realization of the pressing need for comprehensive data on the amount and character of traffic and its influence on the road surface is reflected in the research activities of the U. S. Bureau of Public Roads and of some of the states, notably Illinois, in the stimulating and co-ordinating work of the highway research division of the National Research Council and in the unusually complete traffic census which has been made in Connecticut.

In its relation to highway transport problems, the term "research" must not be misunderstood. It is not confined within narrow laboratory limits. Its scope includes economics, including traffic studies and cost of transport; operation, including control of traffic, the planning of systems of transport and maintenance; design of roads, including subsoil studies, base courses and surface; design of vehicle, involving effect of loads, economy of operation and maintenance; and construction, comprising materials, plant design and control, and construction methods.

Involving the traffic-economics concept, also, is the active thought which highway engineers are giving to motor-vehicle legislation, with particular regard to limitations of weight, size and speed of motor trucks, and the establishment of a scale of license fees which will insure a road maintenance fund adequate for the upkeep of the system. The utter lack of uniformity in motor-vehicle laws in the 48 states was shown by a detailed survey, the results of which were published in this journal Sept. 1. Except in a few instances, license fees for motor trucks bear little relation to the destructive influence of these vehicles on the highway system. This field of motor-vehicle legislation offers profitable opportunity for study on the part of highway engineers, and one that they are not neglecting.

Highway transport economics, too, has occupied a prominent place in the programs of engineering societies. A number of traffic conferences, notably those at New Haven, Baltimore, and Ann Arbor, have been held. The American Society of Civil Engineers, at its forthcoming annual meeting, will make this a prominent feature. It was an outstanding topic at the recent annual meeting in Omaha of the American Association of State Highway Officials.

The past year, therefore, marks a real advance in highway thought. The highway engineer now realizes that he is not merely a technical specialist concerned solely with the design and maintenance of a roadway structure, but that he is in the *business* of furnishing transportation to the public at minimum cost. His job then involves not merely the provision and maintenance of the minimum possible convenience for traffic but the devising of a system that will be inviting, convenient and that, at minimum expense, will year by year expand to serve the traffic needs of the community. The engineer must take a broad view if he is to do his job satisfactorily. He must visualize the future. He must see the place of the road in the whole economic picture.

Statistics of Construction Cost and Volume

Engineering News-Record Construction Cost Index—Engineering News-Record Construction Volume Index—Spring Material Prices, 1913-21—Labor Rates for 1921—Contracts Let 1920 and 1921

Spring Prices of Construction Materials Since 1913

ENGINEERING NEWS-RECORD'S comparison of spring prices of construction materials has been published once a year since 1919 (Jan. 16, 1919; Feb. 12, 1920; Mar. 3, 1921). The accompanying larger tabulation gives prices of the principal materials in the New York market, for cement in Chicago, and on structural steel at the Pittsburgh mill as well as in New York warehouses. In January, 1919, we suggested that a reasonable price schedule might be the average spring prices from 1913 to 1918—that is, from the first pre-war year to the current date. We have since repeated the suggestion, and it is interesting to note—from the smaller tabulation—how price levels have been ever more nearly approaching this schedule.

At the beginning of 1919 the price average of the twelve materials in the smaller table was 69 per cent above the general average of spring prices of 1913 to 1918, inclusive; at the beginning of 1921, the average had fallen to 31 per cent; at present the average stands at only 2 per cent above the general average of spring prices for the nine years of 1913 to 1921.

The smaller table showing the price situation at the beginning of the several years does not include cement, lumber or brick. Cement (f.o.b. Chicago, without bags) is only 19 per cent above the general average of spring prices of cement; Southern pine is 20 per cent above in the New York market; brick, dock, is 38 per cent above.

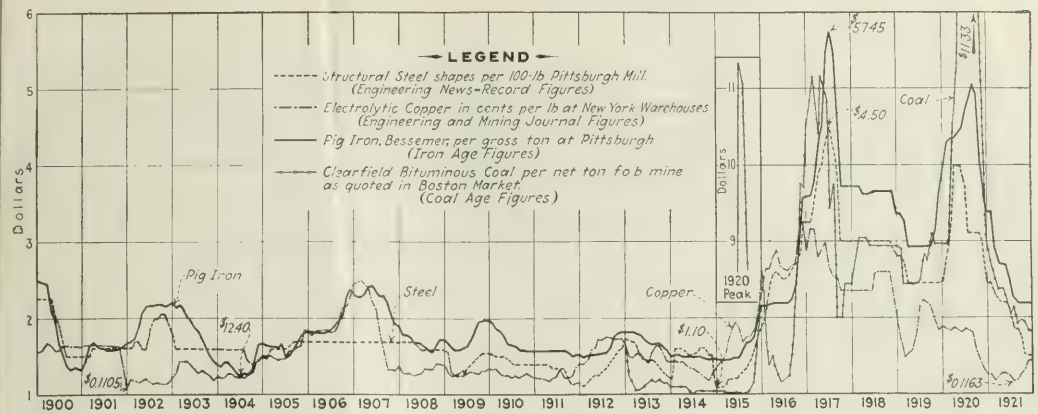
PRICE SITUATIONS IN SPRING, 1919 AND 1921
(+ indicates increase — indicates decrease)

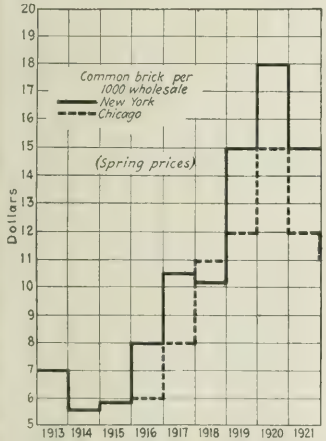
Materials	Per Cent Change, January, 1919, from General Average of Spring Prices, 1913-18	Per Cent Change, March, 1921, from General Average of Spring Prices, 1913-20	Per Cent Change, March, 1921, from General Average of Spring Prices, 1913-21
Crushed stone, New York	+ 42	+ 61	+32
Sand, New York	+100	+ 42	+27
Gravel, New York	+120	+ 111	+14
Cast-iron pipe, New York	+ 91	+ 45	+ 9
Structural shapes, New York	+ 52	+ 14	—18
Tank plates, New York	+ 58	+ 17	—11
Linseed oil, New York	+ 62	— 36	—27
Freight Pittsburgh to New York or Chicago on finished steel products	+ 35	+ 95	+76
Steel sheetpiling, Pittsburgh mill	+105	+ 10	—18
Structural shapes, Pittsburgh mill	+ 56	— 6	—39
Reinforcing bars, Pittsburgh mill	+ 58	— 6	+15
Reinforcing bars, New York warehouse	— 51	+ 11	—47
Average	+ 69	+ 31	+ 2

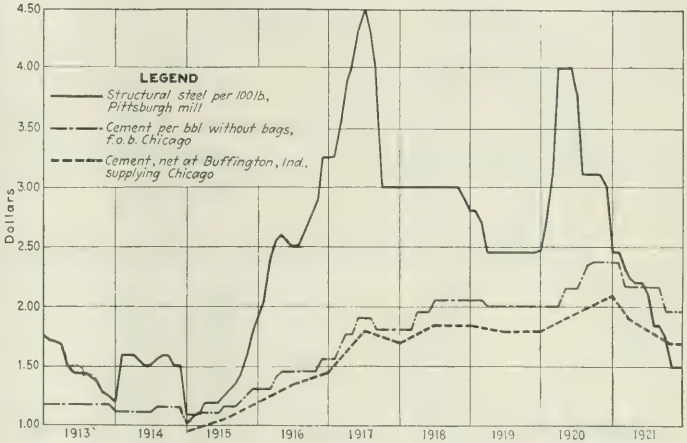
ENGINEERING NEWS-RECORD COMPARISON OF SPRING CONSTRUCTION MATERIAL PRICES SINCE 1913
All Prices New York Except Otherwise Stated

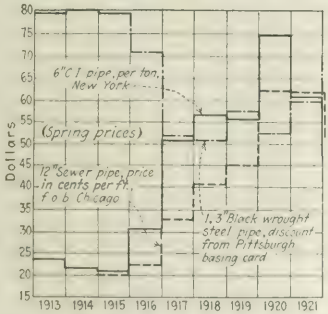
	Portland Cement, per bbl. net, delivered, Chicago	Southern Pine, 3x12 to 12x12, 20 Ft. and Under	Common Brick (per M.)	Crushed Stone (per Cu.Yd., In.)	Sand (per Cu.Yd.)	Gravel (per Cu.Yd., In.)	C.I. Pipe, 6 In. (per Ton)	Beams and Channels, 3-15-in. (per 100 lb.)	Beams, Etc., Pittsburgh Mill	Reinforcing Bars, 7/8-in. and Larger, Pittsburgh Mill	Reinforcing Bars, 7/8-in. and Larger	Steel Sheetpiling, Pittsburgh Mill	Tank Plates, 1/4-in. and Heavier (per 100 lb.)	Hollow Tile 6x8x12 in. (2 per Block), Factory, Perth Amboy, N. J.	Linseed Oil (Raw, in Barrels)	Freight to Pittsburgh, on Steel (per 100 Lb.)
April, 1913	$1.19	$28.50	$7.00	$0.90	$0.50	$0.85	$24.00	$2.15	$1.70	$1.50	$2.25	$1.60	$1.61	$0.084	$0.48	$0.16
May, 1913	1.19	28.50	7.00	0.90	0.50	0.85	23.50	2.15	1.65	1.50	2.25	1.60	1.61	0.084	0.50	0.16
June, 1913	1.19	28.50	7.00	0.90	0.50	0.85	23.00	2.15	1.50	1.50	2.25	1.60	1.61	0.084	0.48	0.16
Average	$1.19	$28.50	$7.00	$0.90	$0.50	$0.85	$23.50	$2.15	$1.62	$1.50	$2.25	$1.60	$1.61	$0.084	$0.49	$0.16
April, 1914	$1.12	$28.50	$5.50	$0.95	$0.50	$0.90	$22.00	$1.95	$1.15	$1.20	$2.25	$1.60	$1.31	$0.084	$0.54	$0.16
May, 1914	1.12	30.00	5.50	0.95	0.50	0.90	22.00	1.85	1.15	1.15	2.25	1.60	1.31	0.084	0.54	0.16
June, 1914	1.12	30.00	5.60	0.95	0.50	0.90	20.50	1.85	1.10	1.15	2.25	1.60	1.31	0.084	0.53	0.16
Average	$1.12	$29.50	$5.55	$0.95	$0.50	$0.90	$21.50	$1.85	$1.13	$1.17	$2.25	$1.60	$1.31	$0.084	$0.54	$0.16
April, 1915	$1.11	$28.50	$5.50	$0.90		$0.85	$20.00	$1.90	$1.15	$1.15	$1.95	$1.60	$1.36			$0.169
May, 1915	1.11	28.50	5.75	1.05		0.85	20.50	1.90	1.20	1.15	2.00	1.50	1.32			0.169
June, 1915	1.15	26.50	6.00	1.05		0.85	22.00	1.90	1.20	1.20	2.00	1.50	1.37			0.169
Average	$1.12	$27.75	$5.75	$1.00		$0.85	$20.75	$1.90	$1.18	$1.17	$1.97	$1.53	$1.35			$0.169
April, 1916	$1.42	$31.50	$8.50	$0.95	$0.40	$0.80	$30.50	$2.50	$2.50	$2.45	$3.10	$2.50	$2.50		$0.81	$0.169
May, 1916	1.46	31.50	7.25	0.95	0.40	0.85	30.50	2.50	2.75	2.50	3.25	2.50	2.65		0.81	0.169
June, 1916	1.46	30.50	8.00	0.95	0.50	1.00	30.50	2.50	2.75	2.50	3.10	2.50	2.75			0.169
Average	$1.45	$31.00	$7.90	$0.95	$0.45	$0.90	$30.50	$2.55	$2.67	$2.47	$3.15	$2.50	$2.65		$0.81	$0.169
April, 1917	$1.76	$32.75	$9.50	1.20	$ 0.50	$1.25	$47.50	$3.75	$3.88	$3.35			$5.00		$1.04	$0.169
May, 1917	1.90	34.75	11.50	1.25	0.50	1.35	55.50	3.80	4.00	3.50			5.50		1.21	0.169
June, 1917	1.91	39.75	10.25	1.25	0.50	1.25	55.50	5.00	4.31	3.50			7.00		1.31	0.169
Average	$1.86	$35.75	$10.40	$1.25	$0.50	$1.30	$51.70	$4.15	$4.06	$3.45			$5.80		$1.19	$0.169
April, 1918	$1.96	$42.75	$10.25	$1.75	$1.25	$2.00	$55.35	$4.20	$3.00	$2.90	$4.09½	$3.10	$4.45	$0.14	$1.55	$0.195
May, 1918	1.96	42.75	10.00	1.75	1.25	2.00	55.35	4.20	3.00	2.90	4.09½	4.00	4.45	0.14	1.55	0.195
June, 1918	2.00	43.25	10.25	1.75	1.25	2.00	61.55	4.20	3.00	2.90	4.09½	4.00	4.45	0.14	1.58	0.195
Average	$1.97	$43.00	$10.15	$1.75	$1.25	$2.00	$57.35	$4.20	$3.00	$2.90	$4.09½	$3.70	$4.45	$0.14	$1.56	$0.195
April, 1919	$2.00	$45.00	$15.00	$1.75	$1.25	$2.00	$57.70	$3.47	$2.45	$2.35	$3.37	$2.55	$3.67	$0.159	$1.55	$0.27
May, 1919	2.00	45.00	15.00	1.75	1.25	2.00	57.70	3.47	2.45	2.35	3.37	2.55	3.67	0.153	1.63	0.27
June, 1919	2.00	46.00	15.00	1.75	1.25	2.00	52.70	3.47	2.45	2.35	3.37	2.55	3.67	0.153	1.76	0.27
Average	$2.00	$45.50	$15.00	$1.75	$1.25	$2.00	$56.03	$3.47	$2.45	$2.35	$3.37	$2.55	$3.67	$0.155	$1.65	$0.27
April, 1920	$2.00	$72.00	$18.00	$2.00	$1.25	$2.25	$72.30	$5.00	$4.00	$4.00	$5.00	$3.65	$5.00	$0.2274	$1.87	$0.27
May, 1920	2.0	70.00	18.00	2.15	1.50	2.50	76.30	5.00	4.00	4.00	5.00	3.65	5.00	0.2274	1.87	0.27
June, 1920	2.15	70.00	18.00	2.15	1.50	3.00	76.30	4.47	4.00	3.75	5.00	3.65	4.67	None	1.73	0.27
Average	$2.08	$70.50	$18.00	$2.10	$1.42	$2.58	$74.97	$4.83	$4.00	$3.92	$5.00	$3.65	$4.89	$0.2274	$1.83	$0.27
April, 1921	$2.17	$48.00	$16.00	$1.95	$1.25	$2.50	$63.30	$3.33	$2.00	$2.00	$3.28	$2.55	$2.00		$0.73	$0.38
May, 1921	2.17	48.00	15.00	1.95	1.25	2.50	63.30	3.33	2.20	2.10	3.38	2.55	2.40		0.67	0.38
June, 1921	2.17	43.00	14.50	1.95	1.25	2.50	58.30	3.33	2.20	2.10	3.38	2.55	2.40	$0.1156	0.80	0.38
Average	$2.17	$46.25	$15.00	$1.95	$1.25	$2.50	$61.60	$3.33	$2.15	$2.10	$3.35	$2.55	$2.25	$0.25	$0.73	$0.38
General Average	$1.66	$39.69	$10.53	$1.40	$0.79	$1.54	$44.21	$3.16	$2.47	$2.34	$2.83	$2.19	$3.11	$0.1045	$0.98	$0.216
Dec. 15, 1921	$1.97	$47.50	$14.50	$1.85	$1.00	$1.75	$48.00	$2.58	$1.80	$2.68	$1.50	$1.80	$2.78	$0.128	$0.72	$0.38

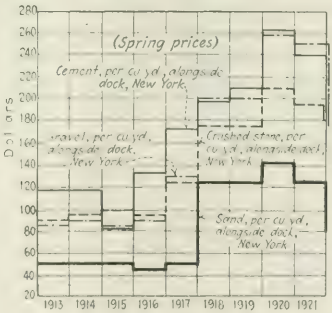
TREND OF MATERIALS PRICES

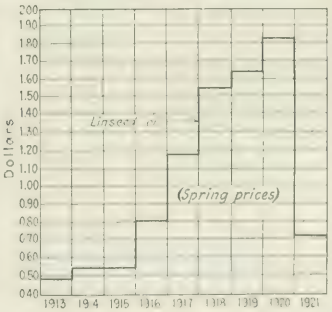


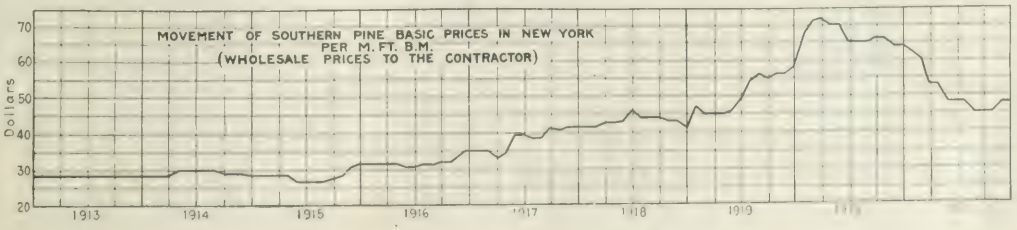










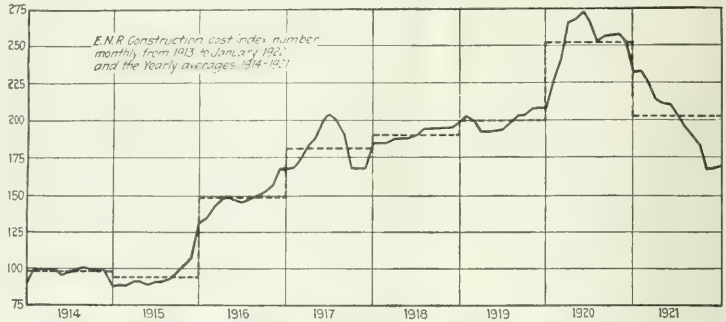


Construction Cost Index Number—Derivation and Values

Statistics of Construction

ENGINEERING NEWS-RECORD'S Construction Cost Index Number is a national index of general construction cost in the United States. For that reason in its computation only the great basic materials and common labor are considered. Steel, cement and lumber are the fundamental materials of the construction industry, and the rate paid common labor eventually determines the cost of labor. The importance of the cost of brick, sand, gravel, crushed stone, and the rest, is not minimized; but these materials are usually produced locally and their prices are subject to fluctuating local conditions.

The *E. N.-R.* Construction Cost Index Number is not referred to Boston or Seattle, to Minneapolis or El Paso but to the 3,507,640 sq.mi. of the United States. Change in towing rates on the Hudson River will affect the price of brick or crushed stone, alongside dock, New York, without making any change whatever in the 3 x 12-in. to 12 x 12-in. Southern pine to contractors in New York, and the average price of common labor in the eighteen to twenty cities listed in *Engineering News-Record* in the first issue of each month. The prices are those obtaining in the last week of each month and published in the first issue of each month. The quantities of these materials and the number of man-hours used in computing the Index Number were selected so that the total cost (quantities multiplied by prices, and added



COST INDEX NUMBER BY MONTHS, AND YEARLY AVERAGES

ENGINEERING NEWS-RECORD CONSTRUCTION COST INDEX NUMBER—1914 *TO* 1921

	1914	1915	1916	1917	1918	1919	1920	1921
January	89.22	87.12	130.46	167.75	184.51	198.05	206.55	230.87
February	99.22	87.36	134.46	167.75	184.51	201.50	225.10	230.67
March	99.22	87.66	142.96	175.66	184.51	198.05	240.85	224.27
April	99.22	90.16	147.31	183.41	186.01	191.25	265.20	213.07
May	99.12	90.16	148.86	187.61	186.01	191.25	268.90	210.82
June	97.62	88.96	146.51	199.26	186.31	191.85	273.80	209.82
July	98.12	90.51	145.76	204.01	188.65	193.65	265.65	203.82
August	99.36	91.76	146.56	198.41	193.85	196.65	252.00	193.07
September	100.36	93.01	149.56	190.31	193.85	202.85	255.20	188.27
October	99.76	96.16	152.91	167.11	193.85	202.25	255.20	182.57
November	97.26	101.06	155.66	166.51	193.55	206.85	255.32	166.32
December	97.51	107.06	167.15	167.11	194.75	206.85	251.62	167.82
Averages	98.00	92.58	147.35	181.24	189.20	199.26	251.28	201.78

nationwide cost of construction. On the other hand, a price movement in either steel, cement or lumber wields an influence that is almost invariably continental in scope.

The *E.N.-R.* Construction Cost Index Number is based on the prices of steel, cement, lumber and common labor in 1913. Furthermore, these materials and common labor are weighted according to their relative importance as adjudged by *Engineering News-Record*. These weightings are: Steel, 37.50 per cent; cement, 7.14 per cent; lumber, 17.10 per cent; labor, 38 per cent. The weightings were determined by studying the annual production of the three prime materials and the number of common laborers (exclusive of farm labor) in the United States. The markets considered are structural steel in Pittsburgh, cement without bags f.o.b. Chicago;

JANUARY, 1921, AND JANUARY, 1922,

Cities	Bricklayer — January 1921	Bricklayer — January 1922	Carpenters — January 1921	Carpenters — January 1922
Atlanta	$1.12½	$0.90	$0.80	$0.70
Baltimore	1.00	1.25	.80	.80
Birmingham (May, 1921)	1.00	1.00	.87½	.75
Boston	1@1.25	.90	1.00	.75
Cincinnati	1.25	1.12½	.90	.87½
Chicago	1.25	1.10	1.25	1.00
Cleveland	1.00	1.04	.90	1.04
Dallas	1.25	1.00	1.00	1.00
Denver	1.25	1.37½	1.16½	1.00
Detroit	1.25	1.00	.85@1.00	.80
Kansas City	1.12½	1.07½	1.00	1.00
Los Angeles	1.25	1.25	.87½	1.00
Minneapolis	1.25	1.00	1.00	.80
Montreal	.80	.80	.75	.60
New Orleans	1.00	.00	1.00	.88
New York	1.25	25	1.12½	1.12½
Pittsburgh	1.50	1.12½	1.25	1.00
St. Louis	1.25	1.25	1.25	1.25
San Francisco	1.25	1.16	1.12½	1.03
Seattle	1.12½	1.00	1.00	.80
Philadelphia (Dec., 1921)	1.00	1.00	.90	.90

Cost and Volume

together) for 1913 would be $100 for a "unit of construction."

For example, if the quantities are 2,500 lb. of structural steel, six barrels of cement, 600 ft.b.m. of lumber, and 200 man-hours, and the prices are $1 per 100 lb. for shapes, $1.19 per net bbl. of cement, $28.50 per 1,000 ft.b.m. of lumber, and 17 cents per hour for common labor, the total computation will be $99.74; 100 is the base *E. N.-R.* Construction Cost Index Number.

The accompanying tabulation gives the *Engineering News-Record* Construction Cost Index Number for every month from 1913 to January, 1922, while the chart gives both the monthly and yearly numbers.

Construction Volume Index Number Since 1913

THE *E. N.-R.* Volume Index Number, placing present value of contracts let on a 1913 purchasing basis, was announced in the issue of Oct. 20, 1921, p. 670. Its purpose is to show actual amount of construction in pre-war terms rather than the current money value of contracts let. For example: Engineering contracts let in 1921 aggregated $1,231,370,965, against $690,539,644 in 1913. This comparison is spectacular, optimistic, but misleading, because the 1913 dollar was worth 100 cents whereas the average 1921 dollar by comparison bought only 49½ cents worth of construction.

The Volume Index Number is based on 1913—despite the fact that this was a subnormal construction year by 15 to 25 per cent—for two reasons: 1913 is the last pre-war year, and most index numbers (including the *E. N.-R.* Construction Cost Index Number) are based on 1913 prices. As a matter of fact, 1913 is normal neither as regards the volume of construction nor the monthly distribution as shown by contracts awarded. To correct the latter condition current monthly volumes are compared with the *average* monthly value of contracts let in 1913. In other words, as an example, the value of contracts in July, 1913, which was $106,011,049, is not compared with the value of contracts let in July, 1921, which was $84,791,980, but with the average monthly value in 1913, which was $57,545,000.

Letting C represent the value of contracts let in 1913 (or any fraction of 1913), C_1 the value for 1921 (or the same fraction of 1921), I the *E. N.-R.* Construction Cost Index Number for all or the considered part of 1913, and I_1 the Cost Index Number for all or the same part of 1921, the formula for computing the Volume Index Number is:

$$Vol.\ Index\ No. = \frac{\frac{C_1}{I_1}}{\frac{C}{I}} = \frac{IC_1}{I_1C}$$

But I and C are constants—100 and $57,545,000 (for and month of 1913) or 100 and $690,540,000 for the whole of 1913; therefore,

$$Monthly\ Vol.\ Index\ No. = \frac{C_1}{575{,}450I_1}$$

$$Yearly\ Vol.\ Index\ No. = \frac{C_1}{6{,}905{,}400I_1}$$

Thus computed, the Volume Numbers for the months of 1921 and for the entire year were as shown below:

ENGINEERING NEWS-RECORD CONSTRUCTION VOLUME INDEX NUMBER, 1913 TO 1921

1913 (entire year)	100
1921 (entire year)	88
1920 (entire year)	91
1921	
January	41
February	43
March	88
April	86
May	90
June	117
July	90
August	94
September	114
October	109
November	101
December	118

Trend of Labor in the United States

LABOR rates, the cost of living and the prices of construction materials all reached their peaks in 1920, and have since been declining. The labor peak, as shown by *Engineering News-Record's* monthly averages of common-labor rates in the twenty cities, was in September, when the average rate was 62½ cents per hour. The Bureau of Labor Statistics gives the cost-of-living peak as occurring in June, at 117 per cent above 1913. Construction cost also reached the peak in June, when the

RATES FOR BUILDING TRADES LABORERS IN TWENTY-ONE CITIES.

Hoisting Engineers		Hod-Carriers		Pile-Drivers		Structural Iron Workers		Common Labor — Union		Common Labor — Non-Union	
January		January		January		January		January		January	
1921	1922	1921	1922	1921	1922	1921	1922	1921	1922	1921	1922
$1.00	$1.00	$0.35	$0.30			$1.00	$1.00	$0.35	$0.35	$0.25	$0.20
.87½	.87½	.46@.50	.34	$0.74	$0.74	1.00	1.00			.30@.35	.30
		.25@.40	.25			1.00	1.00			.20@.25	.15@.25
.90@1.00	.90	.70@.80	.60	.80@.90	.90	1.05@1.25	.90	.65@.70	.40		
1.00	.87½	.70	.72½	1.00	77½	1.00	77½	60	.37½		
1.10	1.10					1.25	1.05	1.00	.72½	.60@.65	.35@.50
1.00	1.04	.57½	.60	.80	.91	1.00	1.04	.57½	.57½		
1.00	1.00	.60	.60	1.00	1.00	1.25	1.00	.50@1.00		.40@.60	.35@.45
1.16½@1.18½	1.00	.75@.81¼	.75@.81¼		1.00	1.15½	1.00	.50@.56¼	.50@.55	.37½@.50	.30@.40
1.10	.80@.90	.70	.50@.60	1.10	1.00	1.25	.60@.80	.50@.60	.50		
1.00	1.00	.90	.80	1.00	1.07½	1.10	1.07½	.75	.70		
.87½	1.00	1.00	1.12½	.87½	.87½	.87½	1.00	.56¼@.62½	.50		
1.00	.80	.75	.65			1.00	.80	.60	.50	.50	.50
.60	.50	.40	.30@.35	.55	.50	.50	.55			.35@.40	.25@.40
1.00	.90	.65	.40	1.00	.80	1.00	1.00			.50	.40
1.25	1.25	.87½	.87½	1.12½	1.00	1.12½	1.12½	.75@.80	.75		
1.12½	1.00	1.00	.80	1.00		1.25	1.00	.80			
1.25	1.37½	.85	.87½	1.00	1.25	1.25	1.25	.52@.60	.62		
1.12½	1.03	1.00	.92½	1.12½	1.03	1.12½	1.16	.81¼	.75	.50@.55	.45@.55
.87½@1.00	.90	.87	.70	1.00	1.00	1.00	.80@.90	.62½@.75	.50@.60	.50	.50
.90	.90	.75@.90	.75@.90	1.00	1.00	.90	.90	.50@.60	.40@.60		

E. N.-R. Cost Index Number was 273.80. The large chart shows the costs of common labor and of living.

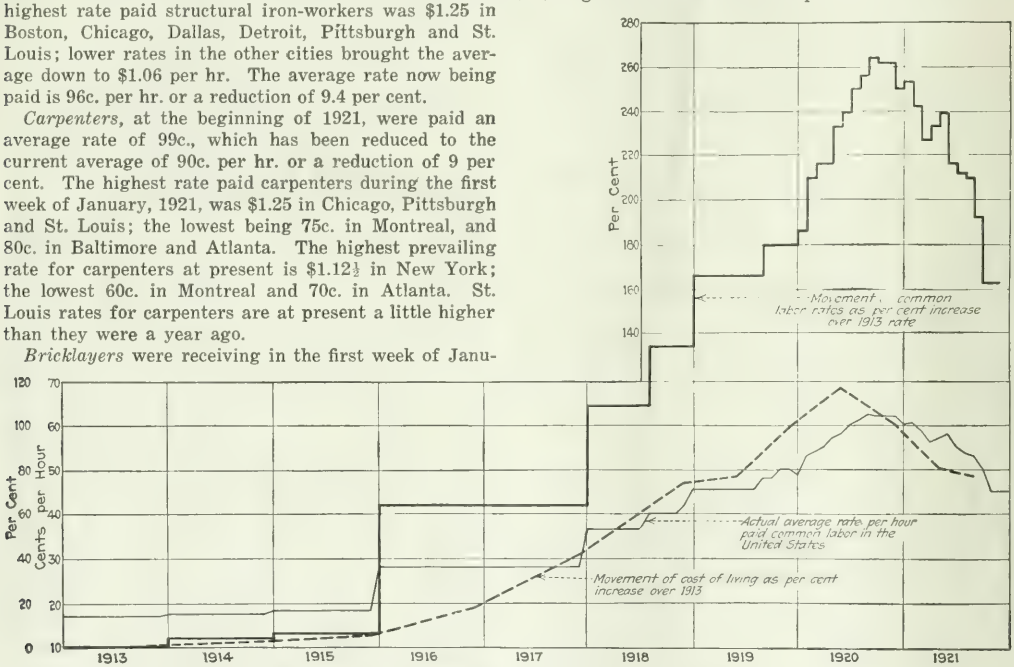
The average rates received in the skilled building trades in twenty-one important American cities during January, 1921, are here shown as compared with the current wage schedules. Of the six classes of skilled labor considered, *structural iron-workers* appear to have received the heaviest wage reductions. Throughout the twenty points in the United States and the one in Canada, during the first week of January, 1921, the highest rate paid structural iron-workers was $1.25 in Boston, Chicago, Dallas, Detroit, Pittsburgh and St. Louis; lower rates in the other cities brought the average down to $1.06 per hr. The average rate now being paid is 96c. per hr. or a reduction of 9.4 per cent.

Carpenters, at the beginning of 1921, were paid an average rate of 99c., which has been reduced to the current average of 90c. per hr. or a reduction of 9 per cent. The highest rate paid carpenters during the first week of January, 1921, was $1.25 in Chicago, Pittsburgh and St. Louis; the lowest being 75c. in Montreal, and 80c. in Baltimore and Atlanta. The highest prevailing rate for carpenters at present is $1.12½ in New York; the lowest 60c. in Montreal and 70c. in Atlanta. St. Louis rates for carpenters are at present a little higher than they were a year ago.

Bricklayers were receiving in the first week of January, 1921, an average wage of $1.16, which was reduced 6.8 per cent, making the present average rate $1.08 per hr. The highest rate paid in January, 1921, was $1.50 in Pittsburgh; the lowest 80c. in Montreal and $1 per hr. in Baltimore, Cleveland and New Orleans. The highest current rate is $1.37½ in Denver; the lowest 80c. in Montreal and 90c. in Boston and Atlanta.

Statistics of Construction

Hod-carriers are next in order of reduction with an 8.3 per cent cut in the average rate. The average in the first week of January, 1921, was 72c.; the current average 66c. per hr. The highest rate then paid was $1 in San Francisco, Pittsburgh and Los Angeles; the lowest 35c. in Atlanta. The highest current rate is $1.12½ in Los Angeles and the lowest 30c. per hr. in Atlanta.



MOVEMENT OF COMMON LABOR AND LIVING COSTS

Hoisting Engineers were cut from an average of $1.01 to 96c.—a reduction of 4.9 per cent. The highest rate for the first week of January, 1921, was $1.25 in New York and St. Louis, the lowest 60c. in Montreal and 87½c. per hr. in Seattle, Los Angeles and Baltimore. The highest prevailing rate is $1.37½ in St. Louis; the lowest 50c. in Montreal; 80c. in Minneapolis and Detroit.

COMPARISON OF CONTRACTS LET

1920

Classification	January	February	March	April	May	June	July	August
Waterworks	$1,143,777	$2,171,725	$2,213,262	$2,719,021	$1,381,655	$1,460,501	$3,793,237	$775,302
Sewers	1,863,840	622,874	1,283,227	4,123,907	2,314,874	2,348,517	3,162,632	2,437,384
Bridges	2,021,553	2,137,393	2,238,661	5,586,877	5,363,709	3,185,682	3,657,615	2,172,717
Streets, roads	12,203,970	21,334,013	26,220,967	33,340,330	30,257,872	31,441,154	29,352,756	18,564,595
Excavation, dredging	1,541,576	786,943	3,151,151	415,512	403,705	604,585	1,941,897	4,179,485
Industrial	56,041,047	63,262,290	48,861,832	65,879,005	39,661,869	40,453,500	30,968,900	25,941,992
Buildings	87,095,987	52,200,466	47,541,028	90,776,835	70,946,738	31,271,042	38,947,190	33,492,290
Federal Government	4,980,945	2,282,373	1,483,605	4,124,269	1,167,045	2,625,739	4,431,976	1,687,499
Miscellaneous	8,256,071	3,466,519	15,129,378	9,602,630	14,373,320	1,319,441	13,028,267	3,410,554
Total	$175,148,766	$148,264,596	$148,123,161	$216,568,386	$165,870,787	$114,710,161	$129,284,470	$92,661,818

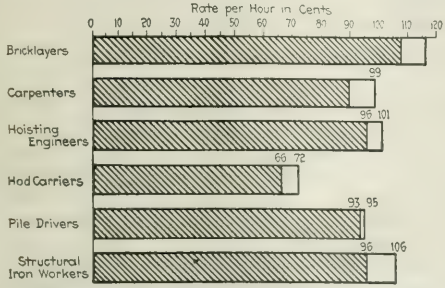
1921

Classification	January	February	March	April	May	June	July	August
Waterworks	$519,028	$2,927,307	$2,028,055	$3,342,150	$4,943,562	$3,494,584	$3,105,969	$2,404,304
Sewers	3,146,948	2,445,075	2,862,131	3,817,401	2,162,460	3,802,040	3,985,991	3,988,318
Bridges	3,030,477	885,529	1,443,060	1,987,808	1,642,894	2,417,632	5,053,520	2,353,227
Streets, roads	11,597,810	12,049,344	25,880,109	31,026,312	35,064,031	56,772,257	33,942,893	28,692,878
Excavation, dredging	1,266,346	305,740	1,625,690	580,039	2,631,799	1,240,398	609,233	89,403
Industrial	12,881,968	4,737,850	15,032,130	9,346,586	7,799,584	6,111,307	6,781,369	7,210,378
Buildings	17,455,673	31,902,608	56,520,231	51,647,900	48,442,471	56,576,768	45,452,153	50,475,001
Federal Government	2,071,141	1,574,927	3,590,617	1,186,403	1,809,588	4,158,430	3,382,964	1,355,545
Miscellaneous	2,358,976	1,728,441	4,231,823	2,732,799	4,408,142	6,005,398	3,696,957	8,075,061
Total	$54,328,367	$58,556,821	$113,213,846	$105,667,398	$108,904,531	$140,578,814	$106,011,049	$104,644,115

* Contains an item of $20,000,000, estimated value of contracts let during week ended December 29.

Cost and Volume

Pile-drivers have only been reduced 2.1 per cent or an average cut of 2c. per hr. The average wage for the first week of January, 1921, was 95c.; the current average rate is 93c. per hr. The highest rate then was $1.12½ in New York and San Francisco; the lowest 55c. in Montreal and 74c. in Baltimore. The highest current



AVERAGE WAGE REDUCTIONS FOR BUILDING TRADES LABOR

rate is $1.25 in St. Louis; the lowest 50c. in Montreal and 74c. in Baltimore.

The highest rate paid union common labor one year ago was $1 in Chicago; the lowest 35c. in Atlanta. The highest current rate is 75c. in New York and San Francisco; the lowest 35c. per hr. in Atlanta, this applies principally to the pick and shovel men in the construction industry. The highest non-union unskilled labor rate was 65c. in Chicago; the lowest 25c. in Atlanta. The highest prevailing rate is 55c. @ 56¼c. in San Francisco; the lowest 20c. per hr. in Atlanta.

Contracts Let During 1921 Total $1,231,370,965 in Value

CONSTRUCTION work throughout the United States during 1921 has been generally steady and not at all inactive as compared with 1920 if contracts let, as reported to *Engineering News-Record*, can be taken as criteria. The total value of the contracts let amounted to $1,231,370,965 in 1921 as compared to $1 582,013,036 for 1920. Such is the comparison of the contract value for the two years in actual dollars.

DURING 1920 AND 1921.

September	October	November	December	Total
1742.791	$11,168,865	$2,150,627	$1,051,335	$30,772,098
2,318,687	8,051,674	4,571,862	2,967,099	36,066,577
2,750,821	1,573,114	2,511,842	2,013,897	35,213,881
26,536,81.	12,894,173	12,443,345	10,833,502	265,423,491
858,751	1,086,067	772,228	476,764	16,218,664
37,709,100	28,044,893	20,586,456	24,790,000	482,200,884
45,321,507	26,385,881	19,502,015	37,843,664	581,324,693
1,662,264	7,487,375	2,399,033	949,408	35,281,531
6,259,158	10,749,260	10,728,049	3,178,570	99,501,217
$124,159,893	$107,441,302	$75,665,457	$84,114,239	$1,582,013,036

September	October	November	December	Total
$1,487,296	$899,991	$4,698,442	$10,752,260	$40,602,948
5,063,990	2,828,974	2,733,230	2,548,484	39,385,042
3,405,876	1,144,810	1,976,449	1,989,395	27 [illegible]77
23,256,996	20,054,543	20,750,756	16,263,498	315,351,427
9,025,229	372,871	726,328	707,424	19,180,500
13,259,789	9,441,074	11,402,944	10,251,075	114,2[illegible]058
60,979,116	62,927,041	42,859,857	43,022,433	568,261,252
3,694,113	385,960	693,751	2,703,952	26,607,391
3,301,392	6,263,410	10,793,828	6,799,447	60,[illegible]74
$123,473,797	$104,318,674	$96,635,585	$115,037,968*	$1,231,370,965

However, during 1920 the average construction cost was much higher than that recorded for 1921. For purposes of comparison it is safe to assume this difference to be 25 per cent less in 1921. Applying then the differential in favor of 1921, the 1921 contract value is raised to practically the same as that recorded for 1920. *Engineering News-Record* has construction news reporters in every state in the country. As they report upon contracts only above specified sums, (for instance only buildings costing $150,000 and over are reported) the figures herein given do not represent the total value of all contracts let. However, *Engineering News-Record's* figures form a large enough percentage of the total values to give a close index of engineering construction conditions.

In the figures compiled and reproduced herewith no account is taken of residential construction, which, it is estimated, during 1921 comprised more than 50 per cent of the total amount of construction work.

In referring to the accompanying table several illuminating facts are apparent. In the first place, the activity in public works construction has been considerably greater during 1921 than 1920. The actual money expended or involved in contracts let for water-works and sewer construction during 1920 amounted to approximately $67,000,000. During 1921, for the same class of construction the figure was close to $80,000,000.

In the second place, there has been more street and road work contracted for during 1921 than in any previous year. The years 1919 and 1920 were considered banner years in highway construction, yet the value of contracts let during 1921 exceeded the contract value for 1910 by $50,000,000. Applying here the differential representing the decrease in cost it is seen that there was put under contract during 1921 a volume of street and road work approximately 50 per cent greater than during 1920.

So far as industrial construction is concerned, 1921 has not been a live year. However, there has been a pick-up in this class of work within the last few months and included in the class of industrial work now being put under contract are a few manufacturing plants for both the automobile and textile industries. The great bulk of the industrial work during 1921, however, has been small-factory construction and a great amount of garage building. The actual money value of contracts let for industrial construction during 1920 was over four times the amount involved in 1921 contracts.

During the last six months of 1920 there was a decided dropping off in the value of contracts from the first six months, whereas during 1921 there has been a net increase. During the last six months of 1920 the total contract value amounted to approximately $613,000,000. For the same period during 1921, the contract value attained a figure of $650,000,000—$37,000,000 higher. Also, the value of contracts let during the last six months of 1921 was almost half the value for the entire year, and this in face of the fact that the greatest amount of work is put under contract during the spring.

With the need still present for practically all classes of construction, with the prices of materials more or less stabilized, with a greater quiescence in building labor circles than existed during the early months of 1921, and with the value of contracts let showing an apparently healthy condition of the industry, there is reason to believe that 1922 will prove a more active construction year than 1921.

Interviews with Industrial Leaders

What's Ahead in 1922

Men prominent in the five leading engineering industry fields were asked by ENGINEERING NEWS-RECORD *to give their impressions of the conditions to expect in the coming year. Portland cement, steel, lumber and construction equipment are represented below. Asphalt is reserved for the issue of Jan. 12, which will specialize on road engineering.*

Lumber Industry

THE lumber industry, according to A. Fletcher Marsh, chairman of the Statistical Committee, American Wholesale Lumber Association, ended the old year in a remarkably extensive preparation for a large increase in business in 1922. In spite of great logging difficulties due particularly to excessive rains and floods, manufacturers have been exerting their utmost to fill their mill stocks to normal capacity, ready to take care of the expected rush of early buying. Every effort is being made to avoid a runaway market in 1922, by having a plentiful supply of manufactured product, even though there is a log shortage. Stocks at the mills had been greatly reduced by the long run of fall business and the year ended with the mills being pushed hard to make shipments before the holidays but apparently not anxious to take on new cutting at the prevailing basis.

As is of course known, labor both direct and indirect enters very largely into the cost of lumber to the consumer; it is still difficult to persuade the worker that he should produce concrete results for a definite wage. The South, which was hard hit by cotton deflation, has had better success than the Pacific Coast in reducing labor cost.

With the opening of the new year Mr. Marsh reports that there was a decided shortage of stocks in the local yards. The hand-to-mouth policy of buying was evident in the lumber trade just as in the other industries. The yards started to increase their buying during December, but are still needing quick shipments.

Although the railroads have done little buying of track material during the past year, from August to December they were in the market for large quantities of car material for rush delivery, causing a rapid price advance on account of deferred purchasing.

To the contractor, who by the nature of his profession must purchase for rush shipment, the foregoing is important. Usually he has had a class of lumbermen catering to his particular needs and accustomed to give his special demands rush attention to the exclusion of the slower moving routine lumber business. During the new year, it now looks as though the contractors might have to share with the railroads, the yards and the industries the demand for rush shipment, and thus have to allow their regular connections slightly longer time in which to make direct deliveries from the mill.

The past year has permitted a more thorough coordination of the lumber distributors, an elimination of the weaker ones and a better understanding of what the contractor wants in the way of service by those who cater to his requirements. Freight rate reductions from the Pacific Coast to points east of Chicago came as a welcome gift the day before Christmas and apparently on the strength of this action rail orders on the Pacific Coast began showing an improvement the middle of the month.

Many of the logging and sawmill manufacturing companies have had a hard pull during the past year due to the necessity of carrying large investments through the period of depression. Fortunately they have shown an eagerness to prevent a runaway market in the spring by developing a surplus of manufactured stock at the mills, to take care of an anticipated early and steady demand, which they look for from the contracting world.

Construction Machinery

FALL letting of contracts will help to fill up the early year seasonal valley in the contractors' equipment machinery business. Cheaper money available for municipalities will start many improvements put off because of legal restrictions. Particularly has this restriction applied to sewer and water-works as well as to municipal and state building. Labor is plentiful and amenable to more efficient methods. Stronger and heavier equipment fitted into a properly pre-arranged plan is being called for by the better contractors. In view of the above facts Philip Koehring, president, Koehring Co., Milwaukee, sees one of the largest years yet ahead of the machinery interests for 1922.

Only in industrial work will there be any pause. The railroads may not get their affairs, particularly labor, ready for large improvements and extensions until late in the season, but in practically every other line greatly increased business is to be looked for. Mr. Koehring particularly impressed the representative of the *Engineering News-Record* with the view that the more progressive contractors, large and small alike, must realize the necessity of planning work ahead, and then of purchasing proper equipment to fit the plan. In his opinion the difference between making money and losing money has been, and will continue to be, due largely to the care with which adequate preliminary plans are made for carrying out construction.

As to heavier construction machinery, he agreed that the views presented at the Omaha convention of the American Association of State Highway Officials were substantially correct. Heavier parts on machines and larger capacity, with all of the elements insured against breakdowns, were as important as to have the continuity of material and water supplies maintained. The average life of a concrete mixer, for instance, is from 4 to 5 years, so that of the 12,000 to 15,000 mixers, 20 to 25 per cent must be replaced every year. This means a certain amount of business but the manufacturers feel that more will be developed if heavier equipment be manufactured.

Structural Steel

"RECONSTRUCTION has been more complete in the field of bridge and structural-steel construction than in any other unit of the entire building industry. This statement applies to prices as well as to production efficiency. Coupled with this favorable basic condition is the fact that a very promising activity within the last three months, interrupting the marked stagnation of the early quarters of the year, promises resumption of something near normal demand. The outlook of the fabricating field for 1922 is good, on the whole, and the new year finds both the fabrication and the erection departments well prepared for best service. But don't quote me!"

Such is the opinion of leading men in the field, who are in close contact with all phases of the industry. What they have to say about the separate elements of the situation supplies a solid foundation for this general view.

From High to Low Production.—The recent history of steel fabrication must be recalled, in thinking of its present condition. With 1919 the pressure of fabrication for ship construction was over. Probably not a pound of ship work was carried over into 1920, but the heaping up of industrial orders then taxed the capacity of the shops, on to near the close of 1920. The phenomenally sharp industrial slump that set in early in that year did not at once strike the structural field, or at least was not so markedly felt, largely because of the lag of fabrication behind the general industrial demand —normally some three to six months. Orders began to drop sharply by summer; the shops felt the effect in early winter, and felt it quite suddenly. More or less steadily throughout 1920 the shops were producing in excess of 60 per cent of capacity, a high production, on the average. In 1921, however, they have been producing at rates ranging from 30 to 40 per cent of capacity, with the grand average for the year probably nearing the lower figure. The only encouraging feature about the 1921 history as a whole is the remarkable steadiness of the production, a reflection in part of the fact that demand had reached rock bottom, and in part of prompt and vigorous reconstruction measures. Finally, in the last three months a steady flow of inquiries, with a fair amount of orders, has demonstrated that the market appreciates the low level of prices. A small drop in the closing week of the year represents probably nothing more than a holiday interruption.

Labor.—Labor has reached full efficiency, it is asserted very positively. Generally speaking, this has been the case for nearly six months. Both quality of work and productivity of the men are up to the best pre-war performance. These statements apply primarily to the work in the shop, but in only lesser degree to erection. Shop production is favored by the general progress in shop equipment and methods, maintained throughout the war and partly stimulated by it. Erection still suffers from a wage rate decidedly higher in proportion than that of the shops; yet in spite of this, some remarkably low erection costs have been recorded.

Price Reconstruction.—Work has been taken at prices having little regard for cost. It is widely known that a number of large contracts for both bridge and building work have been taken within the last six months at prices almost equal to those prevailing before the war. Overhead charges have been ignored, no doubt, in offering such prices.

Average prices prevailing today are less than 50 per cent higher than the lowest pre-war prices, while the excess over normal prices prevailing before the war is very much less. This general condition will no doubt continue for a time, although prediction in this regard is hazardous. Continuing efforts are being made by the works to support their price position by reduction of overhead expense.

Financial Position.—The financial condition of the industry is thoroughly sound. The burden of losing prices has been heavy, but not fatal. There was a very material increase of capacity of the industry during the war, through the construction of new shops; yet this has not been a factor during the post-war period in the way of making competition more severe. The country's producing capacity for fabricated steel work, about 2,000,000 tons annually, is not excessive for the million and a quarter to million and a half tons annual consumption.

When these several conditions are considered in connection with the present free supply of rolled steel—practically all sizes may be obtained promptly from the mills—it is evident that the industry is prepared for most efficient service to the construction and building industries. Its business prospects for 1922 are correspondingly good. Shrewd observers, despite individual differences as to prospects of railroad activity and the like, unite in forecasting something more than a 50 per cent increase in business over that of the year just passed. The 1922 production should surpass 50 per cent of capacity, as compared with 30 to 35 per cent for the year just closing.

Portland Cement

PROPHECY, in the opinion of John R. Morron, president of the Atlas Portland Cement Co., is dangerous business. His opinions as to the prospects of the coming year as they affect the cement industry were, therefore, offered with the qualification that they were distinctly personal and, while based on the best information available to his company and himself, are subject to the possibilities of change in the unusual economic situation existing since the war. In other words, the developments of business, if it were possible to plot them in a composite curve, would follow no recognized law in the past few years, which makes it doubly difficult today to base estimates of the future on the conditions of the past.

With these qualifications, however, Mr. Morron is willing to be quoted as expecting a large volume of construction work in the coming year which, of course, means a large volume of cement used. As is well known, the cement production in 1920 was over 100,000,000 barrels, a record in the industry. Of this enormous volume, over 96,000,000 barrels were shipped from the mills. Up to the first of December, 1921, which is as far as the records now available go, the shipments were practically 99 per cent of the shipments of the similar eleven months in 1920, while the production was slightly greater than the shipments, indicating another record or near record year in cement production. The mills went over the new year probably with about the same stocks as last year; that is, between 9,000,000 and 10,000,000 barrels.

Mr. Morron thinks that the demand next year will be greater than in 1921, but he is of the opinion that this demand may not reach large figures until late in the spring or early in the summer. He expects little if any

increase in industrial building, but a pronounced increase in the already great use of cement in road work, a return to pre-war normal conditions in the railroads, and a great amount of municipal and state construction. This latter will be partly a result of such efforts as the unemployment conference at Washington to provide work by the government in times of slackness in other industries, and partly a result of the favorable financial situation in which the cities and states now find themselves due to the low interest rates which are beginning to be made available for governmental issues. Mr. Morron takes very little stock in the scarcity theory of expected production; that is, the theory commonly stated in the arguments which say that the country is short a million and a half houses and therefore we must expect that approximately that number will have to be built soon. He feels that the number of houses reported to be required is not always an accurate statement of conditions but rather an expression in part of the desire of people to live in somewhat better circumstances than they have been accustomed to or which they can afford in normal times.

Referring to the possible stocking up of the cement mills in the early months of 1922, Mr. Morron expresses the hope that the casual engineer and contractor reader of the new U. S. Geological Survey monthly statistics of cement production and stocks will read such statistics understandingly. He believes that it is a good thing for the users of cement to have some idea of the ebb and flow of cement production, but he has fears that if such figures are published broadcast there may be, on the part of a number of unthinking users of cement, the disposition to forget seasonal activities in cement use and production. For example, finding, we will say, the first of April that there is an exceedingly large stock of cement on hand in the mills the prospective cement user may argue that the mills are overstocked and that therefore the price is bound to fall, when, as a fact, this apparent overstocking is merely the provision of a far-seeing business man to have available a sufficient amount of stock to take care of expected business.

In connection with the price of cement Mr. Morron has no prediction to make. In his opinion there can be no further lowering of railway rates until there has been a proper adjustment of wages; general business is so dependent upon and interwoven with the railways that he believes it is to the welfare of all to have a proper adjustment of wages before advocating a general reduction in rates.

Labor in the cement industry has been reduced in its base rates (although still double the 1914 scale) and the men are also working more efficiently than during the war period.

While coal still costs three times what it did at the mills prior to the war, at the same time it is lower at the mines than it was a year ago, and Mr. Morron does not expect much change from these prices during the coming year.

Cement prices have been reduced, according to Mr. Morron, anticipating these reductions in labor and coal costs, and in fact he says that the prices which have been lately established by his company for cement can be maintained only when based upon the expectation of increased output and shipments.

Review and Forecast of Highway Construction, 1921-1922

Construction Cost Over $400,000,000—Maintenance Cost Nearly $200,000,000—Working Conditions Best Since the War—Outlook Favorable for Increase in 1922

ABOUT $600,000,000 were spent in highway construction and maintenance in 1921. This is $100,000,000 more than the total of any previous year. It seems reasonably certain that the expenditures for 1922 will be at least equal to and probably greater than those of 1921. All road construction activities proceeded in 1921 under far more favorable conditions of prices, wages, supply and delivery than during any previous twelve months since the war. The prospects for 1922 are even better. Maintenance expenditures in 1921 were about $180,000,000 or one-third of the total. They were about $40,000,000 greater than in 1920 and in 1922 they promise to show an equal increase over 1921. In general, 1921 was the most active year in highway improvement, ever experienced, and there is not likely to be any decrease in activity in 1922 and probably there will be an increase. With some of the year left for work to continue, when the data for this year's highway operations were assembled, and with the compilations incomplete in many states, precise mileages or amounts are impracticable. Absolute precision is, however, not needed to indicate general trend and the data assembled are amply complete for this purpose. They have been secured from state highway departments and the Bureau of Public Roads, and by visits during the year to highway operations in many states active in road-building.

Mileages and Types.—Concrete, in 1921, maintained its lead as the favored material for paved roads. Even including waterbound macadam the mileage of concrete was considerably more than half the total. Bituminous roads followed, then macadam and finally brick roads.

Certain states appear with unusual mileages of concrete construction: Pennsylvania with 612 miles, Illinois with 400 miles, New York with 367 miles and Wisconsin with 340 miles. It is more significant, however, that states only just beginning the development of paved roads, have concentrated even more closely on concrete. For example in South Carolina, Nevada, Arizona, Colorado and New Mexico, practically nothing but concrete pavement was constructed. The older road states of the east continue, as in Rhode Island, Connecticut and Massachusetts, their preference for bituminous roads, using them to replace old waterbound

In ENGINEERING NEWS-RECORD *next week, Jan. 12, 1922, there will be a dozen articles on highway design, construction, and—not the least these days—operation. Some of these will illustrate the specific points of construction and design noted in this article.*

macadam. Other eastern states divide their choice between concrete and bituminous roads. New York, notably, employed about three-quarters concrete and one-quarter bituminous construction in its road work for 1921 which is altogether a macadam reconstruction task. Oregon, in the far west, put down twice as much bituminous pavement as concrete pavement, but it is the only far western state to build much bituminous road.

Gravel roads provide the large mileage figures of the year. About one-third of the total road mileage of 1921, including graded and drained but not surfaced road, was gravel. Wisconsin and Michigan led, with about a thousand miles each, while a number of states have completed one or two hundred miles. Gravel road construction improved in general quality, a thicker and a wider surfacing was generally used. In Wisconsin, 30-ft. gravel surfacing was tested out under heavy traffic to observe its behavior.

About a quarter of the road building of the year was permanent grade construction. Many states, unable to afford high priced pavement, did a most creditable volume of work grading and draining. These were mostly middle western states, where for the moment a large mileage of serviceable highways instead of a few high quality main roads is most important.

Considering the building programs state by state, it was rare that there was any considerable distribution of the mileage between the different types of roads. Either one or the other type greatly predominated, as for example in Illinois where, with 400 miles of concrete, there were only about 3 miles of brick, 3½ miles of bituminous and no gravel road. Better balanced programs are those of Oregon and Wisconsin which are also noteworthy for their total mileage. Oregon constructed 57 miles of concrete, 130 miles of bituminous concrete, 486 miles of gravel or stone surface and 504 miles of grading. Wisconsin figures were: Concrete, 340 miles, asphalt penetration, 30 miles, macadam, 33 miles, gravel, 973 miles, miscellaneous surfaces, 229 miles and graded and drained, 1,378 miles. In addition another 504 miles of old grade were gravelled and 119 miles surfaced with other materials.

Conditions and Methods.—All conditions which affect highway construction were more favorable in 1921 than during any year since the war. Labor was plentiful and wages lower; the supply of materials was adequate and their prices were lower; transportation was adequate and deliveries prompt, and the season was one of the finest for construction operations experienced in many years. These conditions were nearly universal.

Transportation rates were the greatest obstacle to construction. In many states, where aggregates for concrete have to be imported by railway, the increase in freight rates has offset to a large extent the decrease in the prices of materials.

Bidding prices reflected the more favorable construction conditions; they decreased 10 to 50 per cent compared with 1920. As examples of the general reduction there are cited the following figures from widely separated states: New Mexico 40 per cent, Nevada 20 per cent, Colorado 20 per cent, Vermont 20 to 30 per cent, Connecticut 40 per cent, Delaware 10 to 15 per cent and Alabama 25 to 50 per cent. Contractors have been plentiful and competition in bidding has been active. In frequent instances the bids have run well below the engineers' estimates.

Construction methods were not generally altered. A great many states prohibited, by specifications, stockpiling on the subgrade and this eliminated methods and equipment designed specifically for continuous or closely spaced stock piles. The swing was toward central proportioning with dry batch haulage by trucks or industrial railway, and in truck haulage practice inclined toward large trucks carrying three or four batches in partitioned bodies instead of single batch small trucks, but the shift was not marked. The industrial railways hauling of cars carrying batch boxes increased in popularity. There were more central mixing plants than in previous years but the practice made very little gain geographically. Paving mixer and finishing machine practice remained about the same. There was an inclination to demand heavier and more sturdy equipment, but almost no progress was made in standardizing equipment.

In general methods, the most suggestive development of the year was working double shifts. A number of contractors in Illinois adopted this practice with highly satisfactory results. One of them, with a four-bag paver, working double shifts for about half of the season, constructed 16 miles of 16-ft. pavement. This is probably the record mileage for an outfit of this size.

Forecast for 1922.—With the greatest year of highway construction just concluded it is also possible to prophecy with some confidence that a greater year is to follow. With reports from 75 per cent of the state highway departments, including all the principal road building states, the summary is as follows: 50 per cent estimate increased expenditures for 1922, 30 per cent estimate an expenditure equal to that of 1921, and 20 per cent estimate a slight curtailment in expenditure due generally to the smaller Federal aid appropriations available. One state, Illinois, which spent $17,838,000 in construction in 1921 expects in 1922 to spend $35,000,000 in paving, grading and bridges. This is perhaps the greatest percentage of increase which any state hitherto active in road building contemplates, but a number of the larger road building states estimate increases of 10 to 20 per cent.

It is important to note that the estimates are in money to be expended. With the reduction in costs which has come about, from 10 to 30 per cent, the same expenditure in 1922 as in 1921 means a considerably greater mileage of highways improved. By all counts 1922 promises to be a banner year in highway construction.

Road Widening and Resurfacing in California

The California Highway Commission recently awarded to the Southwest Paving Co., of Los Angeles, a contract for 8.41 miles of widening and surface between Naples and Gaviopa Creek in Santa Barbara County. The main features of this work involve new reinforced concrete shoulders, 2½ ft. wide by 7 in. thick, laid on each side of the old slab. The surface of the new shoulders is from 2½ to 3 in. above the existing pavement and the trough thus formed is to be filled with asphaltic concrete from 2½ to 3 in. thick. The contract price was $92,884 and material to be furnished by the state amounts to $110,877.

The engineer's estimate of the cost of the work was $116,204.

Municipal Bond Sales in 1921 Top All Previous Records

More Than a Billion Dollars Worth Sold But Construction Cost Index Halves Buying Power—Year Closes With Heavy Sales, Falling Interest Rate and Improved Construction Outlook

MUNICIPAL bond sales in 1921 passed the billion-dollar mark. The total exceeded by a half billion the highest previous record. The low war level of 1918 was exceeded by something like a billion and the figure for the immediate pre-war year, or 1913, was multiplied by more than four. These approximations are market totals. They take no account of relative buying powers, which will be shown later when figures based on the *Engineering News-Record* construction-cost index are presented. But even after being reduced to the common denominator of 1913 prices, the 1921 bond sales were far in excess of those for any year later than 1915, and well over those for that year. The 1921 sales, reduced to the 1913 buying power basis, are perhaps 50 per cent above those for 1913, exact comparisons being as yet impossible.

High interest rates characterized the bond issues of 1921, but with a notable decline as the absorptive power of the market rapidly increased at the close of the year. Gilt-edge and certain much-sought-for bonds sold in December at say one per cent lower than in the previous year or, in some cases, than they did well into 1921; but notwithstanding this the prevailing rate for the entire year, taking all issues into account and ignoring volume, was probably 6 per cent or more. This contrasts with a prevailing rate of less than 4 per cent twenty years ago, based, in this case, on both volume of sales and number of issues. The much lower rate at the very close of the year and the very active demand for municipal bonds promised well for 1922

Heavy Bond Sales in Last Quarter of Year

During the last quarter of 1921 bond sales exceeded 400 millions, or more than the total for the entire year of either 1909 or 1910. Thus the *Commercial and Financial Chronicle*, from which most of the basic data in this article are taken, gives the October sales as nearly 114 million and the November as almost 118 million. November high records in the previous ten years were: 57 millions in 1920; 48 in 1919 and 31 in 1913. The *Chronicle* totals for December are not available as this is written, but for the first 11 months of 1921 its totals were 990 million. The *Daily Bond Buyer* gives the 11 months' total as 1,100 million, the December total as 206 millions and the total for 1921 as 1,306 millions. The *Bond Buyer's* figures for 1920 and 1919 also exceeded those of the *Chronicle*. Presumably, the *Chronicle* total for 1921 will be 1,200 million or more.

Prior to the record-breaking total of more than a billion dollars of municipal bonds sold in the United States the record was $691,500,000 in 1919, but 1920 fell behind only $8,300,000, as shown by Table I. By far the lowest year for a long period was 1918, when the total was only $296,500,000. These totals include only permanent additions to the bonded indebtedness of the states, counties, cities, and other minor civil divisions of the country. The totals have been swelled in recent years by state bonds issued for many purposes, notably highway bonds.

It was not until 1913 that municipal bond sales passed the $400,000,000 mark, although they were near that figure in both 1911 and 1912. The advance was rapid in 1914 and in 1915. There was a considerable fall the next two years and a great slump in 1918.

Applying the *Engineering News-Record* construction-cost index—based on 1913 costs of common labor, structural steel, cement and lumber prices—bond issues from 1914 to date take on a much different relationship, year by year. On this basis, a hundred dollars of bonds would buy slightly more material and labor in the United States in both 1914 and 1915 than in 1913, and from 1916 to the present time much less, 1920 having an index or divisor of 251 and 1921 of 202, the latter being slightly above 1919 and higher than for any year but 1920 since 1913. The index by years and the corresponding buying power of bonds sold are shown in Table I.

TABLE I. YEARLY MUNICIPAL BOND SALES IN THE UNITED STATES, BUYING POWER OF PROCEEDS SINCE 1913 AND PREVAILING INTEREST RATES

The total bond sales and the interest rates prior to 1921 are from the *Commercial and Financial Chronicle*; the 1921 figures are estimated. The totals are given in millions of dollars.

Year	Total Bond Issues	Construction-News Cost Index	Buying Power 1913 Basis	Prevailing Interest Rate — Per Cent	Prevailing Interest Rate — Amount*	Prevailing Interest Rate — Per Cent of Total*
1921	1,200+	202	600+			
1920	683 2	251	272 2	5+	332 7	49 15
1919	691 5	199	347 5	5	278 3	40 71
1918	296 5	189	156 9			
1917	451 3	181	249 3			
1916	457 1	147	310 9			
1915	498 6	93	536 1			
1914	474 1	98	483 8			
1913	403 2	100	403 2			
1906	190 0			4	120 1	63 22
1901	140 2			3½	68 7	49 00

* The figures in these two columns are computed on the various yearly totals less purchases for New York City sinking fund. By "prevailing rate" is here meant the rate which shows the largest percentage of total bond sales.

The buying power of bond proceeds fell from the corrected total of 536 million dollars in 1915 to 157 millions in 1918, notwithstanding respective bond sales of approximately 500 and 300 millions. Similarly, the nearly 700 millions of bond sales of 1919 had a purchasing power of only some 350 millions. The rise of the construction-cost index to 251 in 1920 cut the real value of the again almost 700 million bonds to less than 275 millions. The fall in the index of 1921 to 202 is a material aid to purchasing power but cuts the real value of the immense total of more than a billion of bond sales to less than half, so that notwithstanding this unprecedented addition to the municipal bond burden of the country, it gives little more purchasing power than did the half billion actual bond sale of 1915, with its 536 billion purchasing power, but for 1921 to be actually in advance of 1915 is a reason for congratulation. Should one go further and apply corrections for (1) increase in population and (2) vast increase in construction needs due to accumulations of deferred construction there would be a heavy further shrinkage and a marked increase in the gap between construction needs and purchasing power of the bonds sold in 1921,

True, the story cannot be fully told even by reducing the bond sale proceeds to a pre-war buying-power basis, for even then no distinction is made between bonds issued for new construction and those put out to fund floating debt incurred for work already completed or

to refund bonds falling due. As to the latter, the *Chronicle* figures show that from 1920 as far back as 1917 the first of these ran 1.67, 1.93, 3.27 and 3.40 per cent of the gross sales, while under the combined classification "funding and improvement" corresponding percentages were 7.37, 6.98, 8.36 and 4.94. It seems safe to say that the combined funding and refunding bonds of 1921 would not exceed 10 per cent of the total. If a deduction of such a percentage were to be made for 1921, so should it be for other years, so the relative standing for the various years might not be much changed. The $55,000,000 refunding bonds sold by New York City in December, 1921, to refund "corporate stock" issued for rapid transit purposes from July, 1917, on was presumably quite abnormal but illustrates what may happen.

TABLE II. NEW YORK *TIMES* REPORTS OF MUNICIPAL BOND SALES IN DECEMBER, 1921

Rate Per Cent	For the Week Ended Dec. 9 No.	Dec. 9 Amount	Dec. 16 No.	Dec. 16 Amount	Dec. 23 No.	Dec. 23 Amount	For the 3 Weeks Ended Dec. 23 No.	3 Weeks Amount
6½					1	$92,000	1	$92,000
6	7	$2,511,000	8	$3,817,000	6	6,136,000	21	12,464,000
5½	2	435,000	4	5,563,000	4	1,227,000	10	7,225,000
5¼			1	1,200,000			1	1,200,000
5	4	4,347,000	6	6,100,500	16	7,594,000	26	18,041,500
4½			1	1,500,000			1	1,500,000
4½	4	8,891,000	5	63,796,000	1	200,000	10	72,887,000
4	2	1,600,000	..	.....	..	.....	2	1,600,000
3½	..	.....	..	.....	1	250,000	1	250,000
Totals	19	$17,784,000	25	$81,976,500	29	$15,499,000	73	$115,259,500

To the retarding effect on bond issues of the high cost of construction work or low buying power there has been added a high interest rate, which, besides discouraging bond issues, has in many cases barred them because of the statutory fixing of the rate of interest or the prohibition of the sale of bonds below par. Although these drags combined—low purchasing power and high interest rate—were not sufficient to keep the total municipal bond sales from reaching an unprecedented figure, they unquestionably held back the total sales materially. Proof of this is afforded by the marked rise in sales at the close of the year, accompanying the decline of interest rates and the increasing frequency of high premiums, with the consequent equivalent further reduction in the cost of loans when yields are figured.

Using again the *Chronicle* figures (Table I) we see that while in 1901 almost half of the total bonds sold bore only 3½ per cent interest and while in 1906 about 63 per cent of the sales were 4 per cent bonds, in 1919 some 41 per cent of the bonds were at 5 per cent and in 1920 about 49 per cent were in excess of the 5 per cent rate. Unfortunately, the *Chronicle's* summary does not show how much the 5 per cent rate was exceeded in 1920 and the prevailing rate for 1921 (i.e., the rate at which the largest percentage of all the bond issues were sold) has not yet been announced.

Some light on the prevailing rate towards the very close of the year is thrown by sales of 73 leading issues totaling $115,300,000 reported by the New York *Times* for the three weeks ended Dec. 23 (see Table II). The prevailing rate—again by volume—was 4½ per cent for some $73,000,000, or about half of the total sales in this list; but this included a single issue of $55,000,000 sold at 4½ per cent by New York City. The sales in excess of 5 per cent or more in this list were only some 18 per cent of the total, in marked contrast with the 49 per cent for the whole year 1920. Presumably, complete reports for the three weeks in question would show less of a decline, but that there was a marked decline in the latter part of the year seems certain.

Further testimony as to this decline is afforded by comparing (what is in some respects preferable from the viewpoint of cities of all classes) the number of issues rather than the volume of sales at various rates of interest. For this purpose Table III has been compiled, taking the *Chronicle* sales for October and November, 1921, and the *Times* sales for the three (nearly) following weeks. Besides interest rates, Table III shows yield rates for the corresponding bond sales. Both the main part of Table III and the summary at its foot bear convincing testimony of the declining interest and yield rates in November and December. The yield rates reflect more strikingly than do the interest rates the relief from high cost of bond proceeds at the close of 1921. The $55,000,000 New York City 4½ per cent bonds were sold on Dec. 15 at 103.407, yielding 4.25, and the total subscriptions were almost six times the amount offered.

The recent trend of events in the municipal bond market, combined with the accumulation of deferred municipal construction, is towards continued high total sales of municipal bonds in 1922. Although the improvement in the market for municipal bonds late in

TABLE III. BOND RATE INTEREST AND YIELD RATES IN THE UNITED STATES FOR THE LAST QUARTER OF 1921

October and November figures compiled from the *Commercial and Financial Chronicle*. December figures from New York *Times*

Interest Rate Per Cent	Number of Cities at Each Interest Rate October	November	Three Weeks Ending Dec. 23	Yield Range Per Cent	Number of Cities at Each Yield Rate November	Three Weeks Ending Dec. 23	Week Ending Dec. 23
8	4	3		8	1		
7	5	14		7–7.99	3		
6½	4	3	1				
6	273	278	21	6–6.99	68	7	2
5½	1	2					
5¼	57	55	10				
5¼	12	10	1				
5	54	72	26	5–5.99	121	19	5
4½	1	5	1				
4¼	4	7	10				
4¼		1					
4	4	3	2	4–4.99	43	46	22
3½			1				
	419	453	73		236	72	29

NUMBER AND PER CENT OF ISSUES AT 6 OR MORE AND AT 5 OR MORE PER CENT

	No.	Per Cent	No.	Per Cent	No.	Per Cent		No.	Per Cent	No.	Per Cent	No.	Per Cent
6 or more	286	68	298	66	22	30		72	30	7	10	2	7
5 or more	410	97	437	96	59	82		93	82	26	36	7	24

1921 was in part due to year-end investment shifts and to the accumulation of investment funds during a period of quietness in utility and industrial bonds it does not seem likely that changes in these conditions will be sufficient to force the bond sales of 1922 below the 1921 total and stop the downward trend of interest rates. However, it is to be noted that as the municipal bond interest rate falls there will be those among the more venturesome who will seek higher yields on their money. This, and a general business improvement, would divert some of the capital that would otherwise go into municipal bonds and tend to raise the interest rate and discourage city and state bond issues. But with so much work waiting to be done there is strong reason to expect large flotations of municipal bonds in 1922 and with them an increase in construction work. The increase in volume of work will be all the more notable if the construction-cost index continues to fall

Concrete—Past and Future

What the Past Twenty-Five Years Have Taught Us and What We Must Learn If It Is To Continue To Grow in Use

Editorial Review

IT IS now about twenty-five years since reinforced concrete came to the attention of the American engineer. For a dozen or so years before that it had been used extensively by a few specialists in France and Austria, and their patented structures, mainly bridges, were the first evidences of the new material over here. Mass or plain concrete was used, of course, but the cement production and importation figures show how limited was even this use. In 1896, for instance, 9,000,000 barrels were produced and about 2,000,000 barrels imported, and of the amount made in this country only 1,500,000 barrels were portland cement. In other words, assuming all the importations to have been portland cement, the consumption of portland cement in this country twenty-five years ago was one-thirtieth what it was the past year. The total hydraulic cement consumption was probably about one-tenth of that today.

Once reinforced concrete was introduced, however, the spread of its use became phenomenal, and with it came a wider appreciation of the virtues of plain concrete. Production in 1900 had grown to over 17,000,000 barrels, in 1910 to 78,000,000, and in 1920 to over 102,000,000, practically all portland cement. Just how much of this went into plain and how much into reinforced concrete nobody knows nor is it very important now to distinguish between the two. The important thing is that the recognition of the structural capabilities of concrete reinforced with steel opened up a new era in engineering design and construction. Today a knowledge of concrete must be a part of the equipment of every civil engineer and contractor because it enters into very kind of construction. Other subjects are left to specialists, but concrete is universal.

What is Needed Now

This universality has its vices as well as its virtues. So many people are interested in perfecting concrete that more study is probably being given to it than to any other one engineering subject. More interest is displayed at a technical meeting when concrete is discussed. Wider attention is given to technical papers on it. On the other hand, so many men, both ignorant and informed, are putting in concrete that there has grown up the familiarity which breeds contempt, a disdain for further inquiry into its composition and manufacture and a complacence regarding its behavior. These two divergent attitudes need to be brought together. The work of the student must be popularized, the man at the mixer and at the forms must be educated out of his ignorance and complacency. Just now, when the latest report of the Joint Committee on Concrete and Reinforced Concrete is receiving so much attention, seems to be a favorable time to set down some of the things we have learned about concrete, and to inquire into the progress we have made, with a view to orient ing ourselves for future progress.

In these past twenty-five years, roughly 1,500,000,000 barrels of cement have been used in the United States, which, again roughly, converted into cost of concrete made from it reaches the almost incredible sum of $15,000,000,000. What is the present condition of this concrete which cost half as much as the World War cost the United States and which is supposed to be long-lived, if not eternal?

In the first place, most of it—certainly a large part of it—was put in under no engineering supervision whatsoever. The cement was bought bag by bag from the local dealer and is a part of floors, backyard steps, house foundations, drains, fences, and a hundred other little details which the farmer, mason, or city householder builds for his own convenience. Considering the lack of information such builders have regarding the necessities of concrete design and construction, these concretes in minor structures are in good condition. They could be made much better by a closer adherence to better practice but their failure, when failure occurs, is generally of negligible importance.

Building Concrete is Good

Another large proportion of the cement production has gone into buildings, and here, too, the results have been satisfactory in the main. It is rare that one sees the interior of a concrete building in any condition of deterioration. Where failure has occurred it is almost without exception either in the structure during erection or a failure in design due to obvious overloading or a misapplication of the accepted principles of structures. Such concrete may not be as economical as it will sometime be made but it is safe and so far as we can now tell permanent.

The remaining important application of concrete has been to exterior structures. Here the story is not so pleasant. There is no use blinking the fact that concrete as commonly placed in the last twenty-five years is not a permanent material when exposed to the weather. Everyone who travels through the country knows that much outdoor concrete is in various stages of disintegration. Occasionally one comes across concrete masonry in as good condition as a contemporary limestone or granite masonry. This, however, is the exception. Scaling, spalling, cracking, the latter where steel is near the surface, are the common exhibits in bridges, building faces, piers, abutments, which have passed beyond the eight or ten years which seems to be the critical age of outdoor concrete. This does not mean that such structures are at the point of failure. Far from it. In many of them the surface disintegration means nothing more than that that surface has been unable to resist the attack of moisture. The main difficulties are in appearance and not in structural integrity, though here and there there are instances of so near an approach to structural failure as to cause worry. More and more of such cases are being brought to light in technical papers and proceedings, but many more have never been made public because of reticence on the part of their builders and fear of depreciation of concrete as a building material.

What is causing the deterioration of these structures? Quite obviously, the attack of the elements, mainly water, on the cementing element. The stone ingredients can resist such attack but the glue which joins them together cannot always do so. The trouble lies in the porosity, sometimes microscopic, which permits the penetration of the water throughout the mass. When steel is near the surface—just how near it can safely be is still a matter of debate—we get the rusting and most familiar form of final failure.

Outdoor Concrete Must Be Better

The engineering profession must recognize the necessity for a bettering of conditions in the production of outdoor concrete. Some appreciation must be had of the distinction between a concrete always protected from great variations of temperature and moisture and one which is outdoors subject to a change of temperature of 100 or more degrees and of alternate wetting and drying throughout a long period. The fact is that the criterion of indoor concrete is strength, whereas the criteria of outdoor concrete are both strength and density. Current methods of concrete production, even as practiced by the average engineer and contractor, can insure a sufficient strength; they do not always insure sufficient density. There is some relation between the two properties of concrete, but it well may be that the concrete which reaches a strength now thought sufficient for structural purposes is not dense enough to resist for a long time the inroads of the weather.

Density, as such, is not sought in concrete today. Strength is the measure by which quality is judged. Moreover, there is no good measure of density whereby one can judge the capability of a concrete to resist moisture and temperature attack, except the measure of strength, which itself is determined by the not too well related measure of test-piece behavior.

In considering what the future progress of the art may be it will be well to take our bearings on our present knowledge. Look at the constituents first. Cement used to be the favored point of attack in any investigation of inferior concrete. It is no longer so. Portland cement has been standardized in a specification accepted by the government and the leading technical societies, and rarely is there any divergence from it in any individual specification. To achieve such a standard specification has long been the ambition of the cement manufacturers and of most of the cement users. Certainly, it is a great step ahead of the many varying specifications which were common twenty years ago. It must not be forgotten, however, that this accepted standard specification is deadening in a certain way. Cement is standardized so that the user may be guaranteed a superiority to a certain definite minimum of requirement, but he is not guaranteed any uniformity above that minimum. It is a well-known fact that cements, all of which pass the standard specification, are of great variation in their different qualities, particularly in strength, so that while use of any accepted cement may assure a certain strength, there is no assurance that a stronger concrete could not have been obtained by some other equally acceptable cement which gave higher test values.

There is no question, too, of a general feeling among engineers that the cement makers themselves are satisfied with the present situation and that they are more anxious to preserve the standard specification than to get a better product. This is partly true. To improve a product in any way, such as, for instance, by the increased fineness talked of some years ago, would require a large revision of the manufacturing machinery and a great expense with a doubtful improvement in quality. So long as there is no overwhelming evidence that the present product is causing difficulty, the manufacturers will prefer to continue working under the present specification, and to this extent progress is hampered. It is unfortunate, too, that practically all the cement experts are confined to the cement trade. Very few engineers know anything about the manufacture or the chemistry of cement or have sufficient knowledge to make any reasonable recommendation as to the improvement of cement quality. Outside of the manufacturers' employees there are a few experts in the employ of the government and one or two independent consultants, who must look for most of their business from the cement manufacturers themselves. The manufacturers continue to study their material, of course, but they are naturally conservative and little disposed to advocate any changes unless those changes promise wider use or lower cost of the cement

Not Much Hope for Better Cement

It results, therefore, that the only place where we can hope to look for any radical recommendations regarding the cement itself is from the government engineers who are limited in number and who, therefore, must work slowly. There is no doubt that so long as there is no good measure of superiority in cement nor any bonus for a superior product portland cement will continue to be the same product as it is today and that there need not be any great improvement in it looked for. The portland cement of today is a remarkably good material. The point is that no one knows and there is not much chance of engineers finding out whether it is possible to produce a better material.

A few years ago many engineers thought that practically all had been learned about steel, the material, but the later crystalographic studies have since opened up entirely new possibilities in the material. By the same token, it will not do to assume that we have achieved the perfect portland cement.

Regarding the aggregate, the other ingredient of concrete, we have learned a great deal in the past five years mainly in regard to its proportioning, but a calm survey of this new learning leads one to the conclusion that it is merely the bringing to wide attention of the facts developed a good many years ago. As far back as the seventies, Feret, the French investigator, laid down a good many rules for the manufacture of concrete, which are announced every once in a while today as new matter. It is nearly fifteen years ago that the Fuller and Thompson paper on proportioning appeared in the American Society of Civil Engineers; ten years ago Chapman proposed slump tests and proportioning for strength in the American Society for Testing Materials. The later developments of the void theory, of surface-area measurement and of fineness-modulus investigations are all groping steps toward some final method of proportioning and specifying aggregate which has not yet been reached. The goal of all these methods is to establish some method whereby available aggregate can be graded and mixed so that there will be the most

compact grouping of the various particles that go to make up the concrete.

The quantitative effect of the water in concrete, as investigated by Prof. D. A. Abrams, has been a definite step forward in proportioning. While there is still much doubt as to the wide applicability of his theory to the proportioning of specific mixtures, there is no doubt that the part water plays in the concrete mixture is now much better appreciated and that the average concrete now being made is measurably better since the theory and the experiments in which it was based were made public.

In the production of the concrete itself we are going ahead slowly. Mixing and placing machinery is better mechanically than it was ten, fifteen, or twenty years ago, but in its general principle this has changed but little. Let any engineer cast his memory back twenty years to the concrete machinery used then and he will see that the manufacturers have done a great deal toward making the mixing and placing of concrete a more economical and simpler process, but very little toward making the concrete a better product. There is room for inventive thought in this field.

Design Reform Unimportant

Little has been said in this review about design. This is intentional. In spite of the controversies that can be developed at a moment's notice regarding features of design of reinforced concrete, structures resulting from the standard methods now generally accepted will be but little changed by any proposed new method. It is true that the radical innovation of accounting for concrete plasticity in column design, as advocated in the latest specification of the Joint Committee, will materially affect the design of columns and may in some places cause some serious competition with other types of structure. It is true that the exact placing and proportioning of shear members have a certain definite effect on the total cost of an individual building. Variations in flat-slab designing make a considerable difference in the flat-slab structures of Chicago and New York. Unit stresses seem to grow higher with each new specification. But, after all, these are minor questions in the development of the art of concrete. With the systems of designing which have been accepted in the past the structures standing today are safe and apparently permanent. After all, the design of reinforced concrete is not precise; the material itself is highly variable in strength, the fundamental principle of the co-ordinate action of the steel and concrete is only an approximation, and certainly not well established. If the material itself does not come up to the anticipated unit strength or in a relatively short time seems to deteriorate in strength all the refinements of design are useless.

Every step forward in design promotes either economy or safety in succeeding structures; it does not depreciate the safety nor can it have much effect on the economy of existing structures. Once erected and in some term of acceptable service, with the rare exceptions of progressive deflection under load, the matter of the design of a structure is of no concern. The condition of the material itself is quite different, for that is an ever-present source of trouble. If concrete made today is to have entirely different appearance and qualities ten years from now a serious problem is presented to the designer. If concrete supposed to have a compressive strength of 2,000 lb. and an impervious texture turns out of the forms worth only 1,500 lb. and full of holes, the question whether 0.08 or 0.12 should have been used as a shear coefficient is largely academic.

It is manifest that the progress of the future must come mostly from construction improvements—improvements that will guarantee that every bit of concrete will be what the design assumes it to be, a dense artificial stone of predetermined strength. We must, therefore, be able to insure a dense concrete. How can we do it? There is no single rule which followed will lead on to success. In our present state of knowledge we can only insist on observance of all the little rules which time has developed and these little rules are so numerous that they might be recorded, for example, by listing the side-heads in the Joint Committee specification.

But their fundamentals may be covered possibly by two phrases—more mechanical control, better education of the man on the job.

While what may be called the scientific aspects of concrete are by no means to the stage we hope they will arrive, they are certainly sufficiently advanced to guarantee, if observed in practice, a much better concrete than we now ever get. The cement itself, the choice and grading of the aggregate, the proportioning of the ingredients including the water are all governed by scientific knowledge which, while not perhaps much greater than twenty years ago, is certainly more widely distributed. The practical manufacture of the concrete, on the other hand, remains for the most part in unintelligent, though not necessarily unskilled, hands. Worse than that, it remains in the control of that most dangerous of individuals, the ignorant person who thinks he knows. In spite of all the literature and propaganda advocating proper concreting methods, the man next to the mixer and the forms remains today in practically the same state of information regarding the product as his predecessor was in a quarter century ago.

Mechanical Control Necessary

We must, therefore, do everything we can to take away from him any of the control of the concrete. To some extent this has been done by batch-meters, mixer locks, water-control valves, and other attachments. Much more can be done in the way of mechanical proportioners such as Nathan C. Johnson has developed, and in tests which will really serve as a gage of consistency. Any device will prove effective which will take away from the concreting man himself discretion as to condition of concrete and will tend to produce uniformly a desired mixture and consistency. The determination of that desired end is much more easily achieved today than the execution.

With these mechanical devices—indeed, even before they can be perfected—must come a better education of the mass of concrete workers. This might be made a subject for a long paper, so important it is. All there is space for here is to say that to penetrate the complacency of the average concrete foreman is a harder job than to educate the ignorant foreign laborer who works under him, but that until the former is made to see how little he really knows about concrete and the latter taught that rules are rules and must be obeyed, concrete will never reach the degree of perfection as a building material its possibilities warrant.

The Motor Bus as a Factor in Highway Transport

Commission Control, Franchises and Protection Against Competition Required for Successful Operation

By John N. Mackall
Chairman and Chief Engineer, Maryland State Roads Commission, Baltimore

With any good road system the logical development is the motor bus. If funds for the construction of roads are provided from the general tax, it is, of course, assumed that the construction of roads is a benefit to all of the people. All the people, however, are not owners, and never can be the owners, of motor cars. Since the indirect benefit received by the people who pay for the highways, but who do not own cars, is not sufficient to justify their paying for construction, the only possible direct benefit is through the motor bus.

With the motor bus comes the fixed schedule and direct competition with established common carriers. It has been demonstrated, and our Interstate Commerce Commission and the public service commissions of the several states are concrete evidences of this demonstration, that the public believes that practically all public services can be best rendered by a monopoly. If this is true of our railroads and water lines, of our telephones and electric light companies, it certainly does not require new demonstration in the case of bus transportation before it is accepted as a fact. This forces us to the conclusion that bus lines running upon public highways on fixed schedules are rendering a public service which can be best rendered by a monopoly, so that any road served by a bus line should be served by a single line under the control of the public service commission.

Protection for Established Lines

If exclusive franchises are to be granted for the use of a section of highway between given points to a passenger line operating on a fixed schedule, it means that the state must grant to this line protection against competition, both regular and intermittent. Frequently, the difference between the success and the failure of a bus line is measured not by the normal traffic carried, but by the extraordinary traffic on Sundays and holidays. This is the traffic on which the jitney lives, and it may be the traffic the loss of which causes the regularly established line to die. But the state cannot afford to grant exclusive privileges, even under control, and protect the line against competition, unless it can be assured that the franchise is in responsible hands, and has sufficient resources back of it to insure its operation for a sufficient period of time to demonstrate what the actual traffic is. Potential bus traffic can only be converted into actual traffic by running on a schedule, with good equipment and at a fairly close interval.

The familiar jitney bus, whether it charges a "jit" or many "jits," has demonstrated that it is but a scavenger, and fills no real need in any community. It operates only during the time when other methods of transportation are crowded, taking away from them what would be a revenue, forcing all established lines of transportation out of business and then departs for more profitable fields. Jitney transportation has always been in the hands of irresponsible people, and perhaps we can go further and say that no jitney bus was ever run when the following elements had been determined in advance: Cost of operation, overhead, insurance, interest and depreciation, and the rate to meet all of necessary charges.

If it has now been demonstrated that the service of bus transportation can best be accomplished by buses running on regular schedules with exclusive privileges, under the control of the public service commission, then we must see that the transportation companies have more than protection, that they have enough intangible assets to warrant the public in putting money into the enterprise. The writer believes that it has been demonstrated that sufficient capital cannot be attracted to this method of transportation unless the states are willing to go further and to grant these exclusive privileges for a definite number of years, and he believes that it should



ONE OF MARYLAND'S MOTOR BUSES

be from 15 to 25 years, so that capital will be attracted to motor-bus transportation, not in the hope of getting the money out before the line "hits the rocks," but in the belief that the investment is in a business which can be operated for the life of the franchise, and that during the lean years when the business is being built up, the franchise can be sold, subject, of course, to the approval of the public service commission, and that the company which built up the line may receive for its franchise rights and good will exactly what they are worth.

Certainly, in these times, capital cannot be attracted to bus transportation unless the returns are going to be very great for a short time, or unless the money can be safely invested for longer times. It is assumed in advance that the public service commissions will not permit rates which will grant enormous returns, so that moderate returns for a long term seem to be the only solution. At this time, it is obviously unnecessary to go into details of what constitutes responsibility on the part of a company, what constitutes protection on the part of the state and what constitutes service to the public. The public is interested only in service. With service must go responsibility on the part of the company and protection on the part of the state.

It is equally obvious that the state should receive an annual rental for the franchise, sufficient to justify all additional expense to which it is put by reason of maintaining the roadbed for transportation companies and granting protection to them. An amount sufficient for this purpose can be charged without in any way affecting the stability of the company. A gross receipts tax of 2 or 3 or 4 per cent will be ample to take care of this

feature and when it is considered that the bus line pays no interest on construction bonds and that it pays no cost of maintenance directly, the amount which it pays to the state may seem large in individual instances, but is small compared to what other common carriers pay.

The State of Maryland has had motor buses running on fixed schedules over its public highways, under the direct control of the Public Service Commission, and with exclusive privileges to the companies operating them, but no satisfactory progress has been made toward the solution of the problem. Because of the lack of franchise, sufficient capital could not be attracted to the lines to enable them to render adequate service during the initial period. With only few exceptions, the bus lines have been in financially irresponsible hands and additional capital could not be attracted because if the company then operating wanted to go out of business for any reason, the rights, franchise and good will which had cost many dollars to build up could not be transferred to a successor in the business.

On the other hand, if the public had been assured that any particular transportation line had privileges good for, say, 20 years, and that when their money was invested in it, it was invested for the life of the franchise, the writer believes that adequate capital could have been attracted and the lines put on a basis mutually satisfactory to the investor and to the user.

Experience in Maryland has demonstrated, at least to the writer, that adequate bus transportation can only be had by the granting of a monopoly to a company for a particular road to run buses on a regular schedule under public service commission control for a definite number of years, during which time absolute protection will be granted against competition. Otherwise, the bus transportation business will remain as it is today, a tremendous gamble in the hands of people with sufficient money to purchase one bus, to be operated with probably sufficient revenue to pay interest and current charges, but with nothing for depreciation. At the end of the life of the bus, such a line will go out of business, to be followed by another to suffer a like fate.

Hydro-Electric Work Now Under Way

In the large table on the opposite page are given the data on the large water-power plants now under construction on the Pacific Coast, and at the bottom of this page similar data are tabulated for the Eastern section of the country. These figures were obtained from answers to questionnaires sent to the respective companies and are therefore authentic.

Federal Water Power Projects Up to December, 1921

Annual Report of Commission Shows Half-Million Horsepower Under Way—Work Hampered by Lack of Funds

Extract from the Annual Report of the Federal Water Power Commission, December, 1921

IN the 16 months following passage of the Federal Water Power Act there were filed with the commission 185 applications for preliminary permit and 85 applications for license to develop water power, 260 in all, which, after deducting conflicting applications and those rejected or withdrawn, aggregated the stupendous totals of 11,060,000 primary and 5,766,000 secondary horsepower or 16,826,000 horsepower of estimated installation. This is twice the water horsepower which has been developed in the United States to date, and exceeds the combined potential water power resources of Norway, Sweden, Finland, and the Arctic and Baltic drainages of Russia. It is 70 per cent greater than the combined resources of France and Italy. It is from five to six times greater than the aggregate of all applications filed with the Federal Government during the preceding 15 years.

The country could not, of course, absorb at once all the power projected for development, and many applications may never be carried out. It is the belief, however, that the greater part of the horsepower involved will eventually be constructed. To complete the projects applied for will require capital exceeding in the aggregate two billions of dollars. The collateral expenditures for distribution systems, for customers' installation, and in accessory industries will be several times greater.

If one considers the very conservative estimate that each

HYDRO-ELECTRIC POWER PLANTS UNDER WAY IN EASTERN UNITED STATES

Company	Name of Plant	Location	Dam and Reservoir	Pipes, Canals or Tunnels	Maker of Water Wheels	Prime Movers	Static Head	Present stage of Development	Ultimate Capacity of Plant k.w.
Niagara Falls Power Co.	Extension to existing plant	Niagara Falls, N.Y.	None	Tunnel, 4,400 ft. long, 32 ft. diam. concrete lined	Not determined	Not determined	215 ft.	To be completed Summer 1922	
Henry Ford & Son, Inc.	Green Island Hydro-El. Plant	Troy, N.Y.	Federal dam across Hudson, 20 ft. high, 1200 acre ft. res.	Open ore bay 200 x 16 ft.	Allis-Chalmers	4-2,000 hp. propeller type, high speed vertical shaft.	Av. 13 ft. Max. 17 ft.	Started Apr. 1, 1921. To be completed May 31,'22	8,000 hp.
Alabama Power Co.	Mitchell Dam	Coosa River Ala.	Gravity concrete 70 ft high, 70,000 cu. ft. res.	None	Allis-Chalmers	3-24,000 hp. vert. single runner	70 ft.	Started July 1921 To be completed Apr. 1, 1923	120,000 hp.
Manitoba Power Co.	Great Falls Development	Winnepeg, Man.	Gravity concrete, 20 to 70 ft. 6,000 acre ft. res.	None	Not determined	6-28,000 hp.	56 ft.	To be completed Nov. 1923	168,000 hp.
Arkansas Hydro-El. Dev. Co.	Plant No	Little Red River	Hollow concrete, 80 ft. 154,500 cu. ft.	None	Not determined	3-5,000 hp.	70 ft.	Started June, 1921. To be completed Mar. 1922	70,000 hp.
New England Power Co.	Searsburg Plan'	Searsburg, Vt.	Earth embank. 60 ft.	18,500 ft. 8-ft. wood stave pipe	I. P. Morris	1-6,200 vert. single runner	230 ft.		6,200 hp
Southern Power Co.	Mountain Island station	Mt. Holly N.C.	Earth embankment		S. Morgan Smith	4-20,000 hp.	80 ft.	To be completed about Dec. 15, 1923	80,000 hp.
Southern Power Co.	Dearborn Plant	Great Falls, S.C.	Dam already in Duplicating existing plant		S. Morgan Smith	3-20,000 hp.	72 ft.	To be completed about Dec. 15, 1922	60,000 hp.
International Paper Co.	Sherman Island Development	Glenn's Falls, N.Y.	Multiple-arch, dam 70 ft. high.	Canal 3,500 ft. long, 40 ft. deep, 30 ft. wide at bottom and 150 at top	I. P. Morris	3-10,000 hp.	65 ft.	Started 1920. To be completed 1922	50.000 hp.

Some Pacific Coast Hydro-electric Developments Under Way in 1921 or Definitely Projected for 1922

Company	Name of Plant	Location	Dam & Reservoir	Pipes, Canals or Tunnels	Maker of Water Wheels	Penstocks	Prime Movers	Static Head Feet	Present Stage of Development	Ultimate Capacity of plant, kw
Bridge River Power Co.	Bridge River Plant	120 mi. from Vancouver, B.C.	Simple concrete arch 157' high. Capacity 1,250,000 acre-ft.	Two-12,800 ft. long. 12' x 14' concrete lined, 1,550 sec-ft. flow	Not awarded	Eight, dividing into 16 at power house 78" to 50" dia.	16 - 25,000 hp. double overhung impulse units	1,200	Project started middle of 1920	
B.C. El. Ry. Co.	Fourth Unit Stave Lake Plant	40 mi. East of Vancouver, B.C.			Escher Wyss Co.	One riveted steel line 14' dia. 170' long	One 13,000 hp Francis turbine	110	To be in service Mar. 1, 1922	35,400
City of Seattle	Newhalem Plant	100 mi. N.E. of Seattle, Wash.	Small diversion dam on Newhalem Creek	Length 2,675' under 256' pressure at lower end	Pelton Water Wheel Co.	One electrically welded line 1,122 long 33" to 30" dia	One double overhung impulse unit	510	Completed in summer of 1921	
City of Seattle	Gorge Creek Plant	100 mi. N.E. of Seattle, Wash.	240' high	Two 11,000' long	Not awarded	Three, 1,000' long, 11' to 10' dias.	Six 30,000 kva. units	395	Preliminary work under way 11,000' tunnel contract let.	180,000
City of Seattle	Ruby Creek Plant	100 mi. N.E. of Seattle, Wash.	450' high 1,000,000 acre-ft. storage	Length 17,000'	Not awarded		Six 45,000 kva. units	470 to 720	Gorge plant to be completed in 1923	270,000
City of Seattle	Cedar Falls Unit No. 5	About 30 mi. E. of Seattle	No additions to dam.	3 mi. of 78-in. wood stave and steel pipe, normal flow 310 sec-ft.	Pelton Water Wheel Co.	One 2,600' penstock, 78" to 68" dia.	One 20,000 hp. overhung Francis turbine	630	Installation completed Oct., 1921	40,000
Washington Water Power Co.	Spokane Upper Falls	In Spokane	Inclined slab and buttresses 30' high	None	I. P. Morris	One 370' long. Reinforced concrete 18' dia.	One 14,250 hp. vertical reaction turbine	64	Completed May 1, 1921	10,000
Idaho Power Co.	Shoshone Falls Plant	Near Twin Falls, Idaho	Concrete Diversion Dam 20' high	Length 450' 10½' x 10½' 800 sec-ft. flow, concrete lined	S. Morgan Smith	One riveted steel line 172' long, 10' dia. top.	One 14,500 hp. Francis turbine	204	Headworks partially completed in 1921	11,100
City of Tacoma	Lake Cushman Project	About 60 mi. W. of Tacoma	Gravity arch 210' high 150,000 acre-ft. storage	Length 5,300' 14' x 20' 700 sec-ft. flow, concrete lined	Not awarded	Two initial, four ultimate 3,200 long 80" to 48" dias.	(Initial) Two 22,500 hp. units	590	Real estate and right acquired Surveys and test borings under way	56,000
Utah Power & Light Co.	Olmstead Plant	50 mi. S. of Salt Lake City			I. P. Morris	One riveted steel line 798' long 6' dia.	One 7,700 hp. vertical reaction turbines unit	340		
Northwestern El. Co.	Underwood Plant	On White Salmon River	Gravity concrete dam 62½' high			Two concrete lines 133' long 10' dia.	One 4,200 hp. vertical reaction units	60	Final surveys completed	6,000
Port. Ry. Lt. & Pwr. Co.	Oak Grove	55 mi. from Portland	Earth fill 22' high	8½ mile conduit			One 27,500 hp. reaction turbine	860	To be completed in 1924	
California Oregon Power Co.	Copco Unit No. 2	2 mi. S. of Calif.-Ore. State line	Raise water level 14' behind present dam	None	Allis-Chalmers	200' long 16' dia. top and bottom, riveted steel	One 10,000 kw. horizontal reaction turbine	125	To be in service in latter part of 1922	20,000
Pacific Gas & Elec. Co.	Drum Plant Unit No 3.	Bear River Placer County	Previously constructed		Pelton Water Wheel Co.		One 20,000 hp. double overhung impulse unit	1,375	In course of installation	12,000
Pacific Gas & Elec. Co.	Hat Creek No1.	Hat Creek 245 mi. N. of S. F.	Small timber crib diversion dam	Half mile canal 600 sec-ft. flow	Wellman Seaver Morgan	One riveted steel line 1,605' long 10' to 8' dias.	One 15,000 hp. vertical reaction	217	In service	10,000
Pacific Gas & Elec. Co.	Hat Creek No.2	245 mi. N. of S. F	Small timber crib diversion dam	4,500' of flume 800 sec-ft. flow	Wellman Seaver Morgan	One riveted steel line 413' long 10' to 8' dias.	One 15,000 hp. vertical reaction turbine	198	In service	10,000
Pacific Gas & Elec. Co	Pit River No. 1	245 mi. N. of S. F.	Diversion weir	Length 10,160' 14' dia. concrete lined, 1,800 sec-ft.	Allis-Chalmers	Two riveted steel and lap-welded lines 1,372' long 10½' to 8' dias.	Two 40,000 hp. vertical reaction turbines	440.5	To be completed in 1922	63,000
Gt. Western Power Co.	Caribou Plant	195 mi from S. F. on Feather River	Previously constructed	20,400' of tunnel 7 x 7' to 10' circular	Allis-Chalmers	Two riveted steel lines 2,082' long 66" to 42" dia.	Two 30,000 hp. double overhung impulse wheels	1,008	Completed summer of 1921	120,000
City of San Francisco	Moccasin Cr. Plant	140 mi E. of S. F.	Hetch Hetchy dam 226' high 30,600 acre-ft.	18 miles of 10 x 13 ft. tunnel 620 sec-ft. capacity	Not awarded	Three line 4,700' long 104" to 52" dias.	Three or four 25,000 hp. double runner impulse wheels	1,325	Construction under way. Plant to be completed in 1923	150,000
Turlock & Modesto Irrigation Districts	Don Pedro Plant	Tuolumne River above Lagrange	Gravity concrete dam 283' high. 270,000 acre-ft. storage	Power house monolithic with dam	S. Morgan Smith	Three reinforced concrete tubes in dam 200' long 6 dia.	Three 6,700 hp. reaction turbines	160 to 240	Started June 1921	70,000
San Joaquin Lt. & Pwr. Corp.	Balch Power House	Kings River	Multiple arch, 150' high 45,000 acre-ft. storage	Length 27,000' 12' dia. unlined 400 sec-ft. flow	Not awarded	Four lap-welded lines 5,425' long 48" to 24" dias.	Two 44,000 hp. impulse wheels	2,495	Construction to start April, 1922	108,500
San Joaquin Lt. & Pwr. Corp.	Kern Canyon Plant	18 mi. N. E. of Bakersfield	Diversion dam 15' high at tailrace of Kern River No. 1	Length 8,300' 11' circular 800 sec-ft. flow	Allis-Chalmers	One riveted steel line 568' long 8' to 7' dias.	One 12,000 hp. vertical Francis turbine	230	In service summer of 1921	18,000
So. Cal. Edison Co.	Kern River No. 3	130 mi. from Los Angeles	Concrete diversion dam 25' high	12 mi. 8 x 8½ ft., chiefly lined with concrete 600 sec-ft. flow	Pelton Water Wheel Co.	Two riveted and weld. steel lines 2,520' long 7' to 5' dias	Two 22,500 hp. single runner vertical reaction turbines	806	In service summer of 1921	32,000
So. Cal. Edison Co.	Big Creek No. 8	241 mi. from Los Angeles	Concrete diversion dam 60' high	Length 5,600' 20' x 20' unlined 2,050 sec-ft. flow	I. P. Morris Co.	One riveted and welded steel line 2,700' long 8' to 6' dias.	One 30,000 hp. vertical reaction turbine	729	In service August, 1921	135,000
So. Cal. Edison Co.	Big Creek No. 3	235 mi. from Los Angeles	Small diversion dam	Length 30,000 21 x 21' 3,000 sec-ft. flow	Not awarded		Three 35,000 hp. units	825	Tunnel Started Nov., 1921	150,000
Nevada-Cal. Power Co.	Santa Paula Project	Santa Paula Creek 115 mi. from Los Angeles							Preliminary work started in 1921	Tot. for six plants 58,000
Southern Sierras Pwr. Co.	Lytle Creek Plant	Lytle Creek 85 mi. from San Bernardino			Not awarded	One, 6,330' long 24' - 15' dias. riveted steel	One 2,500 kw. impulse wheel	2,047	Work on plant to begin June, 1922, tunnel completed	2,500
Nevada-Cal. Power Co.	Levining Creek Plant	314 mi. from San Bernardino	37' high	2,700' tunnel, normal flow 43 sec-ft.	Not awarded	One 40" to 32" dias.	One 17,000 hp. impulse wheel	1,670	Tunnel completed Jan 1, 1922	12,500

horsepower of developed energy, used industrially, means employment for one skilled workman, the possibilities as a national asset latent in the 16,826,000 hp. represented by applications now before the Commission will readily be appreciated.

Final Action on Some Projects

Up to Nov. 1 final action has been taken on 89 applications, in which 27 preliminary permits and 31 licenses were authorized, involving 1,413,600 primary and 2,627,000 installed horsepower. Of the projects under license construction is now under way on those noted in the accompanying table:

WATER POWER PROJECTS UNDER FEDERAL LICENSE NOW UNDER WAY

	Horsepower — Primary	Horsepower — Installed
Henry Ford & Son, Inc., Hudson River, N. Y.	3,640	8,100
Niagara Falls Power Co., Niagara River, N. Y.	341,500	572,230
Southern California Edison Co., Big Cr., Calif.	165,000	545,000
Alabama Power Co., Coosa River, Alabama	21,760	110,000
Snow Mountain Power & Water Co., Eel River, California.	9,500	16,670
Western States Gas and Electric Co., American River, California	6,400	6,400
Wisconsin-Minnesota Light & Power Co., Chippewa River, Wisc (preliminary construction only)	10,000	20,000
Total	557,800	1,276,400

The commission's serious need is for Congressional authorization which will permit the use of its appropriations in employment of personnel sufficient to make up a small organization of trained and experienced men capable of meeting intelligently the important and perplexing engineering and economic problems which are constantly arising and upon the correct solution of which will depend the value of federal legislation and, in no small degree, the future of the electric power industry. The Comptroller of the Treasury having ruled that the commission could employ no person other than its executive secretary, but must rely entirely upon assignment or detail of individuals from the several executive departments, it has been necessary to proceed on that unsatisfactory basis. Recommendation is made that immediate steps be taken to amend the Federal Water Power Act, at least to the extent necessary to permit the commission to employ its own personnel.

More Assistants Needed

It is pointed out that a satisfactory general law has been passed, but its full benefits are not being received because of lack of adequate means for its administration. Until the situation is corrected the commission must pursue one or two courses—carry out the provisions of the law, act only upon such applications as it can handle in compliance with the law and defer action indefinitely upon the remainder; or ignore the requirements of the law, issue permits or licenses without adequate investigation, without making the valuations required by the act and without enforcing the safeguards provided by the act. As industrial conditions improve, there will be pressing need for more and cheaper power. This can be supplied to the degree needed only from the sources under federal control. Instead of further delay the government should be bending every effort toward releasing under reasonable safeguards the water powers it has been hoarding for so many years.

Much time and care has been devoted during the year to compilation of the rules and regulations governing administration of the Federal Water Power Act. The first ten regulations included matters which had been covered in considerable degree by regulations under earlier laws. The remaining subjects to be covered were largely new, concerned matters not hitherto involved in federal administration, and required a careful study of the act and the consideration of legal, economic, and financial questions of considerable complexity. In the preparation of these regulations advice and criticism were freely sought in order that the regulations, when adopted, might be suited to the actual conditions surrounding electric-power development. Final amendments were adopted by the commission on May 28 and promulgated on June 6, 1921.

New York Port Authority Submits "Comprehensive Plan"

Scheme Includes Most of Details of Report of Bi-State Commission, but Adds Motor Truck Delivery for Immediate Relief

IN COMPLIANCE with provisions of the acts creating it, the Port of New York Authority, under date of Dec. 21, 1921, submitted to the legislatures of New York and New Jersey the "Plan for the Comprehensive Development of the Port of New York." This "comprehensive plan" had to be submitted before the beginning of this year, and it will have to be approved by the two legislatures before the Authority can begin to function as a governing body, or before it can embark on any of the enterprises it has planned. Except for some changes in routing of the various belt-lines and some emphasis on a scheme for immediate relief of freight congestion by means of motor truck distribution, the plan is about the same as the one submitted a year ago by the New York-New Jersey Interstate Port and Harbor Commission. (See *Engineering News-Record*, Jan. 27, 1921, p. 177; Feb. 10, 1921, p. 271.) That is, there are the various systems of belt-lines, inner and outer, including a tunnel across New York Bay from Bayonne to Brooklyn and the automatic electric conveyor in tunnel under the Hudson and under Manhattan.

Fundamental Principles

The fundamental principles of the scheme are stated as follows:

First—That terminal operations within the Port District, so far as practicable, should be unified;

Second—That there should be consolidation of shipments at proper classification points so as to eliminate duplication of effort, inefficient loading of equipment and realize reduction in expenses;

Third—That there should be the most direct routing of all commodities so as to avoid centers of congestion, conflicting currents and long truck-hauls;

Fourth—That terminal stations established under the comprehensive plan should be union stations;

Fifth—That the process of co-ordinating facilities should so far as practicable adapt existing facilities as integral parts of the new system, so as to avoid needless destruction of existing capital investment and reduce so far as may be possible the requirements for new capital; and endeavor should be made to obtain the consent of the States and local municipalities within the Port District for the co-ordination of their present and contemplated port and terminal facilities with the whole plan;

Sixth—That freight from all railroads must be brought to all parts of the port wherever practicable without cars breaking bulk, and this necessitates tunnel connection between New Jersey and Lond Island, and tunnel or bridge connections between other parts of the port;

Seventh—That there should be urged upon the federal authorities improvement of channels so as to give access for that type of waterborne commerce adapted to the various forms of development which the respective shorefronts and adjacent lands of the port would best lend themselves to;

Eighth—Highways for motor truck traffic should be laid out so as to permit the most efficient inter-relation between terminals, piers and industrial establishments not equipped with railroad sidings and for the distribution of building materials and many other commodities which must be handled by trucks; these highways to connect with existing or projected bridges, tunnels and ferries.

Ninth—Definite methods for prompt relief must be devised that can be applied for the better co-ordination and operation of existing facilities while larger and more com-

prehensive plans for future development are being carried out.

After reiterating the arguments made by the previous commission in favor of its general plan, which include the general principle that the Manhattan waterfront must be released for ocean steamers, the Jersey waterfront reserved for railhead connections from rail to ship and that break-up stations should be west of the Bergen hills and inland in Manhattan, the report outlines the "comprehensive plan" as follows:

The keystone to the arch of the structure which we term the "comprehensive plan" is the medium of connections between the two sides of the port. This keystone is, therefore, the necessary belt line connecting all of the nine railroads on the westerly side of the port, together with a tunnel under the bay and belt line to connect them with the three trunk lines on the easterly side of the port. In locating these there are two main factors to be considered i.e., the purely physical factor and the service factor. The location of this belt line on the westerly side and of the tunnel was determined by many impelling reasons and only after very intensive study.

The chief reasons are:

(a) That in this location can be made the shortest connecting link between all of the railroads terminating on the west side of the port,

(b) That it lies adjacent to and easterly of the existing breakup and classification yards of each of those railroads, with which it can be readily connected;

(c) That the cars from trains broken up and classified in those yards will then continue to move to this shortest connecting belt line by the shortest and most direct route and in the right direction;

(d) Conversely, that the same principle applies to westbound movements;

(e) The proposed tunnel from Greenville to Bay Ridge is the straightest, shortest and most direct course from that belt line to the easterly side of the port. It is the most favorable location for construction, for freedom from interference by moving craft during construction, for under-water depth below which any permanent structure must be built, for absence of curves and for easy grades.

Considered, therefore, merely from the physical aspect of tunnel construction alone, this location has the most advantages. Considered from the question of short connections and approaches, both the physical and operating elements make it the best.

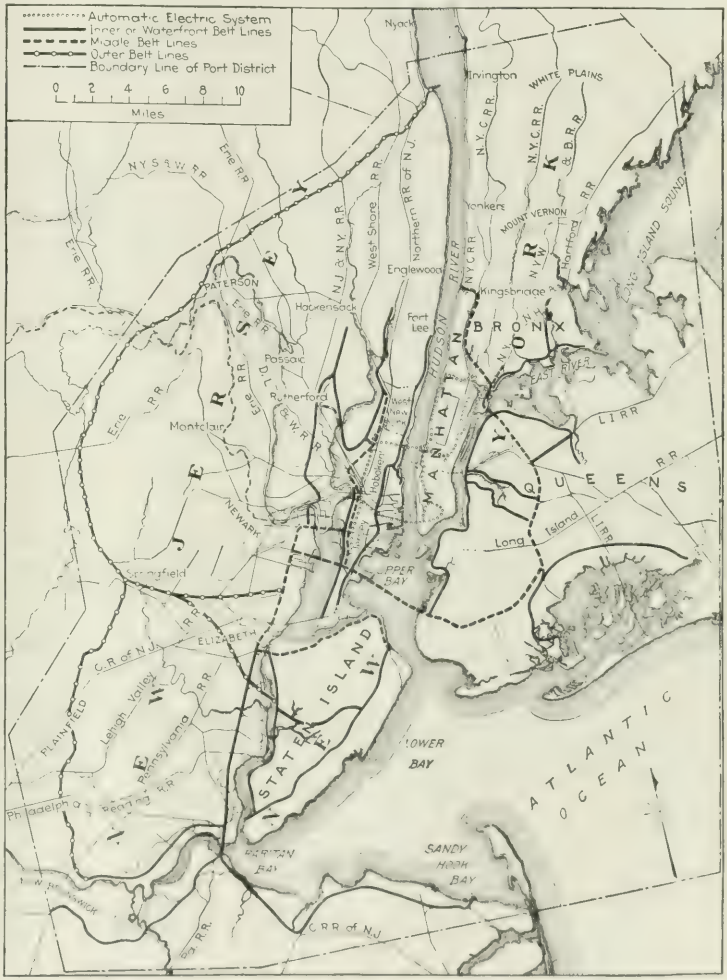
It is by means of this same belt line that at appropriate locations there can be established suitable facilities for the consolidation of the car float and lighterage movement that must continue.

The belt line on the easterly side forming the through connecting is an existing unit. Many other belt lines will be necessary to promote and serve industrial developments and water fronts. These form an essential part of the comprehensive plan and their location has been fully discussed with and generally approved by the various localities to be served. They are located so as to co-relate their local improvements.

Middle Belt Line—The keystone of the arch of railroad terminal co-ordination within the Port District. It connects New Jersey and Staten Island and the railroads on the westerly side of the port with Brooklyn, Queens, the Bronx and the railroads on the easterly side of the port. This connection is the most direct, the shortest and the cheapest of any brought to the attention of the Commissioners for study or consideration.

Its length is approximately 61½ miles, of which approximately 51½ miles have already been built.

The route of the Middle belt line is as follows: Commencing at the Hudson River at Spuyten Duyvel running easterly and southerly generally along the easterly side of the Harlem River, utilizing existing lines and improving



MAP SHOWING BELT-LINE AND MANHATTAN AUTOMATIC RAILWAYS IN PORT AUTHORITY'S COMPREHENSIVE PLAN

and adding where necessary, to a connection with Hell Gate Bridge and the New Haven R.R., a distance of approximately seven miles; thence continuing in a general southerly direction, utilizing existing lines and improving and adding where necessary, to a point near Bay Ridge, a distance of approximately 18½ miles; thence by a new two-track tunnel under New York bay in a northwesterly direction to a portal in the Greenville yard of the Pennsylvania Railroad in Jersey City, a distance of approximately 5 miles, to a connection with the tracks of the Pennsylvania and Lehigh Valley R.R.; thence in a generally northerly direction along the easterly side of Newark Bay and the Hackensack River at the westerly foot of the Palisades, utilizing existing tracks and improving and adding where necessary, making connections with the Jersey Central, Pennsylvania, Lehigh Valley, Delaware, Lackawanna & Western, Erie, New York, Susquehanna and Western, New York, Ontario and Western, and West Shore railroads, a distance of approximately 10 miles. From the Greenville portal of the Bay tunnel and from the line along the easterly side of Newark Bay by the bridges of the Central Railroad of New Jersey (crossing the Hackensack and Passaic rivers) and of the Pennsylvania and Lehigh Valley R.R. (crossing Newark Bay) to the line of the Central Railroad of New Jersey running along the westerly side of Newark Bay and thence southerly along this line to a connection with the Baltimore & Ohio R.R. south of Elizabethport, utilizing existing lines and improving and adding where necessary, a distance of approximately 12 miles; thence in an easterly direction crossing the Arthur Kill, utilizing existing lines and improving and adding where necessary, along the northerly and easterly shores of Staten Island to the new city piers and to a connection, if the City of New York consent thereto, with the tunnel under the Narrows to Brooklyn provided for under legislation as a municipal project—a distance of approximately 9 miles.

Marginal Railroad in the Bronx extending along the shore of the East River and Westchester Creek connecting with the Middle belt line (No. 1) and with the New York, New Haven and Hartford R.R. in the vicinity of Westchester. Its length is approximately eight miles.

Marginal Railroad in Queens and Brooklyn extending along Flushing Creek, Flushing Bay, the East River and Upper New York Bay. It connects with the Middle belt line. It utilizes certain existing lines of the Brooklyn Eastern District, Jay Street, New York Dock and Bush Terminal companies. It has a length of approximately 19½ miles, of which approximately 4 now exist and about 15½ miles will be new.

Short Existing and New Lines connecting up main belt lines and serving as minor marginal lines.

Marginal Railroad on Jamaica Bay—This line is new and connects with the Middle belt line. It has a length of approximately twelve and one-half miles.

Marginal Railroad on Staten Island—This line is new and will open up territory for commercial and industrial development. It connects with the Middle belt line and with a branch from the Outer belt line; with its branch it is about fifteen and one-quarter miles long.

Marginal Railroad on Newark Bay and the Hackensack River and connects with the Middle belt line. This line which does not now exist will open up territory for commercial and industrial development. It has a length of approximately seven miles.

Marginal Railroad extending along the westerly side of the Hudson River and the Upper New York Bay. It is made up mostly of existing lines—the Erie Terminals, Jersey Junction, Hoboken Shore, and National Docks railroads. It is to be improved and added to where necessary. It has a length of approximately 16½ miles of which about 15 miles now exist.

Marginal Railroad connecting with the middle belt line and extending through the Hackensack and Secaucus Meadows. It will open up territory for commercial and industrial development. It is a new line and has a length of approximately 23 miles.

Outer Belt Line, extending around the westerly limits of the Port District beyond the congested section. Its northerly terminus is on the Hudson River at Piermont above the harbor congestion and it connects by marginal railroads at the southerly end with the harbor waters below the congested section. By spurs it connects with the Middle belt line on the westerly shore of Newark Bay and with the marginal railroad on the westerly shore of Staten Island. It will have great value in that it will afford military protection to the Port District. It will serve as an interchange between the railroads beyond the congestion and will open up territory for industrial development. It has a length of approximately 71 miles which is all new construction.

Automatic Electric System for serving Manhattan Island Its yards will connect with the Middle belt line and with all the railroads of the Port District. It is a standard gage underground railroad deep enough in Manhattan to permit of two levels of rapid transit subways to pass over it. The only standard railroad cars that will be brought through to its Manhattan terminals will be those with perishables and food products in refrigerator cars. Cars with merchandise freight will be stopped at its yards. Freight from standard cars will be transferred on to wheeled containers, thence to special electrically propelled cars which will bear it to Manhattan. This frieght will be kept "on wheels" between the door of the standard freight car at the transfer point and the tailboard of the truck at the Manhattan terminal or the store door as may be elected by the shipper or consignee, thus elminating all extra handling. Freight cars will thus be released more quickly from the terminals, thus effecting a material saving in the use of railroad equipment.

Union terminal stations located on Manhattan in zones of equal trucking distance, as to pick-ups and deliveries, will be served by the system. These terminals will contain storage space and space for other facilities. The automatic electric system will bring all the railroads of the port to Manhattan on equal terms as to time, service and cost.

It will be noted that these belt-lines, different in some details from those indicated in the earlier report, the most important divergence being the connection from the Middle belt-line into the middle section of Staten Island, where it connects with the Narrows tunnel line, recently proposed by the Board of Estimate of the City of New York.

In defense of the automatic railway freight delivery scheme, the report reiterates the arguments of the Bi-State report, but it notes that the execution of this part of the plan "must be a process of evolution rather than revolution." In recognition, apparently, of the difficulties in initiating such a radical and expensive plan, the Port Authority recommends the early consolidation of railroad car float and lighterage service, the unification of truck services and the establishment on Manhattan of inland union terminals serving such consolidated and unified floating and truck operations "the inland terminals to be so designed and placed as to become the terminals of the automatic electric system when built and installed." The plan for present relief, however, is only sketchily treated in the report, which includes a map showing the subdivision of Manhattan Island into a number of "trucking zones" with interior and waterside terminal stations.

No details are given of the manner in which the Authority proposes to raise the funds necessary for its works, except by stating that financing is a function independent of taxing powers and that it will be carried on as in similarly constituted bodies here and abroad. Nothing is given as to possible costs, nor, in any definite fashion, of the chronological precedence of various parts of the scheme.

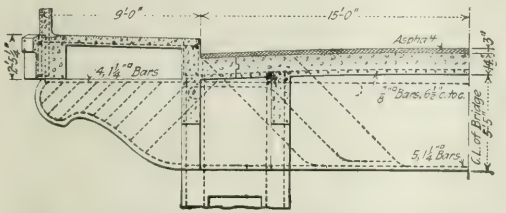
The report contains maps showing the "comprehensive plan," the relation of that plan to the several port and terminal schemes proposed by various municipalities in the port district, detail maps of those separate schemes

and an outline map indicating proposed highway routes in connection with the port.

The report is signed by all the members of the Port of New York Authority: For New York, Eugenius H. Outerbridge, chairman, Alfred E. Smith and Lewis H. Pounds; for New Jersey, J. Spencer Smith, chairman, De Witt van Buskirk and Frank H. Ford. W. W. Drinker is terminal engineer, E. C. Church, transportation engineer, J. A. Jackson, electrical engineer and Nelson P. Lewis, Morris R. Sherrerd and Francis Lee Stuart, members of the Technical Advisory Board. B. F. Cresson, Jr., is chief engineer and George W. Goethals, consulting engineer.

Independent Floor-Beams and Slab in New Concrete Arch Bridge

IN ORDER to simplify the floor forms in the construction of a large concrete arch bridge now being built in Pittsburgh, the engineers designed the slab and floor-beams as independent elements, the slab to rest on top of the completed floor-beams. In construction, the

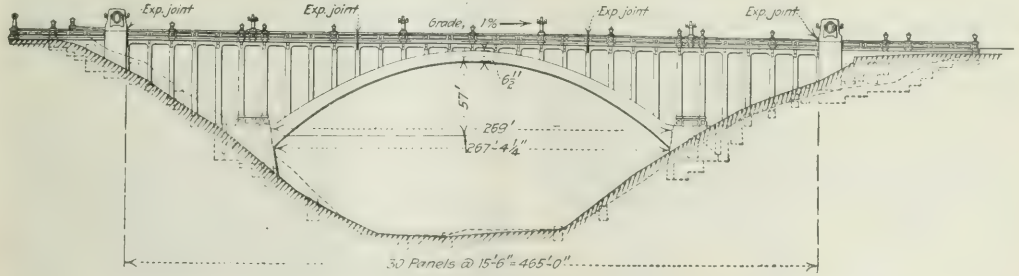


DECK CONSTRUCTION OF BEECHWOOD BLVD. BRIDGE

spandrel columns resting on the arch ribs and the floor-beams will be concreted in forms built up from the ribs and subsequently, after removal of these forms, the forms for the floor slab and the fascia stringers on either side will be built between the floor-beams and supported by them. This avoids the necessity of carrying the heavy floor forms and slab by supports extended up from the arch rib. No definite plane of separation between slab and beams is provided except that formed by the construction joint, and on the contrary the floor-beam diagonal reinforcement is allowed to extend up into the slab. But the beam is designed as though it terminated at the bottom line of the slab rather than as a beam extending to the top of the slab or as a T-beam utilizing part of the slab for compression area.

As shown in the accompanying drawing, the bridge, which is of exceptionally handsome outline, is a two-rib parabolic structure with open spandrels, of 267 ft. 4¼-in. span between faces of abutments, or 279 ft. between theoretical springing lines, and 57 ft. theoretical rise, or 55.89 ft. rise of intrados. It will carry Beechwood Boulevard across the depressed Saline St. at the entrance to Schenley Park. A sketch of the normal floor-beam construction is given in the drawing. The floor panels are 15½ ft. long, center to center of floor-beams. The two arch ribs, 26 ft. apart on centers, are each 8 ft. wide, with a crown depth of 6½ ft. They are reinforced with eight angles 6 x 4 x ⅝ in., connected at intervals of 3 ft. by encircling tie bars 2¾ x ⅜ in.

The bridge was designed by Assistant Engineer Appel of the bridge division, Department of Public Works.



GENERAL FEATURES OF BEECHWOOD BOULEVARD BRIDGE

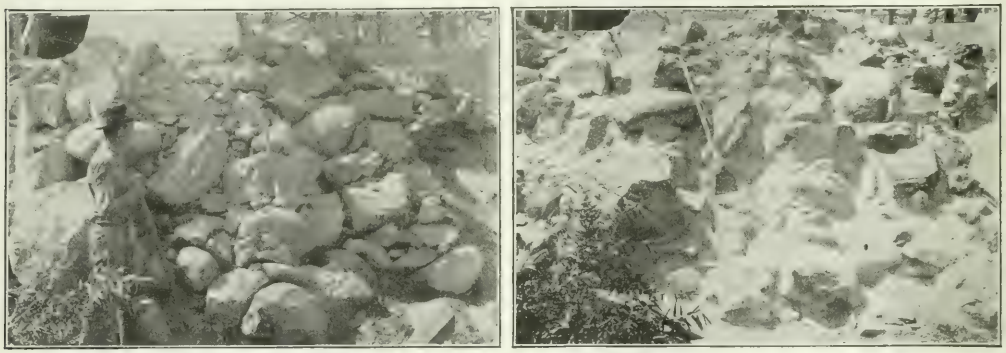
Progress of Federal Reclamation

THE annual report of Arthur P. Davis, director of the U. S. Reclamation Service, shows that the works of the Reclamation Service in the arid and semi-arid states of the West served in the fiscal year 1920-21 areas agrgegating 2,845,000 irrigable acres, including 1,662,000 acres for which the government systems furnished the sole supply of irrigation water, and 1,183,000 acres to which in most cases the Service furnished stored water in bulk to supplement the partial supply of private systems otherwise dependent on unregulated stream flow Of the first class, 1,224,000 acres were actually irrigated and 1,154,000 harvested producing crops to the value of more than $66,000,000. Of the other class, from less complete information, it is roughly estimated that 982,000 acres were irrigated and 950,900 cropped, producing crops to the value of $47,500,000, or a grand total of nearly $114,000,000. Within the projects constructed by the Service are 32,835 irrigated farms with a total population of more than 125,000.

Since the government works began the delivery of irrigation water, the crops produced on the reclaimed lands have exceeded $400,000,000 in value. This includes nothing for the large areas under private systems served government water and does not include increased values produced as livestock and stock products. The increase in the value of lands is estimated to amount to over $500,000,000 based on government reclamation work.

At the end of the fiscal year the service had constructed 100 storage and diversion dams; more than 13,000 miles of canals, ditches and drains; 109,000 canal structures and 7,700 bridges. It had built 1,000 miles of roads, 83 miles of railroad, 4,000 miles of telephone and transmission lines and had excavated over 188,000,000 cu.yd. of earth and rock, over 9,000,000 of which was excavated in the past fiscal year.

HINTS FOR THE CONTRACTOR



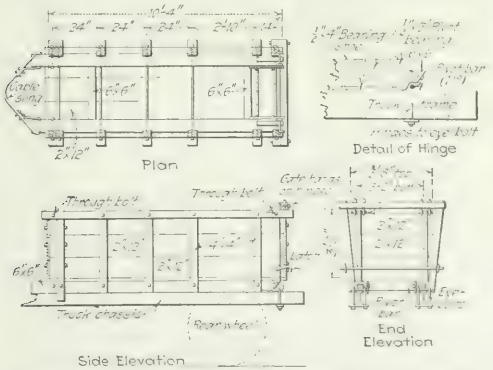
BEFORE AND AFTER COATING ROCK FACE WITH GUNITE IN POWER HOUSE TAILRACE

Gunite Protection For Loose Rock Wall

A ROUGH hand placed rock facing on an embankment near the tailrace of the San Joaquin Light & Power Corporation's Kern Canyon plant was so located that it might be submerged and subject to strong water current during high water. In order to strengthen the face against damage from this cause, the cement gun was used to bond the rocks and gravel together and give the slope a smooth, comparatively impervious coating. The result of this treatment, shown in the accompanying illustration, was a highly satisfactory job at low cost. A vertical face of boulders held in place by a clay bearing gravel like a conglomerate, which was left by the excavation of the tailrace was treated in the same manner.

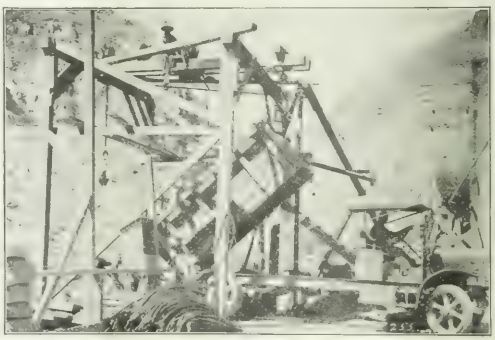
Dumping Device Unloads Gravel Boxes

IN CONSTRUCTION work recently carried out by the San Joaquin Light and Power Corp. it was occasionally necessary to haul gravel in rather large quantities by motor truck. The company did not own any motor trucks equipped with dump bodies but had on hand plenty of ordinary trucks. If the requirements had been for continuous gravel haul, it might have been advisable to secure dump trucks, but, under the circumstances, it was found expedient to use gravel boxes that could be removed quickly when the trucks were needed for other service.



DETAILS OF "DUMPING BOX" MOUNTED ON TRUCK

A box design was accordingly worked out by means of which a hoist installed at the bunkers would dump the load as effectively as the regular dump trucks. The boxes were made of 2 x 12-in. planking, well braced to a frame of 6 x 6-in. and 4 x 4-in. timbers. The rear end of the box was hinged to the truck body, the hinge constituting a center line about which the box would swing when the front end was raised. Five-ton trucks were used and a ½-in. strap iron bearing shoe, 4 in. wide and about 18 in. long was provided at the rear end of the box on the underside of the 6 x 6-in. timber to transfer the weight at the hinge point to the I-beam of the truck chassis.

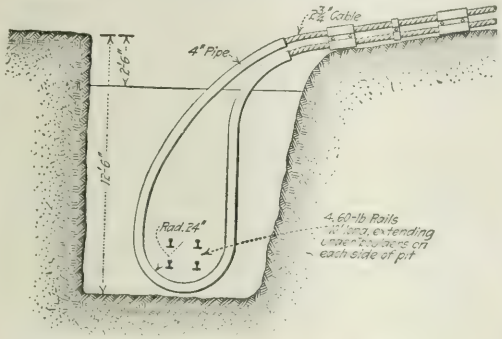


GRAVEL BOX IN RAISED POSITION UNDER GALLOWS FRAME

The lifting was done by an air hoist mounted on a gallows frame over the dumping platform at the storage bins. The hoist operated a 4-part block and tackle that attached to a cable sling on the front of the box. When boxes were to be removed the hinge joint was unbolted and the hoist raised box from the chassis. The boxes had a capacity of 3.92 cu.yd. and were lined with 12-gage iron to prevent wear of the planking.

Cable Strength Developed in Anchor

A METHOD of fastening 2¾-in. cable to an anchorage without sacrificing any of its strength was employed on cableways used recently in the construction of the Kern Canyon plant of the San Joaquin Light & Power Corp, near Bakersfield, Cal. When the concrete anchorage was being cast, there was imbedded in it a 4-in. pipe bent in the form of a loop with both ends projecting on top of the anchorage, the minimum radius being about 2 ft., as shown in the accompanying drawing. When the concrete had hardened the end of the cable to be anchored was welded to the end of a ½-in. cable which was passed through the pipe and used to pull the main cable through. The end of the cable was then made fast by five Crosby clamps 30 in. apart with clips in between. The pipe was filled with grease before the main cable was pulled through. This made it easy to get the cable in and out, and meantime, with the aid of waste stuffed in the ends of the pipe, prevented rusting. After the completion of the work the cable was easily removed and its entire length salvaged



A CONVENIENT METHOD OF ANCHORING HEAVY CABLE

A Barrel Water Heater for Building Work

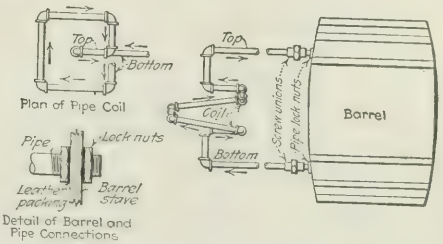
By B. Francis Dashiell
Dunkirk, Md.

A WATER heater for building operations, such as mixing concrete, plaster, mortar, etc., during freezing winter weather is shown by the drawing.

The heating coil is made up of elbows and short lengths of pipe built up in the shape of a square, with the sides slanting to provide a continuous spiral drain from top to bottom. A large barrel is used as the reservoir for the water. The coil is connected to the barrel with pipe lock nuts, leather washers being placed between the nuts and the staves as shown in the detail. Screw pipe unions are placed next to the barrel so that the coil can be detached when removing the outfit.

In operation, the barrel is placed upon a stand so that the coil will be at the proper height above a fire built underneath to be in the hottest part of the blaze. A tight fitting cover should be provided for the barrel as the water will heat more quickly and when once hot will stay so as long as the fire is kept going and water is furnished to keep the barrel filled above the upper pipe connection from the coil.

A simple pipe coil can be used in place of the built up coil, but its construction requires the services of a skilled blacksmith to bend the coils and costs more than the one shown, for which odd pipe pieces and old fittings are used by anyone handy with a wrench.



WATER HEATER FOR COLD WEATHER CONSTRUCTION

Reinforcing for 65-Ft. Cylinder Pier Placed as Unit



LIFTING THE 11-TON CAGE INTO PLACE

IN PUTTING in the piers for two spans of the Long Beach, Long Island bridge, which connects Wreck Lead with Long Beach, cylinders of an unusual length were used. Placement of reinforcing steel became a problem, and this the contractor solved by building up the steel in squirrel-cage fashion, raising the whole by a derrick and lowering it into the cylinders. The squirrel cages were built upon circular templets made of double segmental layers of 2-in. lumber. To these were fastened the 1-in. vertical reinforcing bars, spaced on 6-in. centers. In one of the piers the cages attained a length of 65 ft., the templets being spaced about 8 ft. apart.

Circular reinforcement used was ⅝-in. steel rods spaced on 2-ft. centers and to make the whole positive from breaking ⅝-in. rods were fastened spirally at about 18-in. centers. When the cages had been made up they were hoisted into vertical position and lowered by a floating derrick with an 80-ft. boom. As the cages were lowered the templets were cut out.

In the accompanying photograph the squirrel cage for one of the 65-ft. steel cylinders is being hoisted into position.

The contractor who devised this system was the McLean Contracting Co., Baltimore, and the bridge is being constructed by Nassau County, N. Y., with W Fred Starks in charge for the county.

Reorganization of the French Railroads

OPERATION of the six main railway lines of France under a single agreement with the state; pooling of net revenues into a common fund, from which any deficits of weaker lines will be paid; maintenance of this fund at a specific figure, after an initial contribution by the state, by periodic advances or reductions of tariffs, as required; fixing of maximum rates by the government—these are some of the salient features of the proposed legislation for solution of the post-war problems of French railways, which have been under discussion at public hearings for some months by committees of the Senate and Chamber of Deputies and which will probably be enacted into law by the end of the calendar year, according to a recent bulletin published by the Department of Commerce.

The proposed law provides for a supreme council in which the operating companies, the government, and the public will be represented. This body will formulate the future policies of the railways, which will be binding on all the companies. In all matters of general policy the government will exercise a supervisory control, leaving to the corporations the actual administration and operation of the lines. The state guarantees operating expenses, bonded indebtedness, and preferred dividends, thus making it easy for the lines to raise the large amount of capital necessary for improvements and extensions.

Detailed plans and estimates have been prepared for the electrification of 5,000 miles of railways. The enormous advance in the cost of coal in recent years has given impetus to the utilization of the water-power resources of the nation in electrifying rail lines. Power stations operated with coal will be used in the vicinity of Paris and other large cities to supplement the hydro-electric plants.

Through connections, now definitely planned, will better the communication with Central Europe, the Near East, and the Orient. A line, passing through Nantes, La Rochelle, Bordeaux, and Lyons, will reach Switzerland, Northern Italy, Czechoslovakia, the Danubian countries, the Balkans, and Constantinople; also through Switzerland, Vienna, and Budapest. Another line, more to the north, is planned to pass through Harve, Paris, Strassburg, Prague, and Cracow to Kieff, and will form the western section of the proposed Eurasian Transcontinental line from the Atlantic to the Pacific.

The total length of line now in actual operation, including the Alsace-Lorraine railways which have become an integral part of the French transportation system, is 26,250 miles. About 761 miles are under construction and 688 miles of new lines are projected.

Railroad Accidents

An analysis of the latest Interstate Commerce Commission figures on the annual accident records of all railroads within the United States, prepared by the Committee on Accident Statistics of the American Railway Association, shows that fewer people were killed in 1920 than in any year since 1898. In that year the number of passengers killed was 315, while last year the official records show only 229. Although the total number of employees in the railroad service is several times greater than in 1891, the fatal injuries to employees in 1919 and 1920 were less each year than they were twenty-nine years ago.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Beach Grass As Sand Shifting Preventive

Sir—It is not known just what amount of moisture is required by the beach grass or "helm" mentioned by Mr. Kooy as a possible means of preventing the drifting of dune sand over the highways in southwestern California. (*Engineering News-Record*, Oct. 27, p. 701.) It is believed that the conditions in Imperial County, California, affecting plant life are radically different from those in Holland, where his method has been used with success.

The average rainfall in this part of California is only from 3 to 4 in. per annum, and at Sterling, formerly Mammoth Tank, the mean for over 40 years is but 2¼ in. This station is less than 60 miles from the road mentioned. Incidentally, snow has never been known to fall on this territory. Such beach grasses as grow along the California coast rely a great deal upon the fogs for moisture, but in Imperial County, back of the mountains fogs are almost unknown. Consequently, it is very doubtful whether the climatic conditions here are such as to allow the cultivation of plants to prevent sand drifting over the highways.

R. A. HILL,
With Quinton, Code & Hill,
Nov. 21, Los Angeles. Consulting Engineers.

Purifying Shellfish by Electrolytically Sterilized Sea Water

Sir—I should like to make note of a simple method of disinfecting sea water used in purifying shellfish. Shellfish are to be purified by "floating" in salt water of good sanitary quality, to which a sterilizing substance is added at intervals. The process starts with a "sterilizing interval," during which the water contains an excess of sterilizing material sufficient to sterilize everything exterior to the shells. This is followed by a "drinking interval," during which the shellfish exercise their natural functions in clean water, free from infective matters. A second sterilizing interval follows, to sterilize all material eliminated by the shellfish during the preceding functioning interval. This is again followed by a drinking interval. This alternation of sterilizing and drinking intervals is continued until the shellfish are purified to the extent required by given sanitary standards.

Such a shellfish purification plant operating at Inwood, L. I., will be more fully described in a later issue of *Engineering News-Record*. An electrolytic "cell" was installed to generate the hypochlorite solution directly from the sea water. Ordinarily these "cells" are designed to produce a hypochlorite solution of definite concentration with a standard brine solution and electric current. Regulation of dosage is obtained by varying the quantity of this solution added.

Since, however, the quantity of hypolchlorite formed is proportional to the quantity of electric current passing through the "cell" as well as to the number of unit cells, it is possible to regulate the dosage by regulating the current and permitting a continuous flow of salt solution to pass through the "cell." The current may be regulated by varying the internal resistance of the cell, as by changing the concentration of the salt solution, or by varying the voltage applied, as by changing the external resistance in the circuit. By a suitable combination it is a simple matter to adjust these factors so that a definite dosage is applied, and to so calibrate a rheostat as to read directly in parts per million the quantity of available chlorine under any conditions of operation.

While the simplest practical application of this method lies in the disinfection of sea water used in purifying shellfish it may find application elsewhere.

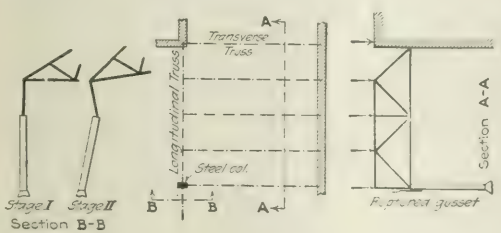
WILLIAM FIRTH WELLS,
Biologist and Sanitarian,
New York State Conservation Commission
Albany, N. Y., Dec. 27.

Column and Truss Bracing Blamed for Theater Roof Collapse

Sir—Defective design is suggested by the report on the Brooklyn theater collapse reported in your issue of Dec. 8, p. 954. The sketches herewith indicate a type of structural design which may or may not have been incorporated in the actual structure (and even if the structure was designed as indicated it would not necessarily prove that the failure occurred in the manner here suggested); but they convey a valuable lesson in structural steel design and for this reason they are brought to attention.

Assume a case where, as in the Brooklyn theater, the ends of certain transverse trusses are carried on a longitudinal truss, one end of which rests on a column. Section AA shows the column properly braced in one direction, but Section BB, Stage 1, shows that it has no bracing at its top in the other. Here we have a condition of unstable equilibrium, and a result as shown for Stage 2 is possible.

The writer feels that in any such case as this the column should be extended to the top chord of the transverse



UNBRACED COLUMN IN BROOKLYN THEATER

truss. Nearly all structural steel failures in the past have been due to lack of proper bracing and in looking for the cause of a failure in structural steel, to borrow a famous expression of detectives, *cherchez* the missing braces. It is to be hoped that the cause of the Brooklyn theater failure will be definitely determined because it will doubtless prove an invaluable lesson.

A number of questions occur to one looking over this design. There is no erection bracing provided. The purlins which are used to brace the top chord should, according to present ideas of structural design, provide ample bracing for this chord. Yet the method is not altogether positive. The question of the strength of the brick piers has been raised. Such pier construction is used largely in theater work, and practice would seem to indicate that it is safe. The piers are very large in proportion to their load, and as they are used to provide stiffness in the wall they probably are so excessive in area that it is inconceivable that they failed under the light truss load unless the bearing plates and trusses were inadequate.

The form of the transverse truss is a peculiar one in that it is a combination of a collar beam and trussed rafters and induces in addition to its direct stress certain compression stresses and flexural stress which make the analysis rather complicated, and might easily lead one to suspect in case of a failure that the design had not been properly made.

To my mind there is however, according to the sketches contained in your report, only one outstanding incorrect point of design, namely the fact that the steel column was not properly braced at the top in one direction.

ELWYN E. SEELYE,
New York, Dec. 12. Consulting Engineer.

Sir—The case of the theater building in Brooklyn the collapse of which you describe in your issue of Dec. 8 is another example of faulty design.

The great fault in this design is one piece with practically all large steel failures. It is the omission of bracing. The long row of roof trusses, so far as the report of the failure shows, and so far as the photographs show, had not a wire nor a rod of lateral or sway bracing. The most natural thing in the world for these trusses to do was to fall over. It is only by a freak of nature that they stood up as long as they did.

Besides having no diagonal bracing of any kind to hold the peaks of these trusses in line there was not an opportunity to tie the roof to the end wall, for, by the photographs, this wall was not yet built above the level of the bottom chords of the trusses.

Naturally the pilasters on which the trusses rested would be messed up a bit by the collapse of the trusses. Also the column supporting the longitudinal truss would be jarred. The trusses as they lie with top chords flopped over all in one direction are sufficient index of the history of the collapse.

Not long ago I checked the design of a building which was without bracing. I recommended that bracing be added. The builder's engineer persuaded the owner that this was unnecessary. But when they came to erect the building, it was found impossible to line it up. Struts and rods were hurried to the site by express.

EDWARD GODFREY.
Pittsburgh, Dec. 13.

Limestone Crusher Dust and Poor Concrete

Sir—The account in *Engineering News-Record*, Dec. 8, 1921, p. 934, of the failure of concrete building in which the aggregate was limestone with a considerable percentage of crusher dust, reminds me that two experiences of this kind have come to my personal attention.

The first case was that of some concrete piers for a steel truss bridge over the Kankakee River in Indiana. After a lapse of about one year, the concrete of these piers was still soft and samples could be taken out with a heavy trowel. The remains of the pile of aggregate showed the concrete had been made with soft limestone containing crusher dust. The coping on the abutment, which was made with sand aggregate, was hard and firm. The concrete in the piers of a railroad bridge over the Kankakee River very near the highway bridge was in good condition. Samples of the aggregate containing different percentages of crusher dust were taken to the laboratory and made into the usual tension and compression specimens. These under test showed a high strength.

When the soldiers were being taught the art of concreting at Purdue University during the war, they had two short sections of retaining wall to build, (a) with sand and gravel aggregate, and (b) with soft limestone aggregate containing unusual proportions of crusher dust. In both cases the cement, weather conditions, workmanship, amount of water, etc., were the same. Section (a) is excellent concrete; section (b) has not hardened and samples can be taken out with a stiff trowel. Laboratory investigations fail to produce data which would be predictive of the condition of this concrete which cannot be charged to "balling-up." The entire wall (b) is of the same character.

I am reminded that beams of reinforced concrete beam containing crusher dust made at Purdue University in 1901 showed excellent strength.

I have put this problem up to expert cement chemists without an answer. It would appear that the use of soft limestone aggregate with crusher dust is attended with grave dangers.

W. K. HATT,
Washington, D. C., Director, Advisory Board
Dec. 27 of Highway Research

NEWS OF THE WEEK

New York, January 5, 1922

Program for Annual Meeting of Am. Soc. C. E.

Conference on National Transportation Problems Will Be Feature—Dinner Dance Announced

The sixty-ninth annual meeting of the American Society of Civil Engineers will be called to order by President George S. Webster in the Auditorium of the Engineering Societies Building, New York City, at 10 a. m., Jan. 18. The usual business coming before the society at its annual meetings will be transacted at this session. The rest of the program is as follows:

Luncheon at McGraw-Hill Building.—Through the courtesy of E. J. Mehren, Editor, *Engineering News-Record*, luncheon will be served to members only at 1 p. m. Jan. 18, by the McGraw-Hill Co. at its building 10th Ave. at 36th St. After luncheon, this, the largest plant for the printing of technical magazines in the United States, will be open to inspection. Motor buses will be provided to transport those in attendance from the Engineering Societies Building, to the McGraw-Hill Building.

Reception and Dinner Dance.—The President's and Honorary Members' Reception, starting at 7.30 p. m., Jan. 18 and followed by a dinner dance, will be held in the ball room of the Pennsylvania Hotel, 7th Ave. at 33d St.

TO DISCUSS TRANSPORTATION

On Jan. 19 a conference on National Transportation Problems will be held in the auditorium of the Engineering Societies Building.

9.30 a. m.—The morning session will be confined to Water Transportation.

12.30 p. m.—Luncheon will be served by the society to members, ladies, and guests on the fifth floor of the Engineering Societies Building.

2 p. m.—The afternoon session will be confined to Railroad Transportation.

For those who do not care to attend the Transportation Conference excursions have been arranged to the New York Stock Exchange, Federal Reserve Bank Building foundations, American Bank Note Co., and the Hell Gate power station.

The smoker at 8.30 p. m. Jan. 19 will be addressed by a speaker of national prominence.

The conference on National Transportation Problems will be continued at three sessions on Jan. 20 and will be devoted exclusively to the subject of Highway Transportation.

Clarence A. Bingham Chosen City Manager of Lima, Ohio

Clarence A. Bingham, who has been successively city manager of Norwood Waltham, Mass., and Watertown, N. Y., has been chosen manager of Lima, Ohio, effective Jan. 1, when the new commission-manager charter goes into effect. Mr. Bingham was selected from about forty men who were considered for the position. His salary will be $8,000 a year.

Great Northern Considers Double Tracking Project

The Great Northern Railway in Spokane is considering the double tracking of its line between Wenatchee and Harrington, a distance of approximately 35 miles, at a cost of something over $700,000, or $20,000 a mile. If the work is approved, construction will begin early in March.

New Standardization Work

Uniform methods of testing wood are to be developed by a committee organized under the general direction of the American Engineering Standards Committee; The American Society for Testing Materials and the U. S. Forest Service are joint sponsors for the work. Railroad tie specifications are to be unified by a committee under sponsorship of the Forest Service and the American Railway Engineering Association. The field covered is to include grouping of ties with respect to treatment, and inspection rules, but not methods of treatment.

By direction of the Secretary of War the supply branches of the army will hereafter utilize in connection with their specifications the standards adopted by the American Engineering Standards Committee.

Chicago Building Deadlock Seems Probable

Pledges to support the carpenters' union in Chicago by refusing to work on jobs under the Landis award or on open shop jobs have been made by all unions affiliated with the Building Trades Council. This resolution, passed Dec. 30, means in effect another building deadlock as the unions propose to call out workers on jobs where non-union men are employed.

The Citizens' Committee to Enforce the Landis Award has announced that outside plumbing contractors will be brought into Chicago to operate under the terms of the award. The master plumbers refused to "go along," and that trade is "open shop" from now on as well as the sheet metal trades which had previously been declared open shop by the committee.

The finance committee of the City Council, in making up the 1922 budget, declared in favor of applying the Landis award in city payrolls. An estimated annual saving of $300,000 in the water department will be effected thereby.

Advertisements in 19 cities of the Central West for sheet metal workers has brought in 200 applicants by the first mail ready to work on the open shop basis.

On recommendation of the public affairs committee the board of directors of the Western Society of Engineers has endorsed the Landis award and pledges its full support to the program of the citizens' committee.

New York Water Power Body Issues First Permits

The New York Water Power Commission on Dec. 31 issued preliminary permits to the Louisville Power Corp. for the development of water power in the St. Lawrence River near Croil Island, and to the St. Lawrence Transmission Co. for a like purpose on the St. Lawrence River at Long Sault Rapids. These applications are the first to receive favorable consideration by the commission.

These permits do not authorize power developments but enable these companies to make examinations, surveys, plans, and estimates and to file them with the Water Power Commission with an application for a license to develop the water powers at the point mentioned, upon such rental as the Commission may then determine to be equitable. The action of the commission upon these applications is an assertion of the rights of the State of New York in the power to be developed on the St. Lawrence River for the benefit of the people of the State of New York.

Preliminary Report Made on City Plan for Cincinnati

A preliminary report on city planning for Cincinnati, described as not a plan but a basis for such a plan, has been submitted to the City Planning Commission by the Technical Advisory Corporation of New York City, after four months of study. A year's further study of the various problems confronting the city is advised before detailed planning is undertaken. General suggestions are made, however, for: two new railroad stations; terminals; changes in downtown traffic; street widening; change single trolley in place of the present double trolley system; electric railway track standardization for the benefit of interurban lines; a housing corporation; flood prevention work. An appropriation of about $105,000 to pay experts for some three years of comprehensive planning work is also suggested.

Philadelphia Takes Over Balance of Street Cleaning Work

The change from the contract to the direct city system of street cleaning and the collection and disposal of garbage, ashes and rubbish, begun last year by Philadelphia, was made complete with the beginning of 1922. The service is being performed by the Department of Public Works, Frank H. Caven, director, and is directly in charge of the Bureau of Highways, of which Fred C. Dunlap is chief, with John H. Neeson deputy chief in charge of street cleaning and E. D. Very as engineer. More details appeared in *Engineering News-Record* Jan. 27, 1921, and portions of a report on the subject by a special commission were printed in the same journal for July 29 and Aug 19, 1920, pp. 236 and 357.

Road Program Costing $34,000,000 Planned for South Carolina

Contractors are taking much interest in the plan proposed by Governor Cooper for the expenditure of $34,000,000 in South Carolina in a six-year road building program. The money is to be raised without adding to the present property tax in the state and will be submitted to the legislature which meets this month. The plan, if put into effect, will give South Carolina 4,000 miles of improved roads, 600 miles of which will be hard surfaced.

Governor Cooper in his plan suggests the following means of raising $34,000,000: Federal-aid for six years, $6.600,000; an increase in the automobile license fees so as to bring in $1,300,000 a year or $7,800,000 in six years; approximately $6,200,000 from the 2-mill property tax already effective; approximately $3,400,000 from a gasoline tax imposed for six years at 1c. per gallon; a state bond issue of $10,000,000.

A number of bridge projects are provided for under the proposed program.

Akron Engineering Societies Approve City Zoning

The tentative zoning plan for Akron, Ohio, submitted in printed form in October, was outlined before the Engineering Society of Akron on Dec. 13 by Charles F. Fisher, planning engineer of the Akron Planning Commission. The society adopted a resolution approving the principle of zoning and providing for the appointment of a committee with power to study the proposed zoning scheme and transmit its finding directly to the City Planning Commission and to the City Council as the action of the society. On Dec. 18 the Akron Chapter of the American Association of Engineers approved zoning and the tentative plan. A committee of the association is preparing a report on the subject.

Condemnation Rights Involved in Seattle Reservoir Case

In the re-hearing Dec. 9 before the State Supreme Court at Olympia, Wash., of the City of Seattle's injunction suit to obtain permission to proceed with the construction of the proposed reservoir in Volunteer Park, assistant corporation counsel argued that the city, under its charter, has the right of condemnation of any piece of property within the corporate limits. A departmental decision of the Supreme Court Aug. 29, 1921, favored the city, and the 83 property owners who are opposing the proposed reservoir, were granted a rehearing enbanc.

At the rehearing, the city presented photographs and maps to show that none of the beauty spots in the park would be damaged by the proposed reservoir, and introduced evidence to show that it would cost the city $443,000 more to construct the reservoir where the residents want it, north of the park, than on the proposed site in the park.

Attorneys for the residents argued that condemnation is not authorized by the city charter, that the reservoir would constitute a menace to adjoining property, and that would infringe upon the rights of the public to enjoy the parks. An early decision is expected.

New Water Supply for Phoenix

The gravity water supply for the City of Phoenix, Arizona, was put into commission Dec. 15 by turning the waters of the Verde River into the completed system. Prior to this the supply had been obtained from driven wells within the corporate limits of the city. This improvement has cost $1,925,000.

Uncompleted Concrete Arch Bridge Collapses

Two spans of a concrete arch bridge under construction over Lake Worth, between Palm Beach and West Palm Beach, Fla., collapsed on the afternoon of Dec. 29, and a third arch fell on the following day. The concrete structure was practically complete at the time of the accident, but spandrel filling was being placed. This consisted of lake bottom sand, pumped in by hydraulic dredge. It was intended to open the bridge for temporary traffic service during the winter within a few days.

While official detailed information on the conditions existing at the time of the collapse is not yet available, the superintendent for the contractor, the A. S. Hecker Co., of Cleveland, is reported by the Palm Beach *Post* to have stated that the arch barrels were a minimum of 26 days old, that a steam roller had been at work on the fill, and that while this rolling was in progress he heard a cracking noise, the collapse occurring soon after. Harrington, Howard & Ash, Kansas City, consulting engineers and designers of the bridge, advise *Engineering News-Record* that the failure probably resulted from unbalanced loading of the arches by the hydraulic-dredge spandrel filling. The work is under general direction of R. S. Goodman, county engineer, but the construction was supervised by the consulting engineers.

W. Va. Engineers Must Register

According to the act regulating the practice of professional engineering, which became effective July 27, 1921, it will be unlawful to practice in West Virginia as a "registered professional engineer" after Jan. 27, 1922, unless such engineers are duly licensed. Registration is not compulsory except for those desiring to use the title "registered professional engineer."

Lord Ashfield Advocates Motor Roads Underground

(London Correspondence)

According to Lord Ashfield, chairman of the London Traffic Combine, Britain should have 3,500,000 motor vehicles instead of the existing 870,000, so as to bring up the number of persons per vehicle to the same level as that obtaining in the United States. Even now, all roads are inadequate to carry existing traffic, and wide motor roads, he believes, should be constructed parallel with the railroads so as to effect closer co-operation and the solution of the transit problem. Lord Ashfield also emphasizes the necessity for more subways throughout the country, and also the construction of underground roads near London for motor traffic.

War Department Announces Policy on San Francisco Bay Crossing

No decision has been reached by the War Department as to which of the sixteen proposals for the construction of a crossing across San Francisco Bay it may approve. The Chief of Engineers has announced the broad policy which must govern this construction, as follows:

1. No bridge of any kind will be approved north of Hunters Point.
2. No low bridge will be approved north of San Mateo.
3. A tunnel crossing the bay will be approved in any location provided the highest part of the structure is placed at least 50 ft. below mean low water and proper compensation is made for obstruction of cross-section as affecting tidal flow.
4. A combined bridge and tunnel will be approved at a location south of the proposed Alameda River base site, provided the tunnel is so placed as to leave the channel along the San Francisco side unobstructed to a depth of 50 ft. at mean low water for a width of one mile (the width of the unobstructed 50-ft. channel immediately outside the pierhead line may be reduced to 3,000 ft.) measured from the lowest point of the pierhead line, and provided proper compensation is made for obstruction of the cross-section as affecting tidal flow.
5. Not more than one crossing will be approved at present in any location north of San Mateo.

Roads Bureau Calls for Maps of Federal-Aid Highway Systems

Th U. S. Bureau of Public Roads has urged each of the state highway commissions to expedite the preparation of the maps showing the highway systems on which federal-aid funds are to be expended. Among the instructions to be followed by the states in the preparation of these maps are the following:

1. The primary system shall be shown by two parallel black lines ¼ in. apart.
2. The secondary system shall be shown by two parallel dash black lines ¼ in. apart.
3. In a table upon the map shall be shown the total highway mileage of the state, total mileage of the federal-aid highway system, and the mileage in the primary and secondary systems, respectively. (The federal-aid highway system shall be not more than 7 per cent of the total highway mileage.)
4. The whole system and each of the primary and secondary divisions shall be respectively continuous and correlating.
5. Supplementary maps on a large scale should be prepared to accompany the federal-aid highway system maps showing terminals in cities.

Syracuse To Have New Conduit

With the completion of a third conduit about 50,000,000 gal. of water will be brought into Syracuse, N. Y., daily from Lake Skaneateles. The two present conduits have an estimated combined daily capacity of 27,000,000 gal. and completion of the third will nearly double this.

The new conduit is to be 36 in. in diameter and will be approximately 12 miles in length. Only 6 miles of the conduit will be laid this year.

New York City Finally Shortens Chelsea Piers

Just before retiring as commissioner of docks and ferries of the City of New York, Murray Hulbert signed a contract to shorten by 100 ft. the two Chelsea piers which have been a subject of contention between the city of New York and the United States War Department for about a year. The piers were extended under the plea of temporary necessity some years ago, but the City of New York has been endeavoring to make the extension permanent. Successive Secretaries of War have been firm in their insistence that the city should reduce the length of the piers to the dimensions required for a safe navigation of the Hudson at this point. The city finally, following orders of the Secretary of War to the Chief of Engineers to shorten the piers himself, agreed to do the work.

U. of P. Announces Short Highway Course

The brief course in highway Engineering given last year by the civil engineering department of the University of Pennsylvania is to be repeated. This year's sessions, under the general direction of Director Milo S. Ketchum, will begin Jan. 23 and end Feb. 8. Conferences on important highway engineering subjects will be arranged for Feb. 9 and 10. Several evening lectures will be given by eminent specialists.

In addition to the courses given during the first session, courses will be given in the maintenance of highways, in contracts and specifications, and the duties of the inspector. Instruction in laboratory and class-room will for the most part be in charge of practising engineers who have had a large experience in the design and construction of highways.

Among the non-resident instructors are the following: H. E. Hilts, principal assistant engineer; W. A. Van Duzer, assistant maintenance engineer; W. R. Wolfinger, assistant construction engineer; Malcolm H. Ulman, chemist, and H. S. Mattimore, engineer of tests, Pennsylvania State Highway Department; Julius Adler, deputy chief, Bureau of Highways, Philadelphia; William C. Perkins, chief engineer, Eastern Paving Brick Manufacturers' Association; D. S. MacBride, Portland Cement Association; Charles H. Clifton, City Testing Laboratory, Philadelphia.

Fall River Lets Garbage Collection and Disposal Contract

A 5-year contract for the collection and disposal of the garbage of Fall River, Mass., has been awarded by the Board of Health (Samuel B. Morris, agent) to Edward J. Dunn of that city for $79,000 for the whole period. Four other bids ranged from $48,000 to $175,000, but the board questioned the possibility of doing the work at the lowest figure, and the next lowest bidder was not anxious for the work. A. H. Barney, Providence, R. I., and W. C. Gardner, the latter holding the present 5-year contract at $39,000, expiring late in January, bid $95,000. The new contractor will dispose of the garbage on a 30-acre farm in Westport. The contractor must make collections throughout the entire city three times a week in June, July, August and September, and twice a week the rest of the year.

Urge Sale of Spruce Railroad

The Seattle (Wash.) Chamber of Commerce, has joined with the Port Angeles Commercial Club in asking that the Secretary of War direct the Spruce Production Corp. to offer at public sale to the highest bidder the government's spruce railroad No. 1, consisting of 36 miles of standard gage railroad in Clallam County, the government sawmill and its machinery, with timber lands purchased in connection therewith, without stipulating any minimum price. The operation of the spruce railroad, it is urged, would permit of saving billions of feet of valuable logs blown down in the great storm of January, 1921, which otherwise must become a total loss.

Boston's Mayor-Elect Fails To Hold Up Garbage Contract

The application of Mayor-elect Curley of Boston for a court order to prevent the City Council and the out-going mayor from executing a contract for garbage disposal for the ten years beginning July 1 next has been denied by a judge of the Massachusetts Supreme Court, and the contract was awarded on Dec. 28 to Coleman Bros. at a total of $3,795,000 for ten years. The judge held that the award was a matter of discretion and judgment rather than of law and characterized the claim of fraud as "the hurling of an epithet." Details of the request for bids, the bids themselves and the recommendations of a special committee, the commissioner of public works and the mayor that the contract be awarded to Coleman Bros. were published in *Engineering News-Record* for July 14, 1921, p. 82, Sept. 15, p. 465, and Nov. 10, p. 788, respectively. The bids were received Sept. 26 but the City Council did not begin hearings on the subject until Nov. 16.

Short Highway Course Planned for Tennessee Engineers

The University of Tennessee, with the co-operation of the Tennessee Highway Department, will offer a six weeks' highway course at the university, at Knoxville, beginning Jan. 9 and ending Feb. 17. The instruction includes, mathematics, mechanics, drawing, elementary surveying, testing of materials, highway engineering and economics, specification writing, and motor mechanics. This will be supplemented by special lectures. The faculty will consist of professors and instructors from the university's engineering department, engineers of the state highway department, U. S. Bureau of Public Roads and from engineering firms and sales organizations.

Minnesota Plans Winter Highway Work

Minnesota has planned a program of winter highway work which will provide jobs for 8,500 men. Charles M. Babcock, state highway commissioner states that, "Competition is keen for winter contracts and half of Minnesota's program has been contracted for at 1917 prices." An outlay of $2,500,000 calls for gravel surfacing, distribution of materials, rock crushing and heavy excavation. The work as planned includes 300 miles of graveling, 50 miles of grading and 50 miles of paving.

St. Paul Voters Hold to Commission Plan City Charter

At an election on Dec. 29 the voters of St. Paul, Minn., defeated the proposed change from the present commission plan of city government to the federal or mayor-and-council plan, outlined in *Engineering News-Record* Nov. 10, 1921, p. 783. The vote stood 16,123 for to 21,549 against.

Wood Preservation Convention at Chicago in January

The 18th annual meeting of the American Wood Preservers' Association will be held at the Sherman Hotel, Chicago, Jan. 24-26. The subjects include the preservative treatment of wood for piles, ties, structural and mine timbers, cars and pipe; also papers on the layout and operation of treating plants.

Among the papers listed are the following: "Effect of Heat on Wood Destroying Fungi in Mills," Dr. W. H. Snell; "A Theory of the Mechanism of Wood Protection by Preservatives," Ernest Bateman; "Econimics of Tie Renewals," V. K. Hendricks; "Factors Affecting the Cost of Treated Ties," E. E. Pershall; "Should the Cost of Treated Ties be Charged to Maintenance or Capital Account?" Earl Stimson; "Tropical Hardwoods for Ties in This Country," Nelson C. Brown; "Creosoted Wood Stave Pipe," H. I. Coale; "Preservation of Mine Timbers," R. R. Horner; Report on Piling in San Francisco Bay, F. D. Mattos; "Report on Piling on the Gulf Coast," E. E. Boehne.

New York City Awards Stapleton Pier Crane Contract

On Dec. 30, the City of New York awarded the contract for the freight-handling cranes for the new shipping piers at Stapleton, S. I., to the Wellman-Seaver-Morgan Corp., for the $324,500 bid on alternate (a) in the tenders. A history of the case, which includes a re-advertising for bids because of charges of irregularities in the low bid, was given in *Engineering News-Record* Dec. 8, 1921, p. 954, and the latest bids were recorded in the Construction News Section of the issue of Dec. 29, 1921, p. 287. The successful bidder's bid in the earlier opening was $396,435 and the contested bid of Heyl & Patterson, Inc., was $370,882, both for alternate (a). The latter company bid $344,921 on the re-advertised tenders.

Dallas Considers $5,000,000 Dam and Water Supply Project

A lake impounding 104,000,000,000 gal. of water is being proposed for Dallas. The site, surveyed last winter by Major W. J. Powell, engineer for the Supervisor of Public Utilities, was visited last week by the Board of City Commissioners for the purpose of determining the feasibility of the project.

This site which is one of four located by Major Powell last winter is at a narrow gorge on Denton Creek, 20 miles northwest of Dallas and of sufficient elevation above Dallas to permit of a gravity flow into the city using the natural river bed for this purpose. The maximum height of the dam would be 105 ft. and the cost of the entire project as at present estimated is $5,000,000.

Idaho Will Examine Applicants for Engineer Licenses

An examination to determine the fitness of applicants for civil engineers and surveyors licenses will be held in the office of the Bureau of License, Boise, Idaho, May 14 and Sept. 12, 1922. Information and application blanks may be obtained from Paul Davis, director of the bureau.

Begin Work on East Approach of Castleton Bridge

Work has been started by the Walsh Construction Co. on building six piers for the east approach of the Castleton Bridge over the Hudson River at Castleton, N. Y. These piers will carry a plate-girder super-structure. The main structure, which will cross the navigable channel of the Hudson by a 600-ft. span with a 400-ft. flanking span, is the principal structure of a cut-off line enabling through traffic to avoid the track congestion and severe grades of the main line through Albany.

Annual Meeting of the New England Water Works Association

The annual meeting of the New England Water Works Association will be held as required by the constitution on Wednesday, Jan. 11, at 2 p.m., at the rooms of the association, Tremont Temple, Boston. No arrangements have been made to provide a program for this date. The meeting will be adjourned to Thursday, Jan. 12 at 1 p.m. in the Boston City Club, the change in date having been made because rooms at the City Club were not available on Jan. 11. The regular program will be carried through at the meeting on Thursday, Jan. 12.

Indiana Reports Road Costs

The Indiana highway commission expended $3,439,926.12 for the construction of new roads in the state during the fiscal year ending Sept. 30, the annual financial report of John D. Williams, chief clerk of the department, shows. During the same period the commission disbursed $4,377,243.84 for road maintenance. Total expenditures for the year amounted to $8,166,121.94. The report was prepared under the supervision of Lawrence Lyons, director of the commission.

The total cost of supervision of all work by the commission was $234,855.20 or 2.87 per cent of the total expenditures and 3.16 per cent of the expenditures for construction and road maintenance.

Bar to Tri-City Sewage-Works Raised by County

Progress on the proposed tri-city sewage-works project for Pasadena, South Pasadena and Alhambra, Cal., may be expected soon, now that the Los Angeles County supervisors have given up their proposed ordinance designed to prevent the use of sewage farms anywhere in the county. The supervisors have approved a site for sewage-works on land now owned and used by Pasadena as a sewage farm. According to R. V. Orbison, city manager of South Pasadena and formerly city engineer of Pasedena, elections to vote on sewage disposal bonds will probably be held soon.

San Francisco Bay Bridge Project To Be Discussed Jan. 10

The general bridge committee comprising city and county officials from various parts of the San Francisco bay region will hold a meeting in Oakland Jan. 10 to discuss the announcement of the war department on the proposed San Francisco Bay bridge (reported in *Engineering News-Record* Dec. 29, p. 1080) and to consider further action. The first step is to be the raising of $150,000 needed for preliminary surveys, although it is reported that at this meeting plans for financing the construction of the bridge itself will be considered.

Richard J. Welch, member board of supervisors, San Francisco, is chairman of the general bridge committee.

Quality of Cement Basis of Association Membership

Amendment to the constitution of the Portland Cement Association at its recent meeting makes membership "contingent upon members' product meeting the standard specifications for portland cement adopted by the U. S. Government and the American Society for Testing Material."

The following officers were re-elected: President, L. T. Sunderland; vice-presidents, Richard Hardy and S. B. Newberry; Treasurer, F. W. Kelly. The new directors are as follows: H. Struckman, Charles F. Conn, H. L. Block, W. M. Hatch, George T. Cameron and David M. Kerk.

Want Part of Motor Fees for City Pavement Maintenance

The municipal legislative program, submitted to the Governor and the Legislature of the State of New York by the New York State conference of mayors and other city officials, recommends that the legislature, at the next session, enact laws that will give to the cities of the state their share of the moneys received from automobile fees that the same be used for the upkeep of their streets and bridges which are used as connecting highways. The present laws regulate the weight of auto trucks outside the limits of the cities; it is the recommendation that the legislature regulate the weight in the city limits to protect the pavements. The method in vogue at present is for the cities to regulate by city ordinance.

Traffic Handling Is Topic of Am.Soc.C.E. Discussion

Traffic handling, its engineering as well as regulatory aspects, will be the main topic of discussion at the meeting, Jan. 11, in the Engineering Societies' Building, of the New York Section of the American Society of Civil Engineers. Two formal addresses will be made by E. P. Goodrich, consulting engineer, New York, and Amos Schaeffer, consulting engineer to the president of the Borough of Manhattan, New York. These papers will be followed by a discussion which will be participated in by Robert Grier Cooke, president, the Fifth Ave. Association; Dr. John A. Harriss, special deputy police commissioner; Clifford M. Holland, chief engineer, New York-New Jersey Tunnel Commissions; and A. T. Warner, traffic engineer, Public Service Railway Co., Newark, N. J.

El Paso Sells Bonds

A bond issue of the City of El Paso, Texas was sold Dec. 20 to Stern Bros. & Co., of Kansas City for ¾ of 1 per cent above par, with interest at 5 per cent on $1,850,000. This was estimated to be a saving of $100,000 for the city over a previous bid of 5¾ per cent.

Agricultural Engineers Meet in Chicago

Flood control, drainage and irrigation in relation to agriculture were among the subjects presented at the annual meeting of the American Society of Agricultural Engineers, held in Chicago, Dec. 27 to 29. Prominent among these hydraulic papers was one on "Flood Control in Agriculture," by Arthur E. Morgan, who discussed this subject with reference to the Miami Conservancy District in Ohio.

Farm buildings, their construction, sanitation and drainage, formed the subject of another group of papers, while a third group dealt with tractors and farm machinery. One session was devoted to college education in agricultural engineering.

The officers for 1922 are as follows: President, A. J. R. Curtis, Portland Cement Association, Chicago; vice-presidents, G. W. McCuen, Ohio State University, Columbus, Ohio, and David Weeks, Dakota Engineering Co., Mitchell, So. Dak.; secretary, Raymond Olney, St. Joseph, Mich.

Engineering Societies

Calendar

Annual Meetings

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; Annual Convention, Cleveland, Ohio, Feb. 13-16.

AMERICAN ROAD BUILDERS ASSOCIATION, New York; Annual Convention and Good Roads Show, Chicago, Jan. 17-20.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Meeting, New York City, Jan. 18-20.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual Conference, Cleveland, Ohio, Jan. 17-19.

The San Francisco Engineers Club held a meeting on Dec. 15 to hear an address by J. B. Lippincott, consulting engineer of Los Angeles, on "Colorado River Hydro-electric Development." O. C. Merrill, executive secretary, federal power commission, also addressed the meeting. C. E. Grunsky, chairman of the meeting, reviewed briefly the early attempts to control the Colorado River and the present situation with regard to irrigation and power problems. The speakers had attended the federal hearing on Colorado River power projects held at San Diego Dec. 12 and reviewed the prospects for early development of power as indicated by statements and discussions at that meeting.

The County Highway Engineers' Association of Missouri will hold its fifteenth annual convention in Kansas City, Mo., Jan. 12-14.

The Trenton (N. J.) Engineers' Club has elected the following officers: Presi-

dent, Harry F. Harris; vice-president, Edward E. Reed; secretary, Joseph E. English; treasurer, James H. Johnson.

The American Society of Agricultural Engineers recently elected A. J. R. Curtis of Chicago, Ill., as its president for the coming year. Mr. Curtis has specialized in the development of farm buildings. Since graduation from Lewis Institute in 1909, he has been engaged in educational and farm promotive work. During the World War he was appointed inspector of government concrete schools. At the present time he is manager of the Cement Products Bureau of the Portland Cement Association in Chicago.

The Northwestern Section, Am. Soc. C. E., at its November luncheon meeting, elected the following officers: Chairman, Frank B. Sanborn; vice-chairman, Walter C. Voss; secretary-treasurer, Charles W. Banks; members of the executive committee, Leonard C. Wason and James H. Manning.

The American Wood Preservers' Association will hold its annual convention Jan. 24, 25 and 26 in Chicago.

The Engineers Subdivision, Chicago Association of Commerce, Dec. 21, elected the following officers for 1922: Chairman, Morris W. Lee; vice-chairman, Christopher Van Deventer. Other members of the executive committee are H. Boyd Brydon, James N. Hatch, William Lang, J. L. McConnell, Albert Newton, Robert Isham Randolph and C. C. Woodmansee.

The Toledo Chapter, A. A. E. has elected as president Joseph Hoffman, civil engineer and surveyor.

The County Highway Engineers' Association of Missouri will hold its 15th annual convention in Kansas City January 12, 13, 14.

The American Association of Engineers will hold its eighth annual convention in Salt Lake City, Utah, June 4-6.

The Washington Society of Engineers elected the following officers at its recent annual meeting: President, John S. Conway; vice-president, R. H. Dalgleish; secretary, A. C. Oliphant; treasurer, O. B. French.

The Providence Engineering Society will hold its annual dinner Jan. 31.

The San Francisco Section, Am. Soc. C. E., at its annual meeting Dec. 20 elected the following officers: President, Thomas H. Means; first vice-president, two-year term, Frank G. White; second vice-president, one-year term, G. A. Elliott. The members present at the meeting ratified the action of the board of directors in protesting to the Governor and to the director of the state bureau of engineering the sudden and summary removal of a capable engineer from the office of chief of division of water rights. The paper of the evening, presented by Charles Gilman Hyde, professor of sanitary engineering, University of California, was "The New Pumping and Filtration Works of the City of Sacramento, Cal."

The Kansas Section, Am. Soc. C. E. held its first meeting in the Chamber of Commerce, Topeka, Dec. 17, 1921. The president, L. E. Conrad, presided. In a short business meeting following the banquet, the section endorsed the adoption of an engineers' license law for Kansas and the president was appointed delegate to the meeting of the Kansas Engineering Society at Hutchinson with authority to discuss the law for the section. M. D. Downs gave a talk on city planning, referring particularly to the recent developments along that line in Topeka by the City Planning Board. M. W. Watson explained the details of recent federal-aid legislation, and reported in general on the road situation as expressed at the recent meeting of the American Association of Highway Officials at Omaha.

Personal Notes

ROLLEN J. WINDROW, state highway engineer of Texas during the past three years has tendered his resignation to the State Highway Commission to become the personal representative and advisor of Theodore Gary, chairman of the newly reorganized Missouri State Highway Commission and also to aid Mr. Gary, who is a capitalist, in his extensive private enterprises, among them being large telephone interests. As state highway engineer, Mr. Windrow received $10,000 per year until the last Legislature reduced this to $9,000, which included all traveling expenses, making him the highest paid official in the state. As advisor and assistant to Mr. Gary, Mr. Windrow is to receive an annual salary of $12,000 plus all traveling expenses and the cost of moving his family from Texas to Kansas City. Mr. Windrow is in no sense becoming the state highway engineer for Missouri, and no part of his salary is to be paid by that State. He is exclusively employed by Theodore Gary. For three years Mr. Windrow has been the Texas state highway engineer and before that served as a member of the State Board of Water Engineers and also as county engineer for McLennan County, his home being in Waco. He is a graduate civil engineer from the Texas A. & M., class of 1906.

C. J. ULLRICH has been appointed chairman of the local committee to make preparations for the National Convention of the American Association of Engineers to be held at the Hotel Utah, Salt Lake City, June 5, 6 and 7, 1922.

COL. CHARLES E. STANTON, U. S. A., retired, has been appointed commissioner of public works of San Francisco, Cal.

THOMAS H. MATHER, recently supervising engineer, U. S. Army Reserve Depot, New Cumberland, Pa., has been appointed city engineer of Syracuse, N. Y., to succeed Henry Allen.

WALTER W. MCGUIRE, formerly with the General Motors Corp. and the Water Division of St. Louis, is now secretary of the Chamber of Commerce at Carrollton, Mo.

DAVID R. DIEHL, an engineer employed by the New York Central R.R. in Cleveland, has been chosen city manager of Westerville, Ohio.

E. S. BORGQUIST, former district engineer with the Utah State Road Commission, has accepted a position with the Kittitas Reclamation District at Ellensburg, Wash. The engineering work is being done in co-operation with the U. S. Reclamation Service as a unit of the Yakima Project.

R. F. KELKER, JR., M. M. GATES and C. E. DE LEUW have dissolved partnership. The new firm of Kelker & De Leuw will engage in general municipal and sanitary engineering in Chicago.

HERRING & SCHELLHOUS, engineers of Forest City, Ark., have dissolved partnership. Mr. Herring will continue the practice of engineering in Forest City.

JAMES J. WALSH, for 21 years associated with the late Howard C. Holmes, will conduct the business as his successor under the name of Howard C. Holmes Co., specializing in harbor and municipal engineering in San Francisco.

WILLIAM A. SCHMIDT, building contractor, Johnstown, Pa., has been appointed street commissioner to fill the vacancy caused by the death of John Kammer.

T. M. JASPER, assistant professor of mechanics, University of Wisconsin, has been placed in charge of tests on the joint investigation of the fatigue of metals being carried on at the engineering experiment station, University of Illinois, in conjunction with the National Research Council and Engineering Foundation. PROF. J. B. KOMMERS, formerly engineer of tests, returns to the University of Wisconsin.

Obituary

GEORGE A. STACY, superintendent of the Marlboro, Mass., water and sewer department and former president of the New England Water Works Association, died at his home in Marlboro, Dec. 22.

HOWARD M. CHERRY, formerly with the Keystone Bridge Co., of Pennsylvania, died Dec. 21 at his home in San Diego, Cal. He had served 12 years as a member of the board of supervisors of San Diego and one term as county auditor.

HIRAM PHILLIPS, of St. Louis, Mo., who was employed as consulting engineer on the new Verde River water system for the city of Phoenix, Ariz., was instantly killed Dec. 22 in an automobile accident. L. B. Hitchcock, city engineer of Phoenix, accompanied Mr. Phillips on the trip, the purpose of which was a final inspection of the new system before the water from the Verde River was turned into the city's mains. Mr. Phillips was a former president of the St. Louis board of public improvements.

Business Notes

THE COMBUSTION ENGINEERING CORP., New York City, announces the opening of a branch office in Pittsburgh. W. C. Stripe, formerly manager of the Philadelphia office, will be in charge.

F. S. SLATER, for several years with Detroit Graphite Co., has resigned to take position with the M. B. Suydam Co., paint manufacturer, Pittsburgh, in its New York office as Eastern sales manager.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Labor Rates and Conditions Throughout the County

Citizens' Committee Enforcing Landis Award in Chicago—Heavy Cuts in St. Louis, San Francisco

It seems probable that the building crafts are most resistant to wage decreases. The chart in the labor review in the forepart of this issue shows that the average shrinkage of wage rates for skilled construction labor has been slight. Common labor, on the other hand, has been reduced an average of 25 per cent over the country. Wage reductions in factories range from 10 to 25 per cent, 20 per cent in the steel industry, 22½ per cent in the textile industries according to United States Bureau of Labor Statistics.

Current conditions in cities reporting to *Engineering News-Record* are as follows:

Los Angeles—Few men idle in the skilled building trades. Concrete workers and pick-and-shovel men receive $4.50@$5 per day. Common unskilled labor receives on the average 50c. per hour and represents the highest percentage of the unemployed. Piledrivers are reported as receiving as high as $1, but the average rate is 87½c.

Cincinnati—Bricklayers on strike, but wage adjustment expected soon.

Denver—Unemployment on the increase and all new work at a standstill as a result of cold weather. An unusually open winter, however, favored building operations until the middle of December.

Baltimore—No labor troubles. Hoisting engineers receive 87½c.; hodcarriers 54c.; piledrivers 74c. and common labor 30c.

St. Louis—Hoisting engineers quoted as low as $1.25 as against the regular rate of $1.37½; hodcarriers 85c.@87½c.; common labor 62½c.@67½c. The building contractors' proposal of a 20 per cent wage reduction from the standard rate of $1.25 per hr., was rejected by about 3,000 carpenters. In East St. Louis common labor on highway work is paid from 25c. to 35c. per hr.

New Orleans—Building trades mechanics are working below the standard pay scale in order to obtain employment. The scramble for contracts on public schools for 1922, indicates the construction stagnation here.

Seattle—Building activities in the Puget Sound district are subject to the usual seasonal restrictions and many prospective builders appear to be holding off until the new year is farther advanced, when it is believed building on a larger scale will be resumed. Architects are crowded with prospective work, including several business blocks, one or more hotels, apartments, residences and small industrial plants. The unemployment situation is unimproved, 8,000 to 10,000 men being idle. Recent floods and high water have hampered construction.

Boston—Carpenters receive 75c.; common labor 40c.@50c. per hour.

Detroit—Official rates unchanged, but some contractors are paying less than the established rates. Few new construction projects are being started to take care of labor being released by projects just completed. A number of bricklayers are reported by the Associated Building Employers to have left Detroit for other cities in Michigan, where schools and public buildings are under contract.

Philadelphia — Few changes in the current building trade's wage schedule are expected in the near future. The Builders' Exchange and Employers' Association has stated that conditions in the construction industry are now stable. Reasonable wage rates, increased efficiency and lower material costs have made this condition possible.

Minneapolis—Common labor is being obtained generally at 40c.@50c., though the city is still paying by ordinance, $5 per 8-hour day. This rate is about 50 per cent above that paid outside of municipal work. Considerable unemployment.

Pittsburgh — The Master Builders Association of Allegheny County and the Carpenters District Council of Pittsburgh and vicinity have signed an agreement until Feb. 28, 1923, in which all disputes between carpenters and employers are amicably settled, the existing scale to remain in force.

Spokane—Organizations of all kinds have united to establish a labor clearing house where all men and women in need of employment are expected to register. Preference is given to citizens of Spokane. Renewal of mining operations and greater demands for northwest lumber are expected to improve conditions.

Chicago — The Landis decision, which reduced bricklayers from $1.25 to $1.10, carpenters from $1.25 to $1, structural ironworkers from $1.25 to $1.05, pick-and-shovel men from $1 to 72½c., and placed hoisting engineers at $1.10, as well as effecting other changes in the wage schedule, is being rigidly enforced

Engineering News-Record Construction Cost Index Number

January, 1922	**168.72**
December, 1921	167.82
January, 1921	230.87
Peak, June, 1920	273.80
1913	100.00

Engineering News-Record's Construction Cost Index Number is .9 points higher than last month owing to a stronger lumber market; pine in New York is $1.50 higher than a month ago. Structural shapes in large quantities can still be bought for $1.50 per 100 lb. The average labor rate for the country this month is 45c., the same as last. Thus, general construction cost is 26 per cent cheaper than one year ago and 38 per cent under the peak; it is 69 per cent above the 1913 level.

Engineering News-Record Construction Volume Index Number

Monthly	
December, 1921	**118.00**
November, 1921	101.00
December, 1920	60.00
1913	100.00
Yearly	
1921 (entire year)	88.00
1920 (entire year)	91.00
1913	100.00

Engineering News-Record's Construction Volume Index Number is 118 for the month of December, and 88 for the whole of 1921, as against 100 for 1913. This means that the actual volume of construction in 1921 (not the mere money value of the contracts let this year) is 13 per cent under the volume of construction for 1913. Our monthly volume number, 118 for December, 1921, is really the increment of construction, and indicates the rate at which contracts are being let as compared with 1913 awards.

Important features of the

BUSINESS SIDE OF CONSTRUCTION

will be found on pages 8 to 13 of this issue, as follows:

Spring Prices of Construction Materials Since 1913
Trend of Materials Prices
Construction Cost Index Numbers—Derivation and Values
Construction Volume Index Number Since 1913
Trend of Labor in the United States
Contracts Let During 1921 Total $1,231,570,565 in Value
Municipal Bond Sales in 1921 Top All Previous Records

by the Citizens' Committee. Every encouragement is awarded by the Committee to employers and employees alike who abide by the decision, but violators on both sides are being severely dealt with. Building activities in Chicago are rapidly approaching normal.

New York — The current building trade's wage rate will probably remain in force until after Apr. 1, 1922. The heaviest increase in unemployment is noticeable in the building trades as compared with other industries. This is especially true of structural ironworkers and those dependent upon large unit construction. Much of this is due to seasonal conditions as recent totals of contracts awarded in this district have been unusually large.

San Francisco—The new decision of the Impartial Wage Board of the Industrial Association of San Francisco has reduced bricklayers and structural ironworkers from $1.16 to $1.12½; carpenters, hoisting engineers and pile drivers from $1.03 to $1 and hod-carriers from 92½c. to 75c. per hour. Common laborers are rated at $4.50 and skilled laborers at $5 per day, this rate applying to union labor; common, unskilled, non-union labor probably receives not more than 45c.@55c. per hour.

Conditions in the Brick Industry

A marked improvement in the brick industry, as compared with a year ago, is noted in current reports from manufacturers, according to the digest issued by the Common Brick Manufacturers of America under date of Jan. 1. Today the proportion of orders on the books to stocks on hand is 68.9 per cent, whereas a year ago the figure was 41.5 per cent. In proportion to the number of firms reporting, the stocks on hand are approximately the same as a year ago, a difference in the relation of the two items resulting from a much greater volume of business on the books. "The outlook for the brick manufacturer," says the digest "is in every way more favorable than it was a year ago."

The price of brick per thousand at the plant Jan. 1, 1921, ranged from $14 to $28, while today the range is from $10 to $20, the higher price now applying only to high-grade brick made in New England, which is commonly used for facing purposes. As an indication, only, of the general drop in price the composite price now stands at $13.47, which is about 50 per cent lower than a year ago. The price is more stable and better equalized throughout the country.

Continuing the digest says: "The industry has for three months experienced a slight improvement in demand, which shows no sign of slumping, and which promises at the resumption of building in the spring to approach a point nearer normal than was attained at any time during 1921." In contrast to the feeling with which the brick manufacturers faced 1921 the digest reports that "It is believed that few manufacturers will feel any hesitancy in making plans for opening their plants as early in the new year as possible."

Contracts for Week Ended Dec. 29

The total contracts let for the week ended December 29, as reported in *Engineering News-Record*, were valued at $19,548,068. The table appearing on p. 13 of this issue, reviewing contracts for the year, contained an estimate of $20,000,000 for the value of contracts let during the week ended December 29, so the total for the year contains but a small error.

Monthly Prices of Construction Materials

Ups and Downs of the Market

War Tax on Freight—Cancellation of 3 per cent transportation tax effective Jan. 1, 1922.

Pig Iron—Eastern Pennsylvania No. 2X quoted in Philadelphia at $22.26 as against $23.26 per gross ton.

Railway Supplies—Light rails quoted at a maximum of $32, Pittsburgh, as compared with $33 per 100 lb. one month ago. Standard section angle bars down 35c. in Pittsburgh and 48c. in Chicago. Reduction of 23c. per 100 lb. on spikes and track bolts quoted in Chicago.

Pipe—Discounts on all sizes black and galvanized wrought steel pipe increase 2½ points, on the Pittsburgh basing card, since last month. No change in wrought iron pipe discounts. Reduction at the mill reflected in increased steel pipe discounts at New York warehouses. Cast iron pipe prices generally firm. Heavy declines in sewer pipe prices in St. Louis; lighter reductions in Montreal and Philadelphia. Slight advance in larger sizes in Baltimore.

Road and Paving Materials—Road oil (65 per cent asphalt) advance ¼c.; binder and flux decline ¼c. per gal. in New York. Asphalt in package drops $1 in New York, $2 in Seattle and St. Louis and $3 in Baltimore; advance $2 per ton in Philadelphia. Asphalt in bulk drops $1 in New York, $2 in St. Louis and advances 50c. per ton in Philadelphia. Granite paving stone down 15c. in Baltimore and 5c. per sq.-yd. in St. Louis. Wood paving blocks up 70c. in St. Louis; down 40@50c. in New Orleans and 15c. per sq.yd. in Baltimore.

Sand, Gravel and Crushed Stone—Sand down 10c. per cu.yd. in Philadelphia and Cincinnati and 40c. per ton in Baltimore; no advances. Gravel, ¾-in., up 5c. per ton in St. Louis and 2c. per cu.yd., in Philadelphia; down 53c. per cu.yd. in Cincinnati. Gravel, ½-in., down 5c. per ton in St. Louis; 87½c. per cu.yd. in Cincinnati, 76½c. in New Orleans and up 10c. per cu.yd. in Philadelphia. Crushed stone up 10c. in St. Louis and down 5c. per cu.yd., ¾-in. size, in Philadelphia.

Lime and Cement—Hydrated finishing lime drops $1.50 and hydrated common $1 per ton in Philadelphia. Common lump lime quoted at $3@$3.49 as against $3.39@$3.69 per bbl. (280 lb. net) in New York; $11 per ton as compared with $15, one month ago, in Montreal and a reduction from $11 to $9.50 per ton in Philadelphia. Natural (Utica) cement advances 16c. per bbl. in Cincinnati. Portland cement up 23c. in St. Louis and 32c. in New Orleans; down 10c. in New York, 9c. in Boston, 14c. in Atlanta, 38c. in Baltimore, 2c. in Montreal and 27c. per bbl. in Philadelphia.

Structural Material—Steel shapes, plates and bars still quoted at $1.50@$1.60 per 100 lb., Pittsburgh mills. Birmingham mills quote shapes and plates at $1.75 as against $1.90 and bars at $1.65 as compared with $1.75 one month ago. During the last month steel shapes have dropped from $3.70 to $3.45 in San Francisco; structural rivets from $3.70 to $3.50 and cone head boiler rivets from $3.80 to $3.60 per 100 lb. in New York warehouses. Blue annealed steel sheets, base size, quoted at $3.28 as against $3.53 per 100 lb. in New York. Wire nails down 40c. at Pittsburgh mill, 35c. in Chicago and 50c. per keg in San Francisco warehouses. Expanded metal lath reduced $3 per 100 yd. in New York; slight declines in Chicago. Reductions ranging from 6c. to 40c. per 100 sq.ft. in triangle mesh at Pittsburgh mill.

Brick and Hollow Tile—Common brick quoted at $14@$15 per 1,000 wholesale, New York, as against $15 last month. Brick down $1 in St. Louis, $2 in Minneapolis, $2.50 in San Francisco and up $1 per 1,000 in Cincinnati. Hollow building tile declines in Philadelphia, St. Louis, Boston, Minneapolis, Cincinnati, Denver, Baltimore and New Orleans; up in Montreal and Dallas.

Roofing Materials—Average drop of 10c. per square in No. 1 and No. 2 grades prepared roofings, in New York and Philadelphia. Slate roofing and shingles also decline. Drop of 20c. per roll in tar felt and $5 per ton in both light and heavy asphalt felt in Philadelphia.

Lumber—Average advance of $3 per M ft. b.m. in Douglas fir in San Francisco yards. Long leaf yellow pine, base sizes, up $1.50 in New York and down $1 in Chicago. Pine shows general upward trend in Baltimore and Birmingham and declines in Dallas. Douglas fir up in Los Angeles, Denver and Minneapolis and down in Seattle and Philadelphia. Hemlock advances in Los Angeles and Minneapolis and declines in Boston and Philadelphia. Spruce down in Boston and Philadelphia.

Steel Sheet Piling—Pittsburgh quotes $1.80 as against $1.80@$1.90 per 100 lb.

Manila Rope—Advances averaging 1c. per lb. in Boston, Minneapolis, Atlanta, New Orleans, Los Angeles and Seattle; declines in Cincinnati, Philadelphia and Baltimore.

Explosives—Decline of 2c. on 40 per cent and 60 per cent gelatin dynamite in St. Louis; 10c. on 40 per cent and 11c. on 60 per cent in Montreal and an advance of 2c. per lb. on 60 per cent in Los Angeles.

Linseed Oil—Down 2c. per gal. in Chicago since last month. Prices stable elsewhere.

Price advances since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Per Gross Ton—Quotations compiled by The Matthew Addy Co.:

	Current	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25 @ 2.75)	$22.50†	$46.50
Northern Basic	22.02†	40.00
Southern Ohio No. 2 (silicon 1.75 @ 2.25)	23.52†	47.00
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25 @ 2.75)	28.50†	52.10
BIRMINGHAM		
No. 2 Foundry (silicon 2.25 @ 2.75)	18.00†	42.00
PHILADELPHIA		
Eastern Pa., No. 2X, (2.25@2.75 sil.)	22.26†	46.00*
Virginia No. 2 (silicon 2.25 @ 2.75)	28.74†	46.25†
Basic	20.75†	44.00*
Grey Forge	22.50†	45.50*
CHICAGO		
No. 2 Foundry Local (silicon 1.75 @ 2.25)	21.70†	43@45
No. 2 Foundry Southern (silicon 2.25 @ 2.75)	24.66†	46@48
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley (silicon 1.75 @ 2.25)	22.46†	44.00
Basic	20.96†	38.00
Bessemer	21.96†	42.00

*F.o.b. furnace. † Delivered.

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh			
	Current	One Year Ago	Birmingham	Chicago
Standard bessemer rails	$40.00	$45.00	..	$40.00
Standard openhearth rails	40.00	47.00	$40.00	40.00
Light rails, 8 to 10 lb.	31.00@32.00	2.45@3.00*	1.60*	1.65@1.80*
Light rails, 12 to 14 lb.	31.00@32.00	2.41@2.95*	1.60*	1.65@1.80*
Light rails, 25 to 45 lb.	31.00@32.00	2.32@2.85*	1.60*	1.65@1.80*

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8 Ft.	7 In. x 9 In. by 8 Ft. 6 In.
Chicago, White Oak	$1.35	$1.50
Chicago, Hardwood and Red Oak	1.20	1.30
Chicago....Empty Cell Creosoting (add'l)	.45	.50
San Francisco	Green Douglas Fir .75	.92
San Francisco, Empty Cell Creosoted, Douglas Fir	1.70	2.20

For ties on standard "railroad administration" specifications, f.o.b. cars, St. Louis:

	White Oak	Red Oak	Pine and Sap Cypress
Grade 3	$1.15	$1.05	$0.95
Grade 2	1.05	.95	.85
Grade 1	.95	.85	.75

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh		Chicago	St. Louis	San Francisco	Birmingham
	Current	One Year Ago				
Standard spikes, ⅜-in. and larger	$2.25	$3.65@3.90	$	$3.60	$4.50	$4.05
Track bolts	3.25@3.50	5.50@6.00		4.60	5.50	4.15
Standard section angle bars	.40	2.75@3.75		3.25	4.00	3.25

PIPE

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the latest Pittsburgh basing card.

BUTT WELD

Inches	Steel Black	Galv.	Inches	Iron Black	Galv.
1 to 3	71	58½	⅛ to 1¼	44½	29½

LAP WELD

2	64	51½	2	39	25½
2½ to 6	68	55½	2½ to 6	42	29
7 to 8	65	51½	7 to 12	40	27
9 to 12	64	50½			

BUTT WELD, EXTRA STRONG, PLAIN ENDS

2 to 1½	69	57½	⅛ to 1¼	44½	30½
1½ to 3	70	58½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	62	50½	2	40½	27½
2½ to 4	66	54½	2½ to 4	43½	31½
4½ to 6	65	53½	4½ to 6	42½	30½
7 to 8	61	47½	7 to 8	35½	23½
9 to 12	55	41½	9 to 12	30½	18½

STEEL—From warehouses at the places named the following discounts hold for steel pipe:

	Black		
	New York	Chicago	St. Louis
⅛ to 3 in. butt welded	66%	60%	56½%
2½ to 6 in. lap welded	61%	57%	53½%

	Galvanized		
	New York	Chicago	St. Louis
⅛ to 3 in. butt welded	53%	46%	42½%
2½ to 6 in. lap welded	47%	43%	39½%

Malleable fittings, Class B and C, from New York stock sell at list less 5%
Cast iron, standard sizes, 32½% off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	New York						
	Current	One Year Ago	Birmingham	Chicago	St. Louis	San Francisco
4 in.	$50.30	*$73.30*	$38.00	$46.60@48.30	$46.20	$54.00
6 in. and over	47.30@48.30	*63.30*	35.00	42.60@44.10	43.20	50.00

Gas pipe and Class "A," $3 per ton extra; 16-ft. lengths, $1 per ton.

CLAY DRAIN TILE—The following prices are per 1000 lin.ft.:

	New York					
Size, In.	Current	One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	$40.00	$62.00	$35.00	$50.00	.....	$55.00
4	50.00	77.50	85.00	60.00	$90.00	65.00
5	80.00	110.00	140.00	80.00	115.00	84.00
6	105.00	140.00	140.00	100.00	150.00	110.00
8	175.00	228.00	200.00	150.00	250.00	181.00

SEWER PIPE—The following prices are in cents per foot for carload lots:

Size, In.	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3	$0.14	$0.087	..	$0.0875	$0.12	$0.12	..
4	.14	.087	$0.09	.6875	.12	.15	$0.18
5	.21	.1305	..	.0875	.18	.18	.165
6	.21	.1305	.135	.1375	.18	.21	.25
8	.35	.203	.225	.20	.28	.30	.35
10	.52	.3045	..	.275	.42	.42	..
12	.67	.3915	.3825	.36	.54	.54	.80
15	1.15	.522	.5625	.450	.72	.90	..
18	1.55	.725	.765	.6938	1.00	1.32	..
20	1.98	.87	1.125	.9000	1.20	..	..
22	2.64	1.16	..	..	1.60	..	..
24	2.97	1.305	1.4625	1.20	1.80	2.16	2.40
27	4.50	1.885	..	2.00	3.75	3.00	..
30	5.00	2.088	3.20	2.65	4.75	3.60	..
33	6.55	2.61	..	3.30	5.50	..	..
36	7.50	2.9725	..	3.65	6.00	..	..

	3	5	8	12	24	36
Boston	$0.108	$0.162	$0.252	$0.486	$1.62	$4.92
Minneapolis	..	..	.40	.77	2.55	5.66
Denver	..	.15	.30	.50	1.95	..
Seattle	.145	..	.36	.72	2.59	..
Los Angeles	.11*	.165*	.275	.495	1.65	..
New Orleans	..	.108	.27	.459	1.755	..
Cincinnati	.10	.15	.233	.45	1.50	4.305
Atlanta	.098*	.147*	.245	.4165	1.5925	..
Montreal, *delivered*	.30*	.45*	.705	1.35	4.50	6.50
Detroit	.105	.1575	.245	.4725	2.115	5.4325
Baltimore (*f.o.b.*)	.1225	.2275	.35	.665	2.29	5.25
Kansas City, Mo.	.15	.21	.335	.60	2.41	4.74
Philadelphia	.095	.145	..	..	1.44	..

*4-in., 6-in., 9-in., respectively.

ROAD AND PAVING MATERIALS

ROAD OILS—Following are prices per gallon in tank cars 8,000 gal. minimum f.o.b. place named

		Current	One Year Ago
New York, 45% asphalt	(at terminal)	$0.05½	$0.09
New York, 65% asphalt	(at terminal)	.05½	.09
New York, binder	(at terminal)	.05	.09
New York, flux	(at terminal)	.05	.09
New York, liquid asphalt	(at terminal)	.06½	.11
St. Louis, 50-60% asphalt	(f.o.b. plant, Chicago)	.01½*	.12
Chicago, 40-50% asphalt		.05	.08½
Chicago, 60-70% asphalt		.05	.08½
Dallas, 40-50% asphalt		.10	.10
Dallas, 60-70% asphalt		.13	.13
Dallas, 75-90% asphalt		.15	.15
San Francisco, binder, per ton		15.00†	15.00

* Freight $21.75 per ton to Wilmington, Ind.
† F.o.b. Oleum, Cal. Freight to San Francisco, $0.80 per ton.

ASPHALT—Price per ton in packages (350-lb bbl. or 425-lb drums) and in bulk in carload lots:

	Package	Bulk
New York (Bayonne, N. J.)	$25.00	$16.00
Boston	No quotations.	
Chicago	25.85	19 50
San Francisco, *f.o.b. refinery*, Oleum, Cal.	21.50*	15 00*
Dallas	35 00	27 00
Seattle	35 00	21 50
Denver	45 00	65 00
Minneapolis		20 50
St. Louis	26 00	20 00
Baltimore	35 00	20 00
Los Angeles, *at factory*	22 50	15 00
Montreal	28 00	21 00
Atlanta	27 50	21 50
Detroit (petroleum asphalt)	24 50	20 00
Cincinnati	26 10	21 80
Maurer, N. J. (natural asphalt)	36 00	33 00
Maurer, N. J. (artificial asphalt)	22 00	20 00
Philadelphia	**24 00**	**17.00**

*Freight to San Francisco, 80c. per ton.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums. Rebates of about $1 per bbl., no rebate for drums.

PAVING STONE—

New York	5-in. granite, 28@29 blocks per sq.yd.	$130.00 per M
Chicago	About 4x8x4 dressed	3 35 sq.yd.
	About 4x8x4 common	3 00 sq.yd.
San Francisco	Basalt block 4x7x8	65 00 per M
Boston	5-in. granite	125 00 per M
Atlanta	Granite	.2 00 sq.yd.
Detroit	Granite, 26½ blocks per sq.yd.	107.00 per M
Baltimore	Granite	*2.00* sq.yd.
Montreal	Granite	125.00 per M
New Orleans	Granite, 4 x 8 x 4	3.25 sq.yd.
Cincinnati	Granite	4 30 sq.yd.
St. Louis	4x8x4 dressed	*3.30* sq.yd.
	4x8x4 common	*2.95* sq.yd.
Kansas City	No. 1 Granite	3 95 sq.yd.
Philadelphia	Granite	125.00 per M.

FLAGGING—

New York	Bronx	$0.25 sq.ft.
	Manhattan, 4 ft.	.26 sq.ft.
	Queens, 5 ft.	.26 sq.ft.
	6x20-in. cross-walk	1 00 lin.ft.
Chicago	18 in. wide	.99 lin.ft.

CURBING—Bluestone per lineal foot, in New York, costs 77c. for 5x16 in., 88c. for 5x18 in.; in cargo lots.

WOOD BLOCK PAVING—

	Size of Block	Treatment	Per Sq.Yd.
New York	3	16	$2 09
New York	3½	16	2.17
New York	4	16	2.37
Boston	3	16	2 17
Chicago	4	16	3 00@3.25
Chicago	3½	16	2.50@2 75
St. Louis	3½	16	**3 20**
St. Louis	4	16	**3 70**
Seattle	4	16	Off market
Minneapolis	3½	16	2 13
Atlanta	3½	16	2 30
New Orleans	3	16	*1 60*
New Orleans	3½	16	*1.80*
Dallas	4	16	*2.00*
Baltimore	4	18	3.90
Montreal	3½	16	*3.45*
Detroit	4	16	4 50
Detroit	3	16	2 84
Cincinnati	4	16	3 00
Kansas City	4	16	2.60
Philadelphia	4	16	2 15
	3½	16	3 50

CONSTRUCTION MATERIALS

SAND AND GRAVEL—Price for cargo or carload lots is as follows, per cu.yd.:

	Gravel				Sand	
	1½ In.		¾ In.			
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
New York	$1 75	$3 00	$1 75	$3 00	$1 00	$1 50
Denver	2 50	2 00	2 50	1 80	1 10	1 60
Chicago	2.00	2 75	2 00	2 75	2 00	2 75
St. Louis, *per ton*	*1.65*	1 65	**1 30**	1 70	1 25	1 70
Seattle	1.50	1.50	1.50	1.50	1.50	1.50
Dallas, *delivered*	*2.00*	2.50	*2.00*	2.50	*2.00*	2.00
Minneapolis, *at pit*	1.50	2.00	1 50		50	1 00
Cincinnati, *at pit*	*1.00*	2 00	*1.50*	2 00	*1.50*	2 00
San Francisco	2.25	2.50	2.25	2.50	1 50	1 65
Boston, per ton	2.65	2.60	2.65	2 60	2 00	1 60
New Orleans	*2.00‡*	3.60	*2.08‡*		1 35	1.85
Los Angeles, per ton	1.35†	1 25	1 35†	1.25	1 20†	1 15
Atlanta, per ton	1.85	2.50	1.85		1 25	1 50
Detroit	2.00	1.85*	2.00	1 85	2 00	3 50
Baltimore, per ton	1 40	1.40‡	1.60	1 60‡	*1.00*	70
Montreal, per ton	1 25	1.50‡	1.50		1.25	1.25‡
Birmingham, per ton (Crushed slag used instead of gravel)					1 28	1.25‡
Philadelphia	**1.50**		**1.57**		*1.80*	

* Fine white sand: Pacific, $4 per ton; Ottawa, $4.50

† Freight from quarry to Los Angeles is 70c. per ton, and is included in above price.

‡ Per cu. yd.

CRUSHED STONE—Price for cargo or carload lots f.o.b. city, unless stated otherwise, is as follows, per cu.yd.:

	1½ In.		¾ In.	
	Current	One Year Ago	Current	One Year Ago
New York	$1 80@1 90	$1 90@2.00	$1.80@1 90	$2.15
Chicago	1 60	2.75	1 60	2 75
St. Louis *delivered*	**1 65***	1 89	**1 65***	1 89
Dallas, *delivered*	*2.50*	2.50	*2.50*	2 50
San Francisco	2.25	2 50	2 25	2 50
Boston, *delivered*	3.00*	3 00* (del.)	3 00*	3 00* (del.)
Minneapolis, *at plant*	2 00	2.00	1 25	2 25
Kansas City	2 75	2.35	2.75	2.35
Denver	3 50		3 50	
Seattle *delivered*	3 00	**3.50** (del.)	3.00	3 50 (del.)
Atlanta	*2.00**	3 00	2 00*	3 25
Cincinnati *delivered*	2.37‡	2 30	2.08	2.15
Los Angeles	1 60*	**1.60***	1 70*	**1 70***
Detroit	1 90*	2.00	1 90*	2.00*
Baltimore	1.75*	**1.75***	1 65*	1.75*
Montreal	2.00*	**1.75***	**2.10***	1.75*
Birmingham *delivered*	3.20	....	3.10	....
Philadelphia	1.70*	....	*1.55**	....

*Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plants:

	1½-In.	¾-In.	Roofing	Sand
Youngstown District	$1.30	$1 30	$2.00	$1 30
Steubenville District	1 40	1.40	2 00	1 40
Ironton District	1 40	1.40	2 00	1.40
Emporium, Pa.	1.25	1.25	....	1.25
Easton, Catasaqua, Pa.	1 00	1 00	2.00	0 90
Birmingham, Ala.	0 75	0 95	2 05	0.80
Buffalo, N. Y., and Erie, Pa.	1 25	1 25	2.25	1.25
Cleveland, Ohio	1.20	1 20	....	1.00
Eastern Pennsylvania and Northern New Jersey	1.20	1 20	2 50	1 20
Western Pennsylvania	1.25	1.25	2 50	1.25

LIME—Warehouse prices:

	Hydrated, per Ton		Lump, per 180-Lb. Barrel (net)	
	Finishing	Common	Finishing	Common
New York	$16 99	....	....	*$3.00@3.30**
Chicago	18 00	....	....	1.40
St. Louis	0 58	$0 50	$2.25	0.70†
Boston	23.00	20 00	3.35	3 10
Dallas	25.00	....	....	2.75
Cincinnati	**18.40**	**16 00**	19.00‡	....
San Francisco	22.00	18.00	....	1.90
Minneapolis	29 00	22.00 (white)	*1.70*	1.40
Denver	30.00	....	95†	2.95
Detroit	15.25	13.25	11.50‡	10.50‡
Seattle	27 00	....	3.25	2 75
Los Angeles	30.00	30 00	3.00*	3.00*
Baltimore	15.00	13.00	....	12.00‡
Montreal	21.00	21 00	15 00‡	*11.00‡*
Atlanta	19.00	16 00	2.00	*1.50*
New Orleans	....	17.25	1 75	1.75
Philadelphia	*13.00*	*11 50*	10.50	*9.50‡*

* 280-lb. barrels (net). † Per bushel. ‡ Per ton.—Refund of 10c. per barrel. Minneapolis quotes brown lime; Kelly Is white is $1.70, Sheboygan *$1.55*. St. Louis quotes hydrated lime per 50-lb. sack. Seattle quotes hydrated finishing lime in cloth sacks; paper sacks, $24.00 per ton.

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, f.o.b., exclusive of bags:

	Current	One Year Ago
Minneapolis (Rosendale)	$2.80	$1.85
Kansas City (Ft. Scott)	1 60	1.60
Atlanta (Magnolia)	11 00 ton	1.90
Cincinnati (Utica)	**1 93**	*2.75*
Boston (Rosendale)	.85@ 95	2.35

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b. points listed *without bags*. Cash discount of 10c. per bbl. for payment within 10 days from date of invoice, not deducted.

	Current	One Month Ago	One Year Ago
New York*	*$2.30*	$2.40	$3.50
New York, alongside dock to dealers	2.00	2.00	....
Jersey City	2.15	2.13	3.20
Boston	2.53	2.61	3.41
Chicago	1 97	1 97	2.37
Pittsburgh	2.02	2.02	2.42
Cleveland	2.28	2.28	2.73
Detroit	2.31	2.31	2.68
Indianapolis	2 23	2.23	2.61
Toledo	2 31	2 31	2.71
Milwaukee	2 19	2.19	2.59
Duluth	1 95	1.95	2.35
Peoria	2.14	2.14	2.63
Cedar Rapids	2.28	2.28	2.71
Davenport	2 22	2 22	2.67
St. Louis	**2 20**	1 97	3 45
San Francisco	2 84	2.84	3.09
New Orleans	**3 20**	2 88	4 20
Minneapolis	2 26	2.26	2 71
Denver	3 10	3.10	3 25
Seattle	3 10	3.10	3 03
Dallas	2.55	2.55	3.15
Atlanta	*2.55*	2 69	3 00
Cincinnati	*2.50*	2.37	2.77
Los Angeles	3.31	3.31	3 10
Baltimore	*2.50*	2.88*	2.93*
Birmingham	2.27	2.27	
Kansas City	2 45	2.45	2.76
Montreal*	*3.10*	3 12*	3.52 (inc. bags)
Philadelphia	*2.35*	2 50*	

NOTE—Bags 10c. each; 40c. per bbl.; 80c. per bbl. in Montreal.

Current mill-prices per barrel in carload lots, without bags, to contractors:

Buffington, Ind	$1 70
Universal, Pa	1 75
Steelton, Minn	1 75
Berdwick, Va	**1 95**
Hudson, N. Y	**1 90**
Kingsport, Tenn	1 95
Lehigh Valley District	1.70
Richard City, Tenn	1 95

*Delivered by truck at site of work.

TRIANGLE MESH—Price per 100 sq ft. in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds	Pittsburgh, Mill	New York (Warehouse)	Chicago	Dallas	San Francisco
032	22	$0 68	$1 13	$0 82	$1 15	$1 24
049	28	.87	1 40	1 05	1 46	1 56
068	35	1 05	1 67	1 27	1 80	1 92
093	45	1 35	2 11	1 63	2 30	2 46
126	57	1 65	2 58	2 02	2.86	3 07
153	68	1 97	3 05	2 40	3 40	.....
180	78	2 26	3 48	2 76	3 93	.....
245	103	2 99	4 55	3 63	5 15	.....
287	119	3 45	5 25	4 20	5 96	6 41
336	138	4 00	6 07	4 87	7 32	.....
395	160	4.64	7 01	5 65	8.00	.....

PAVING

036P	.17	$0 52	$0 88	$0 62	$0 88	.....
053P	24	.73	1 20	0 88	1 24	.....
072P	.31	.91	1 48	1 11	1.57	.....
097P	.40	1 18	1 87	1 43	2 02	.....
049R	24	.73	1 20		1 24	.....
067R	31	.91	1 48		1 57	.....
089R	.40	1 18	1 87	....	2 02	.....

Made in 16-, 20-, 24-, 28-, 32-, 36-, 40-, 44-, 48-, 52- and 56-in. width in rolls 150-, 200- and 300-ft. lengths. Galvanized is about 15% higher.

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted are as follows:

Gage	Weight	*New York	Chicago	St. Louis	San Francisco	Dallas
27BB	2.3	$31 20	$23 36	$23 39	$27 62	$25 50
26BB	2.5	22 65	24 90	....	29 21	27 56
25BB	3.0	25 30	27 42	27 45		30 71
24BB	3.4	27 10	29 33	29 33	35 73	33 16
22PO	4.33	31.75	34 06	....	.....	35 10

* Price to contractors at warehouse or delivered on job in Manhattan, Bronx or Brooklyn.

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

			Warehouse, Uncut			
Inches	*Pittsburgh Mill	Birmingham Mill	New York	Chicago	St. Louis	Dallas	San Francisco
½ and larger	$1 50	$1 65	$2 68	$2 68	$2 87	$3 50	$3 00
⅝ and larger	1 55	1 75	2 73	2 73	2 92½	3 55	3 05
¾ and larger	1 60	1 75	2 78	2 78	2 97½	3 60	3 10
⅞ and larger	1 75	1 90	2 83	2 93	3 12½	3 75	3 25
1 and larger	2 00	1 90	2 88	3 18	3 37½	4 00	3.50

* Pittsburgh mill prices on large tonnages only.

Includes 15c charge for cutting to lengths of 2 ft. and over.

Twisted bars cut to length take extra of 27½c. per 100 lb.

ROLLED FROM RAILS

	Chicago	St. Louis	Dallas		Chicago	St. Louis	Dallas
½ and larger	$1 85	$1 90	$3 25	½	$2 00	$2 15	$3 50
⅝ in.	1 80	1 95	3 30	¼	2 25	2 40	3 75
¾ "	1 75	2 00	3 35	....	....	....	....

BRICK—Contractors price per 1,000 in cargo or carload lots as follows:

	Common			Paving Block	
	Current	One Month Ago	One Year Ago	3-inch*	4-inch*
New York (del.)	$17 40@18.40	$18.40	$22.70	$44 50	$49 50
New York (at dock)	14@ 15	15 00			
Chicago	11 00	11 00	15 00	34 00	42 00
St. Louis, salmon	16 00	17 00	17 00		
Denver, salmon	14 00	14 00	15 00		
Dallas	12 65	12 72	25 00	44 00	
San Francisco	15 50	18 00	18 00		44 38
Los Angeles	15 50	15 50	13 50	quot used)	
Boston (del.)	17 00	17 00	30 00	46 50	52 00
Minneapolis (del.)	15 00	17 00	24@26		43 00
Kansas City	14 50	14 50	22 00		
Seattle	14 00	14 00	19 00	48 00	53 50
Cincinnati	19 00	18 00	22@23	41 00	
Montreal (del.)	16 00	16 00	20 00	100 00	120 00
Detroit (del.)	15 00	15 00	20 00	41 50	44 00
Baltimore (del.)	20 00	20 00	20@25	36 00†	
Atlanta	9 00	9 00	20 00	40 00	
New Orleans	14 00	14 00	25 50		
Birmingham	11 50	11 50			
Philadelphia	16 00	16@19			42.00

* For paving blocks 3½x8½x3 and 3½x8½x4 respectively. † Vitrified, f.o.b. plant, Baltimore.

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York						
	Current on Trucks*	One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Perth Amboy N. J., Factory
4x12x12	$0 1120	$0 2444	$0 0821	$0 130	$0 [illegible]	$0 145	$0 17890
6x12x12	16670	3259	0950	[illegible]	[illegible]	20	
8x12x12	20840	.4345	1295	[illegible]	145	315	27370
10x12x12			1584	[illegible]	200		
12x12x12			1811	[illegible]	230		

* 5 per cent off for cash.

	4x12x12	8x12x12	12x12x12
Boston	$0 [illegible]	$0 180	$0 [illegible]
Minneapolis (f.o.b. cars)	[illegible]	[illegible]	[illegible]
Minneapolis (delivered)	[illegible]	[illegible]	[illegible]
Cincinnati	[illegible]	[illegible]	175
Kansas City	085	.167	270
Denver	[illegible]	[illegible]	[illegible]
Seattle	10	.175	30
Los Angeles, factory	103	185	22
New Orleans	[illegible]	26	40
Detroit (delivered)	070	135	225
Montreal	20	30	34
Baltimore	[illegible]	[illegible]	[illegible]
Atlanta	0675	13	
Dallas	13		
Birmingham	095	1785	

San Francisco and New York quote 8x12x12 partition tile.

STRUCTURAL MATERIAL—Following are base prices f. o. b. mill, Pittsburgh and Birmingham together with quotations per 100 lb. from warehouses at places named:

	*Pittsburgh, Mill	Birmingham Mill	New York (del.)	Dallas	St. Louis	Chicago (del.)	San Francciso
Beams, 3 to 15 in	1 50	$1 75	$2 78	$4 00	$2 97½	$2 88	$3 45
Channel, 3 to 15 in.	1 50	1 75	2 78	4 00	2 97½	2 88	3 45
Angles, 3 to 6 in., ¼ in. thick	1 50	1 75	2 78	4 00	2 97½	2 88	3 45
Tees, 3 in. and larger	1 50	1.75	2 78	4 00	2 97½	2 88	3 45
Plates	1 50	1 75	2 78	4 00	2 97½	2 88	3 45

* Pittsburgh mill price on large tonnages; small tonnages $1.60 per 100 lb.

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Warehouse					
	Pittsburgh, Mill	New York Current	New York One Yr. Ago	Chicago	St. Louis	San Francisco	Dallas
½ in. and larger	$2.25@2.40	$3.50	$5.75	$3.43	$3 77½	$5 50	$5 50

CONE HEAD BOILER

½ in. and larger	2.35@2 50	3.60	6 00	3 53	3 87½	5 60	5 65
⅝ and ¾	2.50@2 75	3 75	6 15	3 68	3 87½	5 75	5 80
⅞ and 1	2.75@2 90	4 00	6 40	4 18	3 87½	6 00	6 05

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in. take an extra of 25c.

NAILS—The following quotations are per keg from warehouse.

	Pittsburgh, Mill	Chicago	San Francisco	Dallas	St Louis	Montreal
Wire	$2 50@2.75	$3 25	$4 40	$5 00	$3 48	$4 95
Cut	2.25	6.10	6.00	7.75	4 08	5 00

PREPARED ROOFINGS—Standard grade rubbered surface, complete with nails and cement, costs per square as follows:

	New York			Philadelphia		
	1-Ply l.c.l.	2-Ply l.c.l.	3-Ply l.c.l.	1-Ply l.c.l.	2-Ply l.c.l.	3-Ply l.c.l.
No. 1 grade	$2 08	$2.38	$2 80	$1.92	$2.28	$2 70
No. 2 grade	1 77	2 08	2.45	1.67	1.98	2.15

Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs $1.90 per roll in carload lots and $2.15 for smaller quantities f.o.b. Philadelphia.

Shingles, red and green slate finish, cost $5.40 per square in carloads; $5.65 in smaller quantities, in Philadelphia.

ROOFING MATERIALS—Prices f.o.b. New York:

Tar felt (14 lb. per square of 100 sq.ft.) per roll of 432 sq.ft.	$2.15
Tar pitch (in 400-lb. bbl.), per 100 lb.	1 85
Asphalt roofing (in barrels), per ton, f.o.b. plant*	47 50
Asphalt felt (light), per ton, f.o.b. plant*	72.00
Asphalt felt (heavy), per ton, f.o.b. plant*	73.50

* Delivered in Metropolitan Dist., $3,00 additional.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill

Blue Annealed	Pittsburgh, Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10	$2 25	$2 87½	$3 38	$5 25	$3 28
No. 12	2.30	2 92½	3 43	5 30	3 38
No. 14	2.35	2 97½	3 48	5 35	3 38
No. 16	2.55	3.07½	3.58	5 45	3 48
Black					
No. 18 and 20	2 85	3 95	3 95	5 55	3 80
No. 22 and 24	2 90	4 00	4 00	5 60	3 85
No. 26	2 95	4 05	4 05	5 65	3 90
No. 28	3 00	4 15	4 15	5 75	4 00
Galvanized					
No. 10	3 00	4 15	4 15		4 00
No. 12	3 10	4 25	4 25	5 95	4 10
No. 14	3 10	4 25	4 25	5 95	4 10
No. 17 to 21	3 40	4 55	4 55	6 25	4 40
No. 22 and 24	3 55	4 70	4 70	6 40	4 55
No. 25 and 26	3 70	4 85	4 85	6 55	4 70
No. 28	4 00	5 15	5 15	6 85	5 00

* For painted corrugated sheets add 1930, per 1,000 lb. for 5 to 28 gage. 25% for 12 to 24 gage for galvanized corrugated sheets add 15 all gages.

LINSEED OIL—These prices are per gallon:

	New York		Chicago	
	Current	One Year Ago	Current	One Year Ago
Raw, in barrels (5 bbl. lots)	$0 72	$0 95	$0 [illegible]	$1 25

WHITE AND RED LEAD—Base price in cents per pound:

	Red — Current		Red — 1 Year Ago		White — Current	White — Yr Ago
	Dry	In Oil	Dry	In Oil	Dry or In Oil	Dry or In Oil
100-lb. keg	12 25	13 75	14 00	15 50	12 25	14 00
25 and 50-lb. kegs	12 50	14 00	14 25	15 75	12 50	14 25
12½-lb. keg	12 75	14 25	14 50	16 00	12 75	14 50
5-lb. cans	15 25	16 75	17 00	18 50	15 25	17 00
1-lb. cans	17 25	18 75	19 00	20 50	17 25	19 00

LUMBER

Prices wholesale to dealers in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in more than carload lots:

Lumber Prices to Contractors in Yards at San Francisco

	6–8 and 12 Ft	10–16–18 and 20 Ft.	22 and 24 Ft	25 to 32 Ft
3x3 and 4	$28 00	$31 00	$34 00	$36 00
3x6 and 8	28 00	31 00	32 00	34 00
4x4-6 and 8	30 00	33 00	34 00	36 00
3x10 and 12	30 00	32 00	34 00	36 00
3x14	31 00	33 00	35 00	37 00
4x10 and 12	32 00	34 00	36 00	38 00
4x14	33 00	35 00	37.00	39 00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft
6x10	$33 00	$35 00	$37 00
6x14	35 00	37 00	39 00
8x10	33 00	35 00	37 00
3x14	35 00	37 00	39 00

New York, Chicago, St. Louis and Detroit—Wholesale prices to dealers of long leaf yellow pine.

	New York* — 20 Ft. and Under	New York* — 20-24 Ft.	Chicago — 20 Ft. and Under	Chicago — 22-24 Ft
3x 4 to 8x8	$38 00	$39 00	*39 00*	*$41 00*
3x10 to 10x10	41 00	42 00	*41 00*	*43 00*
3x12 to 12x12	44 00	45 00	*43 00*	*45 00*
3x14 to 14x14	47 50	48 50	*47 00*	*49 00*
3x16 to 16x16	52 50	53 50	*52.00*	*54 00*
3x18 to 18x18	60 00	61 00	*58 00*	*60 00*
4x20 to 20x20	70 00	71 00	*65.00*	*67 00*

* Wholesale price to dealers; to contractors, on lighters or cars, about $5 additional. Short leaf pine up to 14 x 14 costs $15 per M. less.

St. Louis: Yellow pine, 10@12 ft. long, 3 x 4 to 6 x 6, $20 00; 3 x 8 to 8 x 8, $19; 3 x 12 to 5 x 12, $25; 3 x 14 to 5 x 14, $28; 3 x 16 to 4 x 16, $32; 12 x 14 to 14 x 14, $27.

Detroit—Norway pine 2 in. x 4 in., 10 ft. x 16 ft. long, $35, 2 in. x 12 in., 10 ft. x 16 ft. long, $37; short leaf yellow pine 2 in. x 4 in, 9 ft. x 12 ft. long, $27.50 2 in. x 8 in., 18 ft. x 20 ft. long, $31; yellow pine flooring No. 1 common 1 in. x 3 in., $39.75, 1 in. x 4 in., 6 ft. x 12 ft. long, $37.25; yellow pine shiplap $37.00.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12 x 12 and under, for sizes over 12 x 12 add $2, for merchantable add $2 to sizes 10 x 10 and under. For pine add $2 to the price of merchantable for all sizes.

Other Cities

	8 x 8-In. x 20 Ft. and Under — P.	Fir	Hemlock	Spruce	12 x 12-In. 20 Ft and Under — P.	Fir
Boston	$50 00	$52 00	$55 00	*$45 00*	*$54 00*	$52 00
Seattle		*18 00*	.....	.....	.....	*19 00*
New Orleans	28 00	.....	.....	.....	*25 00*	
Baltimore	36 50	.....	.....	.....	38 50	
Cincinnati	42 00	50 00	.....	.....	46 00	64 00
Montreal	78 00	85 00	68 00	78 00	120 00	100 00
Los Angeles	.....	44 00	43 00	.....	.....	44 00
Denver	.....	35 75	.....	.....	50 00	36 75
Minneapolis	40 00	40 00	37 00	.....	47 00	38 00
Atlanta	30 00	.....	.....	.....	38 00	.....
Dallas	33 00	.....	.....	.....	*34 00*	.....
Kansas City	33 00	29 50	47 00	.....	38 00	33 00
Birmingham	20 00	.....	.....	.....	26 00	
Philadelphia	*32.00*	*38.50*	*41 50*	*42 50*	*45.00*	*43.00*

	1-In. Rough, 10 In. x 16 Ft. — P.	Fir	Hemlock	2-In. T. and Gr. 10 In. x 16 Ft. — P.	Fir
Boston	$47 00	$48 00	*$32.00*	$45 00	$48 00
Seattle		*15 00*	.....		*14 00*
New Orleans, at mill	65 00	.....	.....	32 00	19 50
Baltimore	35 00	.....	.....	36 50	
Cincinnati	62 50	80 00	.....	33 50	
Montreal	120.00	60 00	60 00	80 00	80 00
Los Angeles	.....	39 00	38 00	.....	63 00
Denver	.....	30 25	.....	.....	29 75
Minneapolis	38 50	34 25	33 25	36 00	32 75
Atlanta	19 00	.....	.....	22 00	
Dallas	32 00	30 00	.....	36 00	
Kansas City	36 00	33 00	.....	32 50	31 00
Birmingham	18 00	.....	.....	18 00	.....
Philadelphia	35.00	36.00	35.00	33.00	33 00

Montreal—Up to 32 ft.; over which, $3.00 per M. increase up to 30 ft.

Birmingham—Quotes carload lots, f.o.b. sidings. $2 additional per M. ft. for delivery.

Boston and Cincinnati—Prices to contractors in carload lots, f.o.b.

Denver—Quotes dealers prices to contractor on large projects.

FREIGHT RATES

On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.

Baltimore	$0 33½	Detroit	$0 32½
Birmingham	76½	Kansas City	81½
Boston	41½	New Orleans	51½
Buffalo	29½	New York	38
Chicago	38	Pacific Coast (all rail)	1 66⅔
Cincinnati	325	Philadelphia	35
Cleveland	24	St. Louis	47½
Denver	1 35*	St. Paul	66½

* Minimum carload, 40,000 lb.

†Minimum carload, 50,000 lb., structural steel only; 80,000, lb. for other iron or steel products.

CONTRACTORS' SUPPLIES

STEEL SHEETPILING—The following price is base per 100 lb. f. o. b. Pittsburgh, with a comparison of a month and a year ago:

Current	One Month Ago	One Year Ago
$1.80	$1 80@1 90	$3.00

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern Territor New York and East of Missouri River
Hercules red strand, all constructions	25%
Patent flattened strand, special and cast steel	25%
Patent flattened strand, iron rope	10%
Plow steel round strand rope	40%
Special steel round strand rope	35%
Cast steel round strand rope	27½%
Round strand iron and iron tiller	10%
Galvanized steel rigging and guy rope	12½ %
Galvanized iron rigging and guy rope	+7½%

California, Oregon, Nevada and Washington Discount 5 points less than discount for Eastern territory.

Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.

Arizona: Discount 10 points less than discount for Eastern territory.

Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.

North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ¾-in the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ½-in., 8 ft., ¾-in., 6; ⅞-in., 4½; 1-in., 3½; 1¼-in., 2 ft 10 in.; 1½-in., 2 ft 4 in. Following is price per pound for ¾-in. and larger, in 1200-ft. coils:

Boston	$0 20	New Orleans	$0 17½
New York	18½	Los Angeles	16½
Chicago	18	Seattle	17
Minneapolis	19½	St. Louis	18½
San Francisco	16	Montreal	30
Atlanta	21½	Detroit	175
Denver	18	Baltimore	20
Cincinnati	17	Kansas City	17½
Dallas	29	Birmingham	20½
Philadelphia	17½		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0 3075	$0 3425
Boston	24	275
Kansas City	26	295
Seattle	1875	2125
Chicago	2275	2525
Minneapolis	2274	2530
St. Louis	24	27
Denver	2350	2700
Dallas	29	375
Los Angeles	25	29
Atlanta	2675	3025
Baltimore	2550	27
Cincinnati	2275	2725
Montreal	22	26
Birmingham, delivered	165	205
New Orleans	.2725	.3075
San Francisco	195	.23
Philadelphia	2525	.2875

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York.

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0 14	$0.19
12 in.—2 ft. from butt	6 in	50 to 59 ft.	0 18½	0.25
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	0 21	0.27½
14 in.—2 ft. from butt	6 in	50 to 69 ft.	0 24	0.32½
14 in.—2 ft. from butt	6 in	70 to 79 ft	0 26	0.34½
14 in.—2 ft. from butt	5 in	80 to 89 ft	0.33	0.42

SCRAP—The prices following are per gross ton paid to dealers and producers in New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

	New York	Chicago	St. Louis
No. 1 railroad wrought	$10 50	$11 50	$13 50
Stove plate	10 50	12 00	13 50
No. 1 machinery cast	16 50	13 50	16 00
Machine shop turnings	3 00	00	6 50
Cast borings	3 75	5.50	8.50
Railroad malleable cast	9 50	12.50	11 00
Re-rolling rails	11 50	13 00	12 00
Relaying rails	30.00	30.00	27 00

SHIP SPIKES—Current prices per 100 lb.:

In.	San Francisco — Galv.	San Francisco — Black	Seattle Black
½	$9 10	$8 40	$8 55
⅝	8 65	8 55	8 25
¾	8 50	8 50	8 30

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, President

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. Mehren
Editor

Volume 88 — NEW YORK, JANUARY 12, 1922 — Number 2

A Highway Number

APPEARING the week prior to the nineteenth annual convention of the American Road Builders' Association in Chicago, this issue is devoted in large part to articles in the highway field. In planning such an issue the editorial problem, as this journal interprets it, is not the amassing in large volume of contributed and staff articles relating to roadbuilding, but rather the selection of topics which are of outstanding interest to the specialists in this branch of engineering. There can be no doubt, at the present time, that highway engineers are directing more attention to economic and research subjects than to any others. For that reason these topics have been treated rather fully in articles relating to traffic matters, such as Connecticut's thoroughgoing vehicular census and the detour practice in Wisconsin and Maine. From the angle of technical investigation, the status of highway research is summed up and details are given regarding the pioneer work which the State of Illinois is doing. An examination of the issue will indicate, however, that the fields of highway design and construction have not been neglected and a business viewpoint is given by an article on the commercial and technical developments in asphalt paving and bituminous construction. Satisfaction of the desire to know what are the outstanding features of present-day highway practice and thinking, rather than yardage of highway reading matter, has been the special object of this issue.

For a Uniform Contract Form

IN THE NEWS PAGES this week are printed the suggestions of the Engineering Association of Nashville, Tenn., as to certain desirable clauses in a standard construction contract. These suggestions have been forwarded to the American Engineering Council and to the Associated General Contractors as an aid to them in the formulation of the general contract form which is being considered by various bodies following the conference called by Secretary Hoover a few weeks ago. This action by the Nashville engineers can well be followed by other engineering and contracting bodies. It is only by learning the consensus of engineering and contracting opinion throughout the country that the associated societies can produce a satisfactory standard document.

Connecticut's Traffic Study

THERE is nothing new in the taking of a census of vehicular traffic. Past efforts in this field, however, have been confined largely to a mere enumeration of passenger, commercial, and horse-drawn vehicles passing given points in certain periods of time. Some enthusiasm for this kind of a census was shown at first, but an attempt to apply the results in a practical way to the complex problem of rational highway development has demonstrated that the data that secured were insufficient. Connecticut, however, under the direction of Commissioner Bennett, has recently completed a traffic census which is a step far in advance of anything of the sort that has been done in this country and which is made the subject of the leading article of this issue. Enlarging upon the scope of former surveys of traffic, the Connecticut investigations cover not merely an enumeration of vehicles, by types, but also detailed information regarding their weight, origin and destination, length of haul, character of loads, tire equipment and other facts of fundamental importance in guiding the future development of the state's trunk-line system. Pending a completion of the analysis of results, the article on p. 48 is limited to a description of scope of work, methods and total figures on traffic. The significant story will come later. For the present, however, highway engineers will be repaid by a study of the Connecticut methods. They represent a new milestone in traffic research, one of the most important subdivisions of the general field of highway economics.

Getting Under Way Promptly

DELAYS are so characteristic of large public undertakings that there is a refreshing effect about the smoothness and rapidity with which the Delaware River bridge project has been pushed along, to the point where the substructure work could be begun during the past week. The total time since the beginning of the engineering investigations for the undertaking is little more than a year, and it is only seven months since the report on the preliminary studies was rendered. Subsequent to that report, the hotly contested opinions among the public as to best location had to be fought out, and, after the location recommended by the engineers had been agreed upon by all, the tentative structural design had to be restudied, revised and brought into working shape. Thus there was much work to do. None of the items of the work were simple or conventional moreover; the planning of the enormous foundation caissons, for example, could not be hurried through as a routine job. Yet the plans for the substructure were ready for bidding nearly three months ago, and bids were received by the middle of December. Public works directed by commissions do not often move so fast, especially where joint action of two states is involved. The Pennsylvania and New Jersey commissions responsible for the Delaware bridge are entitled to commendation for what they have accomplished.

Thrift Week

FOR SOME YEARS the Y. M. C. A. has been doing a worth while work in promoting thrift. In addition to its continuing activities, it tries once a year to make thrift dramatic. That effort coincides with Benjamin Franklin's birthday. Accordingly Thrift Week begins next week, on Jan. 17, the anniversary of Franklin's birth. Each day has a different emphasis. The first is on thrift itself and the next five on the value of keeping

personal budgets, of life insurance, of owning one's own home, of paying bills promptly and of making a will. The Sunday within the week has the unselfish emphasis, the obligation of sharing with others. Already the results of the association's thrift propaganda have been notable. A long list of accomplishments in almost every part of the country is publishing by the committee in charge of the work. The idea deserves personal application and the personal support of every reader of *Engineering News-Record*. A thrifty America is quite certain to be a sane, a healthy, and surely a prosperous, America.

Slag Concrete For Roads

USE on a large scale of slag as an aggregate for concrete roads is described in this issue. Contractors will observe that slag in this instance was found to be a less workable aggregate than is gravel and crushed stone. It was not so easy to handle out of bins and in chutes. The mixture required to be worked more to finish the slab. Finally a workable mixture had to be determined by juggling the proportions until they gave the required smooth product. When once the methods were adjusted to the material the difficulty of handling it was not substantially greater, but an adjustment was necessary. Old methods were not adequate. This is a condition in slag concrete road construction which contractors have to bear in mind, for slag in some districts offers a distinct advantage in price and availability.

Better-Made Construction Equipment

MANUFACTURERS report the significant fact that they are finding it increasingly possible to put weight and quality into construction equipment with a reasonable expectation of selling the machines. The inference is that contractors are buying equipment on the basis of a continuing business, much as a manufacturer buys tools for his shops, and not on the basis that each job stands alone and must cancel its own equipment investment. There are other signs pointing to the same conclusion. Prominent among them is the development of rental and depreciation schedules by contractors' associations. Contractors individually are paying more attention to the selection, operation and maintenance of equipment by employing plant managers or machinery superintendents. A great advance is yet necessary before contractors are managing their equipment investment in the really efficient manner in which it is managed in almost any factory. But there is progress. Better constructed equipment is one of the signs of this progress. Contractors are learning that steel instead of iron and cut gears instead of cast gears are worth paying for if they propose to continue in contracting longer than the job in hand.

Active Season for Highways

HIGHWAY contractors and manufacturers of road machinery should draw encouragement from the forecast of 1922 highway construction, which was published last week. In 1921 a total of $420,000,000 was spent in construction. It is estimated that the present year's expenditures will be as large and may quite likely be considerably larger. With the same expenditure in 1922 as in 1921, more miles of highway will be constructed because costs have decreased in different localities from 10 to 30 per cent, probably not far short of 25 per cent as an average. It is miles of highway built rather than dollars expended which determines the opportunity for contractors and equipment manufacturers. All signs, therefore, indicate plenty of work for highway contractors and an active market for road machinery during the coming season.

Double Shifts in Road Building

PAVED-ROAD contractors should consider carefully the possibilities of working double shifts. The practice is reported to have been highly successful in the few instances where it has been attempted this year. In one concrete-road operation the normal season's progress with a standard paving mixer and finishing machine outfit was practically doubled. It is quite reasonable to expect such a result. Concrete roads are essentially machine-built structures. Slab fabrication proper is a sequence of machine operations constituting virtually a field factory process. When a factory manager wants to increase production he works two or three shifts of men, using the machines which he has more intensively. Only when this resort fails to meet the demand for production does he consider adding to his equipment. The road contractor has apparently always felt that he must increase his plant when he wanted to hasten production. Logically he should be even more alert than the factory manager to capitalize as rapidly as possible on the machinery which he has. His season of paying production is shorter and he cannot produce ahead and store his product for future demand. His loss through depreciation by obsolescence is more rapid even than that of the manufacturer, since improvements in construction equipment are more rapid and the gain in operating constantly new equipment is greater. In these respects and in others which come easily to mind, double shifts promise a way out of a number of difficulties which beset paved-road contracting.

The Genoa Conference

THE EXPECTED is to come about. Europe, including all of the former belligerents, is to be invited to an economic conference in Genoa in March. Even Russia is included. Though it is expected that the United States will be invited, it is very apparent that the European premiers have concluded that if the United States declines, or merely sends one of its innocuous listeners, they must go ahead and work out their economic salvation with their own resources.

This is indeed good news even though the need for an economic conference has long been realized. There is some regret that the United States has not taken the leadership. She is to a large extent the world's banker. Many of the European nations are indebted to her. She would, therefore, have a tremendous influence in the deliberations.

Against this regret that the United States is not to have a major part must be off-set the satisfaction from knowing that Europe feels that she can with her own resources compromise her economic difficulties. A year ago America was believed to be the only savior. No European statesman can be so dumb as to fail to see that drastic measures alone will avail, and that those drastic measures must be taken immediately. If there can be preliminary accord between England and France, followed by an early acceptance by Germany of a policy of balancing her budget, the other financial inter-relations ought to be possible of satisfactory arrangement.

The case of Russia, however, stands out as the one impossible factor. Yet even Russia is in such dire stress that there is hope that she will be glad to exchange a hopeful practical policy for a bankrupt theoretical one. Looking forward to her entrance into the conference, the Supreme Council of the League of Nations last week laid down at Cannes the conditions of her entrance. Obviously there cannot be trade relations with her nor Russian investments of foreign capital unless property rights are respected and contracts are enforced. These conditions Russia is asked to accept. As a necessary corollary, and as a condition precedent to French dealings with Russia, there is also demanded recognition of the former Imperial Russian debt. Finally, she is asked to agree to abstain from propaganda subversive of the political systems of other countries. The great problem of the moment in international affairs is whether Russia will accept these terms. To other nations they would seem easy. To Russia they are hard, for they require abandonment of the whole basis of the Bolshevist system. Nevertheless, the bankruptcy of Bolshevism is apparent even to the Bolshevist leaders, as is evidenced by their recent capitalistic overtures. There is ground for hope that Russia will sit in at the Genoa Conference.

Despite the natural pessimism regarding the results of international meetings, it would seem impossible for the Genoa Conference to be entirely abortive. Conditions are so bad that even large compromises should be easy of attainment. Certainly the Washington results furnish an excellent example.

Large-Mileage Highway Contracts

WITH millions available for paved road construction and a traveling public demand that this construction shall be rushed, careful consideration is required of the claim being urged that large-mileage contracts will both hasten and cheapen the work. In an inquiry, which has required several months to complete, evidence and opinion on large-mileage contracts have been gathered from some scores of highway engineers and contractors, equipment manufacturers and state executives. The conclusions arrived at will be found in this issue.

That the conclusions given are not categorical and definitive will disappoint the extreme advocates and opponents of large-mileage contracts. It is likewise certain, however, that the majority of engineers and contractors will see in their indefinite and tentative character a true reflection of the conditions imposed on highway development by political, financial and social policies and practices which cannot easily be set aside to make the way clear for a straightforward engineering and business solution.

Few state highway engineers can lay out improved highways as they wish or are free to determine the time and sequence of construction. Law and custom curtail their freedom on all sides and, of the two, custom offers the most binding shackle. Local initiative in highway development has almost the force of a fetish in the popular mind, particularly in the south and west where for years to come the great construction records in paved roads are to be made. Unhampered centralized control of highways, without which large-mileage contracts cannot become a general construction policy, is a doctrine to which the people have yet to be converted in a large part of the United States. Even many of our states, such as Kansas and Texas, lack this control.

With the conditions as related, it is plain that large-mileage contracts have to demonstrate their economy so convincingly that the public can be swung from its allegience to local determination of highway improvement and converted to centralized initiative and control. It is also plain, from the statements in the article referred to, that the first steps in this task have been scarcely initiated. Highway engineers have not yet had the proof that satisfies them that large-mileage contracts offer enough advantages over present practice to warrant any particular effort toward their adoption.

With all that has been said it is obvious to any engineer that the large mileage contract has its place in highway construction. When and where it can be employed to advantage is an engineering question to be answered in each instance by balancing the probable gains and losses.

Highway Detour Practice

HANDLING vehicular traffic through or around construction work—detour practice, as it is commonly known among highway engineers—has developed into one of the major problems of the state highway departments. Until recently the matter was generally regarded as merely an unimportant incident in road construction. This attitude was responsible for such great inconveniences to the traveling public and for such a widespread storm of criticism that a new conception of the relative importance of detours has developed. As indicative of the new attitude attention is invited to two articles in this issue, one representing western practice, by Mr. Hirst of Wisconsin, and the other eastern practice, by Mr. Sargent of Maine.

Service to traffic is today's slogan in highway administration. So vital a part do highways play in our industrial life that the barricading of a route under construction without provision of good detours, or bypasses, can no longer be tolerated. There are two alternatives, the first to send traffic through the work under construction by building the new roadway in halves, and second, to divert it to other routes. Much importance attaches to the making of a correct decision, particularly when it is realized that the routing of the traffic through the contract adds, according to competent estimates, 25 per cent to construction costs. If this procedure is not followed, however, it is clear that with the number of vehicles using our highways today considerable sums must be spent in preparing and maintaining the detour routes. That also involves the expenditure of considerable sums.

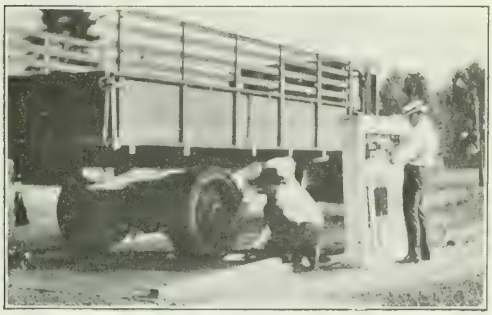
Mr. Sargent has some very pertinent comments on this phase of the subject. His proposed solution of the problem, by employing the money now spent on detours for the widening of existing roads so that traffic may be passed through construction work with a minimum disturbance to such operations, is radical and furnishes abundant proof, if any is now needed, that the subject of detouring demands the same kind of study as other traffic problems.

As was pointed out in an editorial note in this journal some time ago, detouring can be the best or the worst form of advertising in which a state highway department may engage. It establishes a direct point of contact with the public and many of the state departments, as exemplified by Wisconsin's practice, have realized the necessity of marking detours with signs properly placed so as to guide traffic to its destination.

Connecticut Makes Detailed Study of Highway Traffic

Fourteen-Day Census at State Lines Yields Data on the Number, Weight, and Size of Vehicles, Lengths of Haul and Character of Product Shipped by Truck—Airplane Photo to Be Made

TRAFFIC studies involving not merely counts of the number of vehicles, but the collection of data on gross weight, width and condition of tires, character of product shipped, point of origin and destination, and dimensions of trucks have been completed by the Connecticut State Highway Department and, according to plans just announced by Commissioner Charles J. Bennett, are to be supplemented at an early date by airplane photographs designed to indicate the distribution of traffic on some of the state's most intensively traveled trunk-line highways. The field work, undertaken at two traffic-recording stations equipped with platform



WEIGHING TRUCK AND TAKING TIRE WIDTH BY IMPRINT ON PAPER

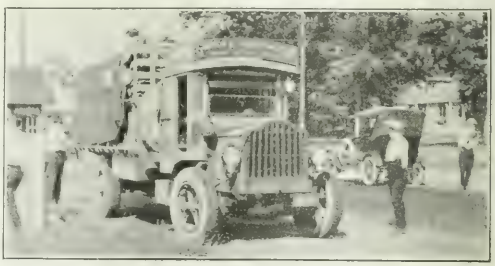
weighing scales located just inside the state boundary lines separating Connecticut from New York on the west and Massachusetts on the north, covered 14-day periods in August and October, 1921, and supplied a mass of data which is now being digested by the U. S. Bureau of Public Roads, with which the Connecticut department is co-operating in its program of traffic investigation.

In point of broadness of scope and completeness of information secured, the studies mark a new epoch in highway transport research. Conclusions, however, must await the detailed analysis of the data. As Commissioner Bennett expresses it, Connecticut at present is in the position of a hen hatching out a nest-full of eggs and is not yet in a position to count its chickens. It is possible, however, to indicate the methods employed in making the traffic studies and the total number of vehicles recorded. In line with this work, but not directly a part of it, observations were made on the use of the highways leading to and from New Haven on the day of the great football classic, the Yale-Princeton game, staged in the Yale Bowl, which is credited with a capacity of 80,000 spectators.

The Connecticut traffic studies are the result of a realization, gained from previous traffic census work in which only the number of vehicles of various types were recorded, that more complete information is needed if the results are to be applied in a practical way to economic highway development. About a year ago the general subject was discussed at a conference of state and federal higway officials out of which developed the drafting of an outline of a highway research program, designed to indicate all of the elements entering into the problem of highway transport and convering the broad subjects of engineering, including the vehicle and the road; transportation economics; administration; and finance. This outline was published in *Engineering News-Record*, Sept. 15, 1921, p. 450. With the approval of Thomas H. MacDonald, chief of the U. S. Bureau of Public Roads, Connecticut undertook to supply some of the information called for in this research program and, accordingly, comprehensive plans were developed for a study of traffic, extending over a period of two weeks, at two widely separated points near the state's boundary lines.

Connecticut, with an area of 5,004 sq.miles and dimensions, measured on lines through Hartford, the state capital, of about 85 miles east and west and 55 miles north and south, is essentially a manufacturing state, and is relatively unimportant from the point of view of agricultural products. Its factories turn out a wide variety of foundry and machine-shop products, especially brass goods, hardware of all sorts, textiles, sewing machines, watches and clocks, nails, fire-arms and ammunition, rubber products, hats, needles, tinware, silverware, and a host of other products, for the most part small, heavy, and expensive.

The state's great industrial activity, coupled with its location midway between two of the greatest Eastern markets, New York City and Boston, creates very especial conditions of highway transport. Hartford, the capital, located about in the center of the state, is only 115 miles distant, by highway, from New York (via New Haven), and 125 miles (via Springfield) from Boston, both of these trips being within the economical operating radius of motor trucks. The result has been



GETTING REAR AXLE TRUCK WEIGHT

the development of an unusually heavy volume of interstate truck traffic. The State Highway Department, therefore, is confronted with the problem not merely of building and maintaining roads to handle motor-truck shipments originating in Connecticut, but also of carrying the traffic which crosses the state in trips between New York, Massachusetts and Rhode Island.

Actual counts have indicated a traffic intensity as high as 8,000 vehicles in 10 hr. on an 18-ft. road. The total length of highways of all types in Connecticut is about 12,000 miles and the State Highway Department



INTERROGATING PASSENGER CAR DRIVERS

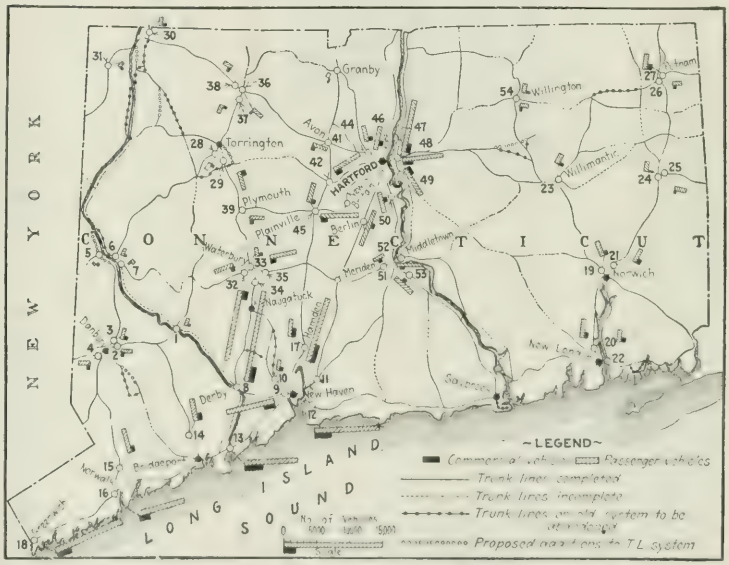
estimates that 90 per cent of all traffic is carried on 900 miles of road, or 7½ per cent of the total mileage. The critical elements in the Connecticut transportation situation, therefore, relate to the relief of traffic congestion by proper distribution, the regulation of motor trucks as regards weight, size and speed, the determination of a scale of license fees adequate to provide for the maintenance of the highways and the planning of new construction or reconstruction, with respect both to location and type of surface, so as best to serve the traffic needs of the future.

As a preliminary to the detailed traffic studies, a three-day count of vehicles at 56 observation posts distributed throughout the state was made, beginning at 12.01 a.m., Saturday, April 30, and continuing until midnight, Monday, May 2, 1921. Table I and the accompanying map show the results of this survey. The greatest volume of traffic was observed at Station 8, at Derby on the route leading to New Haven; for the three days the count showed 14,378 passenger automobiles and 2,445 motor trucks. At Station 18, on the Boston Post Road at Greenwich, 11,482 passenger cars and 2,088 motor trucks passed during the three days. At Station 34, on the Naugatuck Road, between Waterbury and New Haven, third in point of traffic volume, the results were 11,573 passenger cars and 1,123 motor trucks. For a single day the greatest number of passenger automobiles on one road was 6,173 (on a Saturday) and of motor trucks, 1,169 (on a Monday). In general, the results showed a total traffic at all stations for the three days of 203,966 passenger cars and 36,572 motor trucks.

While records such as those secured in the May census, cited above, are useful as an index of traffic conditions, they do not supply the data required, according to Connecticut's highway commissioner, to reach a comprehensive understanding of the relations between traffic and highway development. Numerical counts, by themselves, disclose many vagaries which are unexplainable without additional information. Between two important centers in Connecticut, for instance, there are two roads not more than a mile difference in length and on an equality so far as surface conditions are concerned, one route, apparently, being as desirable as the other. Yet the traffic on the newer road does not amount to one-half of that on the older route. Such cases are not uncommon and they may lead, in Commissioner Bennett's opinion, to the necessity of adopting some form of train-dispatching system to produce a more even distribution of motor-truck and passenger automobile traffic on the state's trunk lines. In the case of trucks regularly operating between certain points day after day it may be necessary for the state highway commissioner or the motor vehicle department to specify routes to be followed. Such means appear to be the only feasible way of relieving present congestion and conserving the highway system.

For making the detailed traffic studies two recording stations were established, one at Greenwich, on the Boston Post Road, near the New York State line and the other at Enfield, on the east bank of the Connecticut River close to the Massachusetts State line and directly south of Springfield, Mass. At each station platform scales were located, the one at Greenwich being of 25 tons capacity and the one at Enfield 10 tons capacity. The 25-ton capacity scales are the type preferred, the lighter 10-ton unit having been only a temporary installation. The heavy scales have a platform about 10 ft. wide and 24 ft. long, and are equipped with a large dial; the operation consists in adding weights, by means of a hand lever device, to the nearest 4,000 lb. after which the scale balances itself automatically. The advantage in having the weights recorded on a large dial lies in the fact that the driver can see the result of the weighing and it is less likely that he will argue about it.

Plans for the traffic census provided for securing the



LOCATION OF RECORDING STATIONS. TRAFFIC CENSUS OF APRIL 30-MAY 2, 1921 (SEE TABLE I)

TABLE I—CONNECTICUT TRAFFIC CENSUS

Taken from 12:01 A.M. Saturday, April 30 to 12:00 Midnight, Monday, May 2, 1921; locations of stations shown on map, p. 49

Station No.	Saturday, April 30		Sunday, May 1		Monday, May 2		Total	
	Passenger	Commercial	Passenger	Commercial	Passenger	Commercial	Passenger	Commercial
1							998	115
2							1,881	291
3							1,729	278
4							1,968	344
5							189	26
6							1,377	186
7							434	89
8	6,173	1,084	4,674	192	3,531	1,169	14,378	2,445
9	3,004	709	2,983	301	2,080	598	8,067	1,608
10	511	102	702	94	458	119	1,671	315
11	2,845	1,074	4,265	416	2,894	1,224	10,005	2,714
12	3,303	1,025	4,012	290	2,929	940	10,244	2,255
13	2,847	967	3,861	590	3,016	1,114	9,724	2,671
14	1,174	321	1,277	171	872	308	3,323	800
15	659	223	1,775	184	1,099	234	3,533	641
16	2,158	600	3,029	273	2,337	598	7,524	1,471
17	801	444	1,127	50	772	468	2,700	962
18	2,007	930	6,610	224	2,865	934	11,482	2,088
19	621	164	1,078	88	688	181	2,387	433
20	944	206	1,078	132	898	246	2,920	584
21	580	136	712	113	517	146	1,809	395
22	265	200	496	79	304	140	1,065	419
23	410	113	707	200	512	79	1,629	592
24	448	20	483	17	393	56	1,324	93
25	622	67	435	36	351	84	1,408	187
26	669	229	636	71	638	412	1,943	712
27	427	160	489	59	441	130	1,357	349
28	320	140	656	20	399	68	1,375	228
29	561	122	1,761	122	624	331	2,946	575
30	419	94	417	48	372	157	1,208	299
31	362	79	364	30	208	62	934	171
32	988	199	1,227	46	896	179	3,111	424
33	796	206	1,265	95	879	262	2,940	563
34	3,541	425	4,645	148	3,387	550	11,573	1,123
35	1,271	354	1,784	102	1,155	207	4,210	663
36	515	50	857	20	423	102	1,795	172
37	357	56	675	26	297	92	1,329	174
38	372	51	607	18	274	71	1,253	140
39	661	127	972	32	559	144	2,192	303
40							251	38
41							2,470	278
42							4,444	590
43							3,020	379
44							2,264	342
45							5,973	632
46							3,444	561
47							8,121	1,302
48							6,570	1,267
49							5,017	1,028
50							3,186	387
51							1,914	282
52							4,021	550
53							3,132	418
54							1,167	107
54							1,004	93
43							6,023	620
*Night census					Total		203,966	36,572

following information on ruled forms carrying the following column headings:

Passenger Cars—Make; license number; roadster (R) or touring car (T); number of cylinders; number of passengers; time; start of haul; end of haul; miles.

Motor Trucks—To economize on the time required to interrogate drivers and weigh trucks two forms are filled in by different men as follows:

Form 1: License number and state; make; time; capacity in tons; loaded (L) or empty (E); estimated time required for trip; name of truck owner; name and address of consignor; name and address of consignee; length of haul in miles; character of load; direction of traffic; regular or irregular trip.

Form 2: License number and state; make; time, total width of body; weight on front axle; weight on rear axle; tires, solid (S), cushion (C), dual (D), or pneumatic (P); width in inches and type of front tire; width in inches and type of rear tire; thickness of tire (channel to road surface); condition of tires.

Motorcycles—License number; single (A), or side car (B); number of passengers; time; location of start of haul; location of end of haul; miles.

Horse-Drawn Vehicles—Passenger (P) or freight (F); number of horses; commodity carried; tonnage; time; location of start of haul; location of end of haul; miles.

In all cases record was made of the date and weather conditions. Sheets of paper, properly ruled into columns, with blank spaces provided for inserting the information called for by the headings, were prepared.

As typical of the methods employed in securing the information on traffic, the methods employed at the Enfield station will be described. The force consisted of seven men, of which three were located at the scales to secure data on the motor trucks and two men on each side of the road to handle the passenger car traffic. One hundred feet on each side of the recording station large painted signs carrying the following legend were erected: "Connecticut State Higway Department. Traffic census for U. S. Bureau of Public Roads."

By means of these signs the traveling public was acquainted with the object of the subsequent stopping of their cars and questioning, and practically no objection was made.

In the first scheme of handling the passenger cars each one of the pair of men on either side of the road handled every other car, the delay due to the questioning averaging about 15 sec. per car. The men quickly became expert in determining the make and type of car at a distance, so that a portion of the information was recorded before the car was actually stopped. This scheme, however, was later modified by having one of the pair of men on each side of the road act as an observer, who called out all of the information relating to passenger cars, to the other, who acted as recorder. This method was ultimately adopted for both northbound and southbound passenger car traffic. With a string of cars in line it took from 8 to 10 sec. to interrogate each passenger car driver by this method.

In handling motor trucks at the Enfield station, only southbound vehicles were weighed, as the scales were located on the west side of the road and it was not considered advisable to send northbound trucks across the road, thereby impeding traffic. One of the three men at the scales acted as a recorder of the information and the other two attended to the weighing and the taking of measurements. Two weighings, one for the front axle load and the other for the rear axle load, were made. The width of the bearing surface of the tires was obtained by running the trucks over sheets of paper and measuring the imprint. The length of time required to weigh each truck and secure the necessary information regarding it varied from 1 to 1½ min. An economy of time was effected by questioning the driver while his truck was being weighed.

While northbound trucks were not weighed at Enfield, the other information called for in the blank forms was procured. In order to prevent delay trucks were sent about 100 ft. beyond the scales and at that point their drivers were queried either by one of the men from the scales or an additional recorder. During periods of unusually heavy passenger traffic, as on Saturday afternoons and Sundays, truck traffic was light and men ordinarily assigned to the scales took notes on passenger traffic. Information regarding motorcycles and horse-drawn vehicles was secured by the force detailed to passenger car traffic. It involved very little work as the traffic of these types was so light as to be almost negligible.

Records of traffic by night were included in a continuous period of census-taking from the morning of Aug. 22 to the evening of Aug. 24, totaling 56 hours. Two men handled the night work. On the night work

TRAFFIC CENSUS AT ENFIELD, NEAR CONNECTICUT—MASSACHUSETTS STATE LINE—AUGUST 16-29, 1921.

Date, 1921	Hours Census was Taken	Passenger Cars			Motor Trucks			Motor Cycles			Horse-Drawn Vehicles			Total Vehicles
		South Bound	North Bound	Total	South Bound	North Bound	Total	South Bound	North Bound	Total	South Bound	North Bound	Total	
Aug. 16	8 a.m.—6 p.m.	774	751	1,525	119	107	226	10	17	27	2	3	5	1,783
Aug. 17	8 a.m.—6 p.m.	755	766	1,521	116	82	198	7	7	14	5	6	11	1,744
Aug. 18	8 a.m.—6 p.m.	699	696	1,395	129	114	243	5	7	12	2	1	3	1,653
Aug. 19	11 a.m.—9 p.m.	932	914	1,846	104	103	207	9	8	17	2	2	4	2,074
Aug. 20	8 a.m.—6 p.m.	1,064	1,030	2,094	83	98	181	18	21	39	4	3	7	2,321
Aug. 21	6 a.m.—4 p.m.	1,755	1,218	2,973	28	27	55	29	9	38	1	1	2	3,068
Aug. 22	8 a.m.—6 p.m.	784	837	1,621	128	80	208	8	8	16	2	1	3	1,848
Aug. 22 and 23	*6 p.m.—6 a.m.	300	308	608	29	36	65	...	...	...	...	...	...	673
Aug. 23	*6 a.m.—4 p.m.	698	591	1,289	118	103	221	5	7	12	2	2	4	1,526
Aug. 23 and 24	4 p.m.—6 a.m.	462	498	960	18	13	31	...	...	...	...	...	...	991
Aug. 24	6 a.m.—4 p.m.	672	658	1,330	74	78	152	8	4	12	3	1	4	1,498
Aug. 25	11 a.m.—9 p.m.	854	822	1,676	81	89	170	8	8	16	...	6	6	1,868
Aug. 26	11 a.m.—9 p.m.	875	924	1,799	84	80	164	5	4	9	2	5	7	1,979
Aug. 27	8 a.m.—6 p.m.	1,092	1,022	2,114	69	75	144	22	9	31	4	3	7	2,296
Aug. 28	9 a.m.—7 p.m.	1,857	1,862	3,719	13	18	31	28	38	66	3	7	10	3,826
Aug. 29	11 a.m.—9 p.m.	784	785	1,569	63	36	99	13	12	25	5	5	10	1,703
		14,357	13,682	28,039	1,256	1,139	2,395	175	159	334	37	46	83	30,851

*Night census.

only those trucks were weighed which carried exceptionally heavy loads.

Speed tests of trucks were taken on two days, Aug. 20 and 22. A concealed observer was stationed on one side of the road with two sighting points on the opposite side, so spaced that the speed in miles per hour was determined by dividing 100 by the observed time of passage, in seconds, between the two points. Truck speeds generally ranged from 15 to 20 miles per hour.

The Connecticut law limits the gross weight of a motor truck to 25,000 lb. and the weight per inch width of tire to 800 lb. The weighing operations disclosed a number of overloads. It is worth noting that the fines collected paid for the cost of the 25-ton scales—about $2,700—within a period of two weeks. The greatest overload was noted on a truck of 2 tons capacity, the unladen weight of which was 5,000 lb., giving a total allowable gross weight of 9,000 lb. The actual gross weight of this truck, as shown by the scales, was 18,040 lb., equivalent to an overload of 9,040 lb., or 225 per cent. A fine of $100 was imposed in this case. Another 5½-ton truck whose unladen weight was 12,000 lb., giving an allowable maximum gross weight of 23,000 lb., was found actually to weigh 31,120 lb., an overload of 8,120 lb., or about 70 per cent. A fine of $200 was imposed in this case. Another 5-ton truck was overloaded 8,920 lb.

At the two traffic-recording stations, during the two 14-day periods, in August and in October, the total vehicles counted numbered 75,155, as shown in the accompanying tables. Of this number, 66,777, or 89.0 per cent, were passenger automobiles; 7,342, or 9.7 per cent, motor trucks; 764, or 1.0 per cent, motorcycles; and 272, or 0.3 per cent, horse-drawn vehicles. During a single day the greatest volume of traffic reported was 5,784 vehicles from 8 a.m. to 6 p.m. Oct. 16 at the Greenwich station; this was a Sunday, on which the passenger cars numbered 5,586 and the motor trucks only 56. On week days at this station it was not unusual to have more than 400 trucks pass between 8 a.m. and 6 p.m.

At the present time it is possible to give merely the number of vehicles recorded at the two stations and their classification as to types. The real story, of course, will be contained in the analysis of tonnages, length of haul, origin and destination of trip, and the other data secured in the detailed census.

It is pointed out, in connection with the October results, at the Connecticut-New York state line, that the period covered is at the tail end of the automobile touring season and that during mid-summer the number of passenger automobiles would have been much larger than that shown in the table. The Boston Post Road at the Greenwich station is of Warrenite construction, with a width of 21 ft., while the road at the Enfield station is of Topeka type, 18 ft. wide.

During the day of the Yale-Princeton football game, Nov. 12, 1921, a traffic census was taken at seven stations on roads leading in and out of New Haven between the hours of 8 a.m. and 8 p.m., during which time 26,016 vehicles were counted. Of this number 24,022 were passenger automobiles and 1,499 were motor trucks. The largest volume of traffic during a single hour was on the Milford Turnpike leading to New York, and amounted to 1,619 vehicles between the hours of 5 and 6 p.m., following the conclusion of the game; of this number 1,601 vehicles were passenger cars (1,569 outbound and 32 inbound) and 15 were motor trucks. The Milford

TRAFFIC CENSUS AT GREENWICH, NEAR CONNECTICUT—NEW YORK STATE LINE—OCTOBER 3-16, 1921

Date, 1921	Period, Hours	Weather	Passenger Cars			Motor Trucks			Motor Cycles			Horse-Drawn Vehicles			Total Vehicles
			East Bound	West Bound	Total	East Bound	West Bound	Total	East Bound	West Bound	Total	East Bound	West Bound	Total	
Oct. 3	8 a.m.—6 p.m.	Rain	1,036	1,176	2,212	220	220	440	2	4	6	3	3	6	2,664
Oct. 4	8 a.m.—6 p.m.	Fair	1,036	1,288	2,324	214	202	416	5	16	21	5	5	11	2,772
Oct. 5	8 a.m.—6 p.m.	Fair	1,120	1,280	2,400	194	217	411	4	7	11	5	14	19	2,841
Oct. 6	8 a.m.—6 p.m.	Fair	1,142	1,288	2,430	178	240	418	5	9	14	12	14	26	2,888
Oct. 7	6 a.m.—4 p.m.	Fair	974	1,060	2,034	184	237	421	5	7	12	9	3	12	2,479
Oct. 8	6 a.m.—4 p.m.	Cloudy and rain	1,190	1,064	2,254	201	183	384	10	7	26	5	6	11	2,675
Oct. 9	6 a.m.—4 p.m.	Fair	2,086	1,694	3,780	43	[illegible]	[illegible]	35	20	55	3	5	8	3,916
Oct. 10	10 a.m.—8 p.m.	Fair	1,120	1,176	2,296	209	[illegible]	424	11	18	29	8	16	24	2,773
Oct. 10	*8 p.m.—8 a.m.	Fair	198	206	404	50	[illegible]	122							526
Oct. 11	*8 a.m.—6 p.m.	Fair	997	1,186	2,183	166	197	363	4	19	23	6	8	14	2,583
Oct. 11	6 p.m.—6 a.m.	Fair	568	262	830	77	28	105	5	2	15	1	2	3	953
Oct. 12	6 a.m.—4 p.m.	Cloudy	1,386	1,194	2,580	98	72	170	12	9	21	2	6	8	2,779
Oct. 13	6 a.m.—4 p.m.	Fair	1,215	1,064	1,736	185	216	401	8	10	18	6	9	15	2,170
Oct. 14	10 a.m.—8 p.m.	Fair	1,199	1,120	2,319	223	207	430	8	11	19	4	9	13	2,781
Oct. 15	9 a.m.—7 p.m.	Fair	1,806	1,624	3,430	157	97	254	10	15	25	4	8	12	3,721
Oct. 16	8 a.m.—6 p.m.	Fair	2,744	2,842	5,586	39	17	56	84	161	245	5	2	7	5,784
			17,274	19,464	38,738	2,438	2,503	4,947	170	266	436	78	111	189	44,304

*Night census.

Turnpike is of concrete type construction and has a width of travel surface of 18 ft. During the 12 hr. period from 8 a.m. to 8 p.m. at this traffic recording station, a total of 8,051 vehicles was recorded. The counts during the 12 hours at the other six stations were: 4,152; 3,310; 2,734; 3,368; 2,763; 1,638. An analysis of the total of 26,016 vehicles during the day showed passenger cars inbound, 11,827; passenger cars outbound, 12,195; total passenger cars, 24,022; motor trucks inbound, 766; motor trucks outbound, 733; total motor trucks, 1,499; motorcycles inbound, 108; motorcycles outbound, 107; total motorcycles, 215; horse-drawn vehicles inbound, 131; horse-drawn vehicles outbond, 149; total horse-drawn vehicles, 280.

The foregoing results of traffic on the day of a big football game, it should be understood, are merely an incident in the Connecticut studies and do not form an essential part of the detailed census, the results of which are now under analysis. As a supplement to the latter work, however, Commissioner Bennett has completed arrangements for the taking of a series of airplane photographs on the road leading from Bridgeport, Conn., to New York by way of Greenwich. This is one of the state's heavily traveled trunk line routes and the object of the aerial photographs will be to show the distribution of traffic and to indicate the points where improvements are needed. A stretch of about 30 miles is to be covered and with the relative speed of the airplane and the fastest moving automobiles estimated at 75 and 30 miles per hour respectively it is believed that much illuminating information can be secured.

Bucket Loader Charges Batch Boxes From Stock Piles

INDUSTRIAL railway haulage was operated with success last year on the Detroit-Chapman road in Dickenson County, Kansas, by stock-piling at frequent intervals and rehandling the material with a bucket loader. This road is 6 miles long with a pavement of 1:2:3½ concrete 18 ft. wide, 8 in. thick at the center and 6 in. thick at the edges.

As the stone was crushed at a small plant having a capacity of only about 100 cu.yd. per day, located 1½ miles from Chapman, it was necessary to delay beginning construction until considerable material had been stock-piled. These stock-piles were made along the highway at intervals of about 2,800 ft. on pieces of land rented for that purpose. The sand was pumped from the river approximately three-quarters of a mile from the road at a point one mile east of Detroit. This also was piled near the stone previous to beginning construction. When sufficient material had been stock-piled to insure continuous operation the paving was started. The hauling was done both by truck and by team, depending on the conditions and the availability of each.

Frequent stock-piling was adopted to reduce the investment to a minimum. It also provided an unlimited storage of material comparatively close to the paver; eliminated the excessive cost of moving from one set-up to another; provided closer supervision because the entire operation was within sight of the superintendent, and eliminated all delays common to longer hauls.

A bucket loader, equipped with a swivel spout, was installed to load the gravel from the stock-piles into batch boxes on industrial cars. The sand was shoveled into the boxes and the cement was dumped in by hand. Each train consisted of four cars or eight batches, and the complete loading time of the train averaged 4½ minutes, or a batch every 34 seconds. A 3½-ton gasoline locomotive hauled the trains to the mixer where the batches were transferred by a boom mounted on the mixer. Only 1,890 ft. of track was necessary as the batches were hauled both ways from the stock-pile. At the loading plant a switch horse was used to handle the cars.

Physical conditions at different locations of the plant made necessary a change in the relative positions of the



PLANT LAYOUT FOR CHARGING BATCH BOXES WITH BUCKET LOADER

stock-piles and the cement platform but it was found very easy to accommodate this system of charging batch boxes to these changes. The equipment consisted of: one 14-E mixer with boom and bucket, mounted on caterpillars; three right-hand and three left-hand switches complete; 1,890 lin. ft. of track; 12 batch-box cars; 24 batch boxes; 2,000 lin. ft. of forms; one finishing machine; one sub-grader; four brakes for batch-box cars; one 3½-ton locomotive; one Barber-Greene loader; one Case road roller, and one 4½ x 5-in. Barnes pump. The total cost of this equipment was somewhat under 25,000.

A crew of 24 men handled all the work at the mixer, as follows: 3 men covering, etc., 1 man edger, 1 machine tamper engineer, 3 men on green concrete, 1 mixer engineer, 2 men on batch transfer, 4 form setters, 3 men light grading and subgrade machinery, 1 roller man, 2 drivers and teams, 1 mechanic, 1 pump man, and 1 foreman.

A total of 18 men handled the work at the material yard, as follows: 1 gasoline locomotive engineer, 1 brakeman, 1 loader operator, 2 loader helpers, 1 man at spout, 6 sand shovelers, 1 sand leveler, 3 cement men, 1 driver and team to build up stock-piles, and 1 switch horse and driver.

With this equipment an average of 768 sq.yd. or 142 cu.yd. was laid per 10-hour day, which means an average of one batch every 2 min. 17 sec. The maximum daily pour was 1,110 sq.yd. in 10 hours or 205 cu.yd., which is a batch every 1 min. 35 sec. On this work a 4-bag batch was used. The superintendent was Mr. J. W. Glidden. The contractors were the List & Hallett Cons. Co., Kansas City, Mo.

Chicago City Drawbridges: Correction

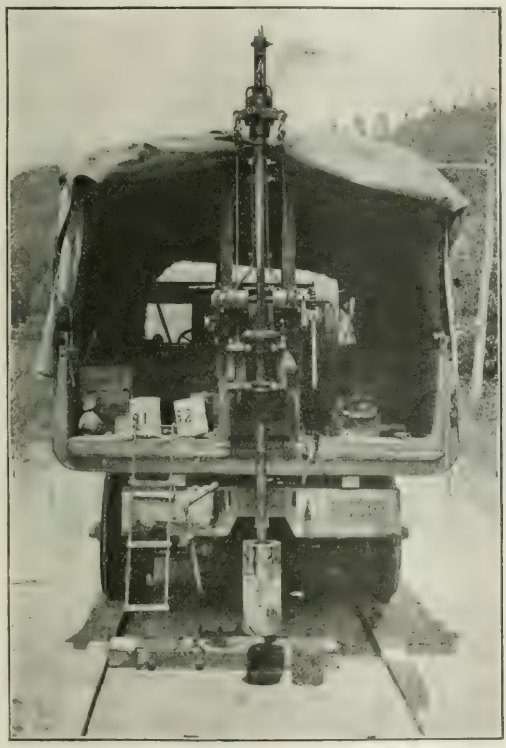
In a note on the highway drawbridges at Chicago, in *Engineering News-Record* of Nov. 17, 1921, p. 817, one was mentioned as being of the Strauss type, but there are two bridges of this type, at Polk St. and Jackson St. The latter was designed for the Sanitary District and not directly for the city. The Strauss patented girder system of trunnion support is represented in a number of other bridges, which however, are of the plain bascule type (counterweight rigidly attached to the moving leaf) and not of the parallelogram counterweight-linkage type (Strauss type).

Mobile Outfit Drills Cores from Concrete Roads

Pennsylvania State Highway Department Uses the Specimen so Obtained for Test Purposes

By D. E. Dunn and R. N. Coolidge
Ingersoll-Rand Co., New York

In obtaining for test purposes cores drilled from concrete pavements the Pennsylvania State Highway Department employees a mobile outfit comprising a 3-ton motor truck carrying the following equipment: (1) A Calyx core-drill (2) apparatus for determining bearing power of soil; (3) molds for concrete repair plugs; (4) bins for cement, sand and stone for repair plugs; (5) accessory tools for the work and repairs.



CORE DRILL ON TRUCK FOR PAVEMENT TESTING

The drill-head is a patented type especially designed for road-testing service, capable of taking cores from 2 to 10 in. in diameter from hard pavements. It is driven by belt from an 8-hp., two-cylinder, four-cycle, gasoline engine mounted in the forward end of the truck box with its own radiator and gasoline tank so as to be independent of the truck for power or supply. The drill is mounted flush with the end of the truck box, as shown in the photograph.

Back of the drill-head is a 130-gal. water tank. A hand force-pump is carried in case of an emergency, so that the tank can be refilled from creeks or rivers. Ordinarily not more than 3 gal. of water are used in drilling a core from an 8-in. pavement.

The drilling tool is a soft steel cylindrical bit with a flat or slightly rounded face rotated approximately 200 r.p.m. on a thin layer of steel shot fed through the bit and lying between the bit and the material to be drilled. Pressure is exerted on the bit as it rotates, breaking the shot into fine, sharp-edged pieces which partially imbed themselves in the face of the soft steel bit and are dragged along by it, thus abrading the material below. A slot is cut in the bit so as continually to work the steel shot to the cutting face and allow them to be crushed between th bit and the pavement. The shot are fed through the inside of the bit and tend to work toward the outside but are caught by the slot and again forced under the bit. This cycle repeats until the shot are ground to a fine powder light enough to be carried to the surface by the water.

Water is fed to the cutting face to cool the bit and wash the cuttings from the hole. As the drilling progresses a cylindrical ring is cut away and the core protrudes up inside the bit. When the hole has been drilled through the pavement, the bit is raised and the core lifted out and marked for future identification when shipped to the laboratory in Harrisburg where it is tested. For work of this sort a majority of states use a 7½-in. bit which takes a core approximately 6¾ in. in diameter.

In starting a hole on the flat road surface a guide board is used for centering and holding the bit in place. After penetrating ½ in. the bit follows the circular groove which it has cut. A ring of wet waste or rags wrapped around the bit and jammed between the board and the pavement has been found by some operators to be efficacious in starting the hole, as the waste holds the shot to the bit. Shot should be fed at frequent intervals and in small quantities. An ounce or two at a time is better than larger feedings at longer intervals. A 7½-in. bit will drill through an 8-in. concrete pavement in from 15 to 25 min. Three pounds of shot, which is inexpensive, is an ample allowance for each hole.

Care should be taken not to use too much water because the bit does its best work in a thin sludge of ground shot and rock, with sufficient water to carry to the surface only the finest rock.

When starting a trip, the core-drill crew is furnished a complete itinerary, with exact locations on the various roads to be drilled. In addition they are directed to drill cores from and take observations at any point where unusual conditions are indicated. They average three to four cores per mile of road, or approximately one every 1,500 ft., plus the extras for unusual conditions.

With a soil drill bit, in place of the concrete drill bit, a 1- or 2-ft. soil core, about 2½ in. in diameter, is removed. After the concrete core has been secured these soil samples are for laboratory study.

While traveling from one location to another concrete repair plugs are cast in special molds. The diameter of these is a little smaller than that of the bored hole. A 4 per cent solution of calcium chloride is used in the mix to accelerate the set. It is only a moment's work to place and grout one of these repair plugs with quick setting cement so that, when the testing outfit moves on to the next place the road is left in good condition.

The drilling outfit, which was developed by the Ingersoll-Rand Co., averages 16 cores per day.

12 Years' Experience with Bituminous Penetration Work on Kansas City Boulevards and Park Roads

A Review of Practice Since 1910 When Oil Binder Was First Tried on Macadam Roads—Asphalt Binder Now Favored—Maintenance Costs Given

By Fred Gableman
Engineer, Board of Park Commissioners, Kansas City, Mo.

SINCE the decision was reached in the spring of 1910 to adopt bituminous penetration methods for new construction and for maintenance and resurfacing of the original waterbound macadam pavements forming the 90-mile park drive and boulevard system of Kansas City, Mo., maintenance and repair costs, for the 12-year period, have averaged 4.385c. per square yard per year. Starting with the experimental application of a light residuum oil in 1906, materials and methods have been constantly studied and improved until the present practice, involving the use of an asphaltic binder by the penetration method, produces results which are believed to compare favorably with the best types of mixed bituminous construction.



REPAIR CREW ON KANSAS CITY BOULEVARD, USING 500-GAL. KETTLE

The standard width for the boulevards originally recommended by George E. Kessler, landscape architect, and adopted by the first Board of Park Commissioners in 1893, was 100 ft. with a central roadway 40 ft. wide, and parking 30 ft. wide on each side. The standard for construction was macadam pavement, 12 in. in depth, a concrete combined curb and gutter, and concrete sidewalk. Results have demonstrated the wisdom of that original plan. The only changes in construction have been the oiled surface and bituminous binder in the wearing surface of the pavement and an increased width of roadways, on account of the immense automobile traffic, of 50 ft. wide in the boulevards recently acquired and on older main arteries 50 and 60 ft. The commission is empowered to regulate the class of traffic on the boulevard system.

In constructing the boulevard a local limestone, somewhat soft for paving purposes, having a French coefficient wear of 6.3 to 8.3 was employed; its use was justified because of its availability. During the first few years, beginning in 1896, a three-course macadam pavement 13 in. thick, with a wearing course of harder material than the native limestone, was used to withstand the wear of steel-tired vehicles and shod horses.

As it was difficult to get shipments of granite or trap rock the specifications were changed in 1901 to use coarse bank gravel for the wearing surface, still retaining limestone for the second course and the base.

In 1900 the construction of the pavement within the parks began. As the traffic on these roadways was less than on the boulevards, they were constructed entirely of native limestone in two-course work, 12 in. thick.

The specifications were changed again in 1904 to use native limestone in the wearing surface course in all pavement construction on the boulevards as well as the park roads. All the roadways paved were given daily maintenance. This consisted of sweeping, making repairs, and daily sprinkling with water.

With the advent of the automobile a new and difficult problem arose in maintenance and in binding the surface of the pavement, for constant wear and raveling made a material increase in the cost of maintenance. In September, 1906, W. H. Dunn, superintendent of parks, began experiments by sprinkling the pavements with a light residuum oil from the Kansas oil fields. The oil cost 77½c. per barrel of 42 gal. on the track. The cost of oiling the roadways for the fiscal year 1907 averaged $0.01055 per sq.yd., which covered labor, screenings and oil. The oil was applied by an ordinary street sprinkling wagon equipped with a tin trough perforated with ¾-in. holes about 1½ in. apart. To make a light dressing and absorb the excess oil limestone screenings were cast over the surface and rolled with a 6-ton roller. Two applications, one in the early summer and one in the early fall, were found sufficient to allay the dust for the entire season.

The oiling operation, continued in 1907 and 1908, produced a direct saving of 48 per cent in the sprink-

ling charge of oil as against water. The oil used was the residuum crude oil obtained from the Kansas oil fields, testing between 19 deg. and 21 deg. Baumé at 60 deg. F., or an average specific gravity of 0.93. This has been the standard grade of oil used in the major portion of all oiling operations to the present time. During the summer this grade of oil has the right consistency to be applied without heating. The first application took about ½ gal. per sq.yd. and cost about 1½ c. per sq.yd., including labor, screenings and oil, with oil costing 80 c. per barrel of 42 gal. on the track. After the first application less oil was required.

This oil, having a paraffin base, left the pavement slippery for a few days. Having only a small asphalt content, there was very little binding quality in it. Experiments were made, using different grades of heavier oil with a larger percentage of asphalt, and also by mixing from 10 to 33½ per cent of asphalt with the residium oil, with the result that the slippery condition was largely eliminated, a better bond of the surface materials was made, and the treatment lasted much longer. These heavier grades and mixtures of oil, however, had to be heated before application.

The successive applications of oil and screenings and the dust gathered in the oiled surface, builds up a mat which, during the summer, is flexible and makes an ideal, smooth surface for travel. But during the winter, the oil gradually evaporating, the mat loses its life and becomes brittle. Towards spring, and especially after snows, when chains have to be used on the cars, the mat becomes broken and ragged. These broken patches leave places for the accumulation of water during the spring, causing a softening of the surface material and a rapid deterioration before it is warm enough to apply new oil. This condition first became noticeable in the spring of 1909 and continued as the mat became thicker. The experience with the oiling operation during the winter and spring months and the experiments with mixtures of oil and asphalt led to the conclusion that a bituminous binder should be used in the wearing surface course in the new construction work, and in repairs and resurfacing work on the old pavements.

Refined Tar Used

In the spring of 1910, the specifications were changed to use refined tar as a binder in the wearing surface. The base course, 7 in. in depth, was constructed of hand-broken stone or crusher-broken stone, as before. The top course, 5 in. in depth, was of crushed limestone from 1¼ to 2½ in. in size, 60 to 75 per cent of which ranged from 2 to 2½ in. To this course, compacted by rolling, a dressing of refined tar was applied at a temperature of not less than 280 deg. F. in sufficient quantity to cover all parts of the pavement and until the tar appeared at the surface, which required not less than 1½ gal. per sq.yd. A covering of limestone grit to absorb the excess of tar and fill all voids was applied and rolled. It was found that some of the tar went into the base course and hence, in later work, an amount of binder rock and grit was rolled into the base course sufficient to fill the voids and thus keep the tar in the top course.

The tar used was Tarvia X. It was applied with a pressure-tank wagon equipped with a hose to distribute the material and a fire box under the tank. After the pavement was used a few days a light dressing of residuum oil was applied, to be absorbed by the dust and screenings left on the surface. This, with successive very light oil and screening dressings, built up a mat and weatherproofed the pavement so that there was no coking or disintegration of the tar in the surface. The first pavement of this construction is still in use, but the life has about gone out of the tar, as evidenced by the disintegration, pitting of the surface and repairs during the past year. The cost of this pavement averaged about $1.35 per sq.yd. by contract, with the stone costing $1.50 on the work, Tarvia 10c. a gallon, labor $2 and teams $4 a day of 8 hours.

Asphaltic Binder Adopted

In seeking a bituminous material with more resilience and lasting quality, that would not become brittle in winter nor bleed during summer, experiments, made with asphaltic cement of such consistency that it could be applied by the penetration method, led to the specification of this material in a contract let in the fall of 1911. This pavement was constructed in three-course work, the base course, 6 in. in depth, constructed as before, a second course, 4 in. in depth, constructed and



PRESSURE DISTRIBUTOR OILING 40-FT. BOULEVARD ROADWAY

water-bound the same as the top course in the water bound macadam pavement, and then a 2-in. bituminous penetration wearing surface course, using Bermudez asphalt as the binder. This top course was constructed of crushed limestone ranging in size from 1 to 2½ in., the surface being left open and porous to permit the penetration of the bituminous binder. An application of not less than 1½ gal. of asphaltic cement was spread by hand, using a fan-shaped, lipped pouring can. By careful application the asphalt was spread uniformly and the quantity gaged closely by this method. The asphalt was heated on the work in 500-gal. kettles equipped with fire boxes and applied at a temperature of from 325 deg. to 350 deg. F. Immediately after the application of asphaltic cement a layer of limestone grit, ranging in size from ¼ to ½ in. was spread to fill the voids, then rolled with a 7-ton roller. The surface was then swept clean of all dust and loose particles of macadam, and a second application of ¾ to 1 gal. of asphaltic cement per sq.yd. was spread, covered with a thin dressing of limestone grit, and rolled. This pavement has received a tremendous amount of mixed traffic

and is still in excellent shape, with scarcely any maintenance outside of the daily sweeping and cleaning.

The specifications for three-course bituminous macadam pavement, using asphaltic cement as a binder, were used until the spring of 1916, when alternate specifications were issued for the bituminous binder material, using either refined tar or asphaltic cement and giving the contractor the privilege of bidding on either one. The construction of the three-course pavement using asphaltic cement remained the same, except that the second course was rolled dry. The construction of the two-course pavement using refined tar remained the same as before, but as the top course, 5 in. in depth, was too thick for thorough penetration and had no seal coat, the specifications were changed in 1917 to make the construction and the amount of bitumen used the same in both pavements. Contracts were let for both classes of pavements at about the same price, and ranged from $1.13 to $1.53 per sq.yd., with asphaltic cement at $20 per ton, Tarvia at 10c. per gallon, stone $1.50 per cu.yd. delivered on the work, labor $2 and teams $4 per day of 8 hours.

Asphaltic Cement Preferred

By close observation and analysis of the two classes of pavements up to the present time, the asphaltic cement is found to give a better result than the refined tar, in that it is more resilient, has more lasting quality, withstands the extreme difference in temperatures between the winter and summer months without becoming so brittle in winter or bleeding so much in summer. During the past year these alternate specifications have been separated and entirely rewritten, the experience and best method of construction by the penetration method to date being embodied. The two specifications are exactly the same as to construction and amount of bitumen, the one specifying asphaltic cement and the other refined tar.

The cost, by contract, of the pavement with asphaltic cement as a binder for the past two years has averaged $2.26 per sq.yd., with asphalt at $30 per ton, stone $2.50 per cu.yd. delivered on the work, labor $4 per day of 8 hours, and $3 per hour for trucks of 4 and 5 tons—trucks being used almost entirely instead of teams.

Different brands of asphaltic cement have been used as a binder in the wearing surface of the pavement, but the major portion has been Texaco 96, which has run very uniform in its tests and given excellent results. The Bermudez asphalt used in the first contract of this class of pavement is a material whose higher price has barred it in competitive contract work.

This asphalt binder material is of such consistency that, under the constant rubber-tired traffic, it absorbs the dust and grit on the surface of the pavement and maintains a dustless pavement without the addition of the oil dressing necessary on the old waterbound pavements. Yet it is firm enough, with the elimination of the heavy trucks from the boulevards, and has bond enough with the native limestone to maintain a splendid pavement, needing scarcely any maintenance, outside of the daily sweeping and cleaning, since it was first used 10 years ago. With the penetration method it is found that the seal coat is necessary to give the surface a thorough bond.

The equipment for applying the asphalt consists of two 500-gal. portable kettles equipped with fire boxes, several fan-shaped, lipped pouring cans, two carts of 1-cu.yd. capacity, and one 7-ton roller, together with a force of 13 men. The two kettles are placed side by side on the pavement just back of the pouring; 1 man fires the kettles and 1 man feeds fresh asphalt into the kettles; 3 men fill the pouring cans and carry them to the man pouring asphalt; 1 skilled man pours the asphalt as the cans are handed him; 2 men load grit into the carts; 1 man tends to the horse and cart, taking it back and forth; 3 men spread the grit; and 1 man operates the rolling. The pouring extends to 75 ft. in front of the kettles on the first coating, when they are moved up to the edge of the pouring and 75 ft. poured in advance again. On the seal coat, one kettle at a time, alternately, is moved to 75 ft. in advance of the pouring and the pouring extended 75 ft. each way. With this outfit, 2,100 sq.yd. on the first application of 1¾ gal. per sq.yd. and 3,200 sq.yd. on the seal coat of ¾ gal. per sq.yd. can be poured per day of 8 hours. A skilled man can spread the asphalt uniformly, which is essential with this class of pavement. This is somewhat of a crude method of application but admirable and economical results have been attained.

Simultaneously with the use of bitumen as a binder in construction work, asphalt began to be used as a binder in repair and resurfacing work, with the result that the old method of water-binding repairs was soon discarded. Various changes have resulted in the following equipment and method of repairs which have been used for the past five years.

Equipment and Methods for Repairs

The equipment for each park district consists of 250 and 500-gal. portable kettles, several pouring cans and fiber hand brooms, wagons and a 7-ton, tandem roller. The patrol outfit on starting out from the district operating yard, takes one wagon loaded with limestone binder rock and grit, one or two barrels of asphalt, and a 250-gal. kettle filled with two barrels of asphalt, hitched onto the rear of the wagon, two pouring cans, a fiber hand broom, and a 7-ton roller. The binder rock is from ¾ to 1½ in. in size and the grit from ¼ to ¾ in. in size. The dust and loose particles are swept out of the ragged or pitted surface of the pavement, which is then filled with binder rock, rolled solid and uniform. Then a coating of hot asphalt is poured over the patch and covered with a dressing of grit sufficient to fill the voids, the grit broomed evenly over the patch and rolled again. The next time the patrol outfit goes over the boulevard, a light dressing of asphalt and screenings is spread over the larger patches and rolled again to give a seal coat and smooth surface for travel.

On more extensive repairs, a 500-gal. kettle and two wagons, one for grit and one for coarser rock, are used. The rock is deposited in piles on the side of the roadway by truck. The roadway is first swept with a rotary street-sweeping broom, the patches then swept out by hand and repairs made as last described.

On sections of boulevards where the surface of the old waterbound pavement has become so ragged and pitted that it needs repairs over a large portion of the pavement, a new bituminous wearing surface is constructed. On short sections this resurfacing is done by the repair crews in the maintenance work. On larger sections, where the old pavement has been in use from 10 to 15 years, the resurfacing is done by contract and the cost taxed against the abutting property.

Resurfacing work began in 1913 with the repair crew,

as an experiment. After the old surface had been removed a 2-in. bituminous macadam wearing surface was constructed in the same manner as for new construction. The seal coat was omitted at first, but it was found necessary the next season to go over this work again with a seal coat to give a smooth surface for travel. The success of these experiments was followed, in 1914, with a contract at 59½c. per sq.yd. to resurface, with a bituminous macadam including the seal coat, a heavily traveled boulevard 1 mile in length. The results have been excellent.

In all recent resurfacing work the old macadam surface is swept, then scarified to break the oil crust and loosen the macadam surface, the oil crust and dirt are raked off and the top course then rolled. This prepares the old surface to give a better bond between the old and new pavement. A 3-in. bituminous wearing surface is then constructed in the same manner as for new construction.

On resurfacing work now under construction, a pressure distributor is being used successfully to apply the asphalt. It has a 1,040-gal. tank mounted on a motor truck chassis and equipped with a fire box to maintain the heat after the asphalt is heated to the required temperature at the plant, and distributes the asphalt under a pressure of 65 lb. This contract was let at $1.37 per sq.yd., which includes the excavation and removal of about 3 in. of the old macadam surface—there being street-car tracks in the center—and the construction of the standard 3-in. bituminous macadam wearing surface.

With the advent of the oil and bituminous surface on the pavement and the rubber-tired vehicle, a flatter crown than originally provided was found advisable to relieve the slippery condition during wet weather. The crown has been changed to 9 in. on the 40-ft. roadways on grades less than 2 per cent, 8 in. on grades of 2 to 4 per cent, and 7 in. on grades of more than 4 per cent. On 50-ft. roadways a crown of 12, 11 and 10 in., and on 60-ft. roadways a crown of 15, 14 and 13 in. has been adopted on the corresponding grades, the parabola still being used for the curvature.

Maintenance Costs

The oiling operation on the old waterbound macadam pavement has been continued each year to keep life in the oil mat and to lay the dust. After the first few applications of oil it takes a very light dressing of oil on each application. This necessitates an equipment by which the amount of oil can be gaged to the fractional part of a gallon. In 1913, the old gravity oil sprinkler was replaced with a pressure distributor made in the Board of Park Commissioners' shops. This pressure oiler consists of a centrifugal pump attached to a steel oil tank mounted on the running gears of the former water sprinklers.

In oiling, only one-half of the roadway is treated at a time, leaving the other one-half open for traffic. The oiling is immediately followed up with a light dressing of limestone grit. The oil if left to penetrate into the surface for about three days before the other one-half of the roadway is oiled.

The average oiling is at the rate of 0.07 gal. per sq.yd. It cost in 1914, $0.004 per sq.yd. for one application or $0.00802 per square yard for the year which included cost of labor, limestone, grit and oil, the oil costing 2¾c. a gallon loaded into oil wagon. In 1920, it cost $0.00525 per square yard, only one application being made, with oil costing 6½c. per gallon. The slight difference in cost per square yard as against the greater difference per gallon for oil is due to the use of less oil.

As the success of the experiments became evident the penetration method was continued and perfected because the Park Department, with the limited funds at hand each year, was not justified in the purchase of the expensive machinery and equipment necessary for mixed bituminous concrete pavement, nor have the contractors under competitive bidding been justified in this purchase for the contract work on the boulevards for the amount of pavement constructed each year. With proper construction and proper consistency of the bituminous material, however, a bituminous penetration pavement has been obtained with the native limestone that is very close, if not the equal to, mixed bituminous concrete.

The success of a pavement is gaged by its original cost, its serviceability, its durability and its cost of maintenance. The following analysis of the cost of maintenance for a period of 20 years is for two boulevards that receive an average amount of travel.

Benton Boulevard through the South Park District, 2.14 miles in length, original cost of construction $1.65 per square yard.

Cleaning	$0.396 per sq.yd.
Sprinkling, oiling since 1906	0.283 per sq.yd.
Repairs	0.411 per sq.yd.
Average total cost of maintenance for the 20 years	$1.090 per sq.yd.

Armour Boulevard in the Westport Park District, 1.25 miles in length, original cost of construction $1.59 per square yard.

Cleaning	$0.407 per sq.yd.
Sprinkling, oiling since 1906	0.283 per sq.yd.
Repairs	0.367 per sq.yd.
Average total cost of maintenance for 20 years	$1.057 per sq.yd.

The figures show that the cost of maintenance on these two boulevards was only a little over 5c. per square yard per year for a 20-year period.

The average cost per square yard of the entire roadway system on the boulevards and parks for the past 12 years has been $0.04385 per square yard per year, distributed as follows:

Cleaning	$0.01401 per sq.yd.
Oiling	0.01320 per sq.yd.
Repairs	0.01664 per sq.yd.
Total cost per year for 12 years	$0.04385 per sq.yd.

Truck Overloads Checked in New Jersey

Twenty-five per cent of the motor trucks weighed on New Jersey's new roadside scales at East Paterson, Newark, Trenton and Camden are found to be overloaded from 1,000 to 19,000 lb. The average overload, according to data from the Motor Vehicle Department, ranges from 3 to 5 tons.

Many trucks are overloaded 6 and 7 tons. In some instances trucks are so overloaded that the springs are pressed down, allowing the load to rest on the axle. the tires being flattened out so that the entire unsprung load is transmitted through the flanges of the wheels to the road.

Many cases have been found where owners have mis-stated the capacity of their trucks in order to secure lower license fees. The weighing at irregular intervals at various points is causing licenses for greater loads to be taken out, thereby increasing the revenue to the State.

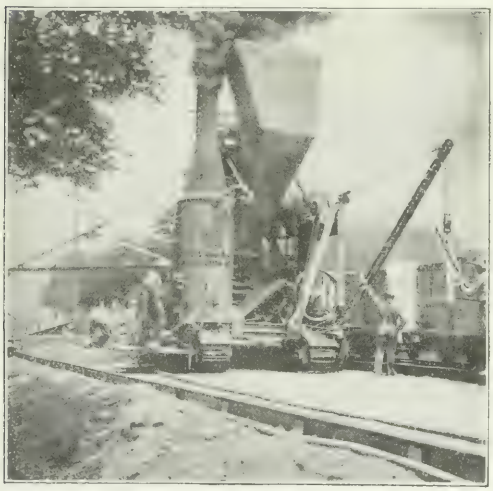
In addition to those mentioned above, scales will be built at Phillipsburg and Jersey City, with capacities of 60 tons. These scales were secured from surplus war materials of the United States Government.

Special Methods in Using Slag in Concrete Roads

Aggregate Proportioning and Handling and Finishing Methods Different for Slag Concrete —Surplus Train Service Profitable

SLAG concrete was successfully used last year on about 18 miles of heavy-section concrete road between Cleveland and Akron, Ohio. This is perhaps the most extensive use of slag in trunk road construction of which there is record. It called for somewhat different methods, particularly in finishing the slab, and for an adjustment by trial of the proportions to obtain the most easily worked mixture. These modifications in methods, an over-equipped haulage system, the development of a subgrade finisher and a steadily good progress, lend interest to a substantially straightforward concrete road building operation.

There is a heavy motor truck traffic between Cleveland and Akron and the new road is intended as a trunk line for this traffic. It is concrete, 18 ft. 4 in. wide, 10 in. thick at the center and 8 in. thick at the edges, with a reinforcement of 32-lb. mesh, 6 in. above the bottom of the slab. There will be 6-ft. shoulders. The ditches



PAVING OUTFIT FOR SLAG CONCRETE ROAD

have slopes of 1 on 1½. Slag for concrete was the choice of the contractor, it being at his option to choose that material subject to specifications. Nominal proportions of 1:1½:3 were specified, but the proportions actually used were more nearly 1:1¾:2¾.

Central proportioning and batch box haulage by industrial railway to a 21-cu.ft. paving mixer and finishing machine, was the general method adopted by the contractor. An average progress of 450 ft. a day, for the season, was made, and on several occasions the day's work was over 700 ft.

A hilly route made the hauling of the dry batches one of the largest problems of the work. There was hardly a level stretch in the 17½ miles of road constructed. The maximum grade was 7 per cent and there were several grades of from 3 to 5 per cent. On the heavy grades train lengths had to be cut down and helper engines used. With 6-ton gasoline engines, an eleven-car train could be handled on grades up to 3 per cent and then the train had to be cut to eight cars. For grades exceeding 3½ per cent a helper engine was required to handle an eight-car train. Without help, a 6-ton gasoline, generally speaking, was limited to a 3 per cent grade with an eight-car train.

There was a rather mixed equipment of cars—many makes with all sorts of journals—but all cars showed excessive axle breakage charged to crystallization. With the many different cars, the trains were also hard to pull. Nine locomotives, three 8-ton steam, one 8-ton gasoline and five 6-ton gasoline, were employed. The 8-ton gasoline was purchased so late in the season that it is hardly correct to count it in the regular outfit and also one of the steam locomotives was so decrepit that it counted for only about half a locomotive. With seven and a fraction locomotives capable of full service and a maximum haul of seven miles, the industrial railway was unusually high powered. Generally about two locomotives were stationed on hills as helpers which left five to haul trains, an unusual number for serving one paver and one finisher. They, however, kept the paver going which, with eleven miles of road to build with one outfit in one season, was the big object.

Track Maintenance

As the eight-ton steam locomotives were more destructive to track than the gasoline locomotives, track maintenance was cut down by hauling half way out with them and then picking up the trains with the 6-ton gasoline engines. An eight-ton steam dinkey, it was found, was a destructive load under such track conditions as the shoulder of a clay road grade made possible. The track used was 24-in. gage with 28-lb. rail spiked to wood ties, which is much heavier construction than is usual. Incidentally the wood ties were found to give a far more sturdy track structure than steel ties. About 6 x 6 in. in section, the wood ties were stronger as girders than steel and when not uniformly supported, carried the rails without bending and thus pinching together the gage. Built in 15-ft. sections, about 80 sections, or 1,200 ft., of track could be shifted daily with six men, but eight men gave better results, as a 15-ft. wood-tie section was rather heavy for six men.

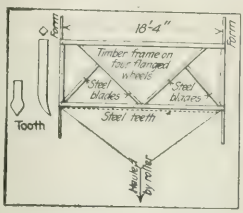
Simple proportioning plant arrangements were possible with the over equipped haulage outfit. Two double-bin charging outfits proportioned all the batches. Kept filled with slag and sand from stock piles, the bins discharged together through measuring chutes into a hopper, thus giving the materials a preliminary mix, which was emptied by gate into the batch box. With plenty of cars this simple outfit met the requirements. Cement was charged by hand emptying the bags through traps in a platform under which the train passed. With trains to spare, rapid charging to reduce terminal delays was not important and the proportioning plant was reduced to its simplest elements.

Experience in unloading and charging the slag aggregate disclosed (1) that it was much more easily handled with a clamshell than stone or gravel and (2) that its movement when being gated out of bins and run through chutes was much more sluggish than stone or gravel. Arching in the bins was more common with slag. In proportioning plant operations,

therefore, experience advises bin construction which reduces the opportunities for arching; good size discharge openings with gates which open quickly and cleanly, and wide, open chutes.

A standard 21 cu.ft. paving mixer and a finishing machine, with supplementary hand finishing tools, put down the paving slab. A one-minute mix was required but the consistency was left almost to the discretion of the contractor who however had to keep to a fairly dry concrete because of the grades. He also had to place the concrete in two layers to provide for the reinforcing mesh 6 in. above the bottom.

Ordinary procedure was followed in batch box charging and in mixing and placing. To place the concrete in two layers the finishing machine was equipped with two strike boards, the extra one designed to drop down inside the forms and smooth the bottom 6-in. layer to receive the reinforcement, which, incidentally, was ordered and shipped in flat sheets cut to slab width. Sheets instead of rolls were preferred, as precut sheets eliminated straightening and cutting in the field and were generally more smooth and better fitting than field prepared sheets. With the reinforcement down, the top layer of concrete was placed and shaped by the regulation crowned strikeboard of the finishing machine.



NEW FORM OF SUBGRADE FINISHING MACHINE

Succeeding operations of slab construction were modified by the slag ingredient of the concrete. Slag is light, with always a tendency to float, particularly in a wet mixture, and machine tamping brought it to the surface so that machine belting would not produce a smooth surface. In fact the action of the belt seemed rather to aggravate the roughness by "dragging" the surface fragments of slag. To meet the conditions the belt was removed from the machine which then only struck off and tamped the slab. The hand finishing process worked out was to "belt" the slab with a flexible board and then finish with a float.

With the slag brought well to the surface by the tamping it was found that a finishing operation which would press the slag down and hold it until it stayed down, due to the mortar overflowing, was essential. A 12 x ½ in. board laid flat across the slab like a belt was the device adopted to do the work required. By shuttling the board crosswise of the slab and gradually advancing it 12 in. and then letting it stand a minute or so the slag was pressed down and held until it locked. The finishing of the green concrete, was, then, a series of zig-zag advances of the board with alternating periods of rest. When the concrete had dried out it was hand floated with a long handle steel float. Curing was affected by covering the slab with canvas tents on wheels, five or six coupled tents being pulled by the finishing machine, and then sprinkling the surface after the tents had been hauled ahead.

Slag concrete not only required the special finishing methods described, but its proportions had to be worked out by trial to get a mixture reasonably easy to work at all. The nominal proportions were 1:1½:3 but this gave too harsh a mixture to be finished well or even to mix smoothly. As the result of trial 1:1½:2¾ mixture was adopted. There was no difficulty with this mixture following the methods described.

With a clay soil, very hard when dry, it was found that finishing the subgrade required a more positive acting and stronger tool than the regulation subgrader. A machine of the general form illustrated was developed and met the conditions. The frame rides on four flanged wheels from which it can be lowered so that teeth and blades engage the soil or raised to clear the ground. The innovation from standard subgraders is the row of spoon-shaped teeth which loosen the packed earth.

The contractors for the work described were the Bates & Rogers Construction Co., Chicago, Ill., and it was built under the direction of the Ohio Department of Highways, E. E. Blosser, state highway engineer.

Culvert Pipe Load Investigations

EXPERIMENTS on the weight transmitted to culvert pipe under various depths of fill indicate that the load may be greater or less than the prism immediately above the pipe, depending on the manner in which the pipe is laid. If the pipe is laid in the ground the load may be as much as 1¾ times the weight of the prism. If it is laid in a trench in material well compacted the transmitted load may be even less than the prism. In general these are the findings deduced from uncompleted experiments recently reported to the members of the Joint Concrete Culvert Pipe Committee by Dean Anson Marston, Iowa State College. Work along this line has been carried on since 1915 but was interrupted during the war.

The experiments were made with a 20-ft. length of 42-in. pipe divided into 2 ft. sections each of which rested on an independent weighing device. A 20-ft. embankment was gradually built up with a sandy loam soil, weighing 96 lb. per cu.ft., readings being taken at frequent intervals of height at each of which a truck of 10-ton total load was passed over each 2-ft. section. Similarly, the loads were measured when the embankment was removed. The 20-ft. fill was left on during the winter for observation during various conditions of temperature and rainfall.

Under the above conditions the following formula for the load on pipes seems to have been established:

$$W = KwD_oH$$

in which

W = actual pressure on culvert, in lb. per lin.ft.
K = a constant (for the 1919-20 tests, $K = 1.75$ approximately).
w = weight of embankment material, in lb. per cu.ft.
D_o = outside diameter of pipe culvert, in feet.
H = height of embankment above top of culvert pipe, in feet.

The safe maximum loads imposed on pipe culverts by sandy loam top soil would probably be $W = 200\ D_oH$, which indicates a straight-line law. It is not certain that the constant K is the same for all diameters and it may be materially affected by the height which the culvert projects above the surface of firm ground adjacent and by the comparative rigidity of the foundation and surface adjacent to the culvert.

Concentrated load effects are small, according to the 1920 tests, when the surface of the embankment was more than 4 ft. above the top of the pipe. For heights less than 2 ft. the full weight is transmitted

The strength of pipes as determined by different methods of bedding are as follows: (See *Bulletins* 47 and 57, Iowa State Engineering Experiment Station.)

(1) "Impermissible pipe laying," where the pipe rests on the flat bottom of a trench without special bedding fit, causes a reduction of at least 20 per cent below ordinary supporting strength. (2) "Ordinary pipe laying," where the bottom is rounded for 60 to 90 deg. of the lower circumference, the ordinary supporting strength is about equal to that developed in the laboratory by the use of "standard sand bearings" as prescribed by the standard specifications. This construction should carry 8 ft. of embankment and all ordinary concentrated loads on highways. (3) "First class pipe laying," where the under side of the pipe is thoroughly bedded for at least half of the circumference, the supporting strength is 20 per cent greater than in (2) above. (4) "Concrete beddings" of considerable thickness under the pipe,, reaching to one-third its height increases the strength 80 per cent above the ordinary bedding. (5) For superior strengths the pipe may be used as an interior form for the surrounding concrete, the strength depending on the design. Detailed results of the various tests will be given in a forthcoming *Bulletin* of the Iowa Engineering Experiment Station.

Car Operation Waste Eliminated by Use of Containers

LOSS of mail by theft, less expense in mail handling, quicker transfer at important gateway points, and increase in load per car, are some of the advantages to be gained in the use of container cars, pointed out by Walter C. Sanders, of the equipment engineering department of the New York Central lines, before the members of the American Society of Mechanical Engineers at their annual meeting held recently in New York City.

Mr. Sanders reviewed the work that the New York Central has already done in the matter of transportation of mails and freight with the use of container cars, and outlined what is being attempted in the construction of even larger cars than are now in use. Reference to construction and operation of container cars may be found in *Engineering News-Record,* March 31, 1921, p. 557.

A summary of the advantages of the container car system of transportation, both for mail and for merchandise, Mr. Sanders gave as follows:

It will furnish a means of expediting delivery of less-than-carload lots of commodities by eliminating the time and expense of rehandling, checking and trucking.

It will eliminate costly crating and packing:

The immediate loading and unloading of containers at terminal points eliminates the item of demurrage, at the same time promptly releasing rolling stock, clearing the yards of cars and reducing congestion.

It will eliminate the piece-meal loading of cars at railway sidings in exposure to all sorts of weather.

It will tend to keep the car moving at all times, making possible double the mileage as made now by the ordinary type of rolling stock;

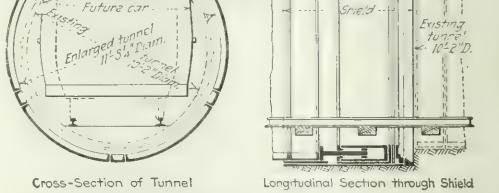
Containers are fire and weather-proof and also burglar-proof in that they cannot be opened while on the car or while being transferred by handling device to and from car.

The New York Central is now having constructed three new mail-type container cars that will carry eight containers of a new and improved design, the outside measurements being: Length, 7 ft. 2½ in.; width, 9 ft. 3½ in.; clear height, 8 ft. 2 in.; with a 5-ft. 9-in. x 3-ft. 6-in. door on the length side of the container The cubic capacity will be 438 ft., light weight, 3,000 lb., and capacity, 7,000 lb.

Tests conducted on the New York Central during the past few months show that the express type of container car can be emptied of its nine containers by an ordinary crane in 21 minutes, reloaded with other containers and put back in operation in about the same amount of time. The tests were made with an ordinary moving track crane, since no special devices have as yet been constructed for use in handling containers.

Will Enlarge London Tunnel by Shield Method Under Traffic

ENLARGEMENT of the City & South London Ry. rapid-transit tunnel in London to take larger rolling stock and permit of exchange of traffic with other rapid-transit railways is likely to be started soon under a plan of procedure developed by Mott & Hay, engineers. The method to be used, which is of exceptional interest, has been tried out during the past summer on a length of about 200 yds. near Stockwell Station and proved successful. The City & South London tunnel is the oldest of the London deep rapid-transit lines, having been built between 1886 and 1890 by J. H. Greathead. Its diameter is only 10 ft. 2 in. inside of the cast-iron lining, and in consequence the cars are very small and the clearances close. The diameter is to be increased by 18¾ in., utilizing the segments of the existing lining supplemented by short intermediate segments to make



Cross-Section of Tunnel — Longitudinal Section through Shield

ENLARGEMENT OF C. & S. L. TUNNEL
Broken line, present section; full line, enlarged section.

up the increased circumference. This rearrangement of segments is shown in the cross-section herewith. The change is to be made under protection of a tunneling shield as indicated by longitudinal section. The shield will permit the present trains of the line to pass through it, and the track is to be carried through old tunnel, shield, and new tunnel uninterruptedly. Actual work in advancing the shield, excavating the ground, and placing the lining of the enlarged tunnel can, of course, proceed only when trains are not running, which means during the early morning hours. Conditions normally will give about four hours working time per day, in which time two rings, or a 40-in. length of the tunnel, should be reconstructed. When completed, the improvement is expected to double the carrying capacity of the line by permitting traffic interchange and the use of larger rolling stock.

What 1921 Developed in Paved Road Design

Heavier and More Reinforcement in Concrete Slabs—Macadam Roads Widened by Concrete Borders—Split Slabs Used in the Wider Concrete Roads

THE specific developments in concrete road construction in 1921 were: Increased resort to reinforcement; extension of the service of macadam roads by border strips of concrete, and the design of pavement slabs with longitudinal joints or planes of weakness. In general, the scientific design of paved roads was brought closer to realization by Federal and State investigations of impact loads and of subgrade action. With the close of the year highway engineers could undertake to design pavements with some knowledge of load stresses and of the support rendered by subgrades.

An increased tendency to place a sturdy steel structure within the concrete slab was evidenced, in states where concrete roads are universally reinforced, by increasing the weight of the reinforcement and by developing systems of bar reinforcement or by using bars locally to strengthen light mesh reinforcement. In states where plain concrete road construction is the practice, steel has been introduced to resist displacement by shearing action or for bonding purposes, where cracks develop or longitudinal joints are introduced.

Trend in Reinforcement Use

An increase of the weight of the steel was observable in all states where reinforcing is general. Pennsylvania nowhere used less than 0.56 lb. per square foot of steel fabric with ¾-in. bars across the slab on both sides of joints. In New York some 0.3-lb. mesh was employed, but commonly in such cases L-bars were added at the four corners of the 33-ft. slabs, and, for the later designs of the year, full bar reinforcement, weighing 0.6 lb. per foot, was adopted. With heavier reinforcement, bar systems are made possible as well as steel fabric, and competition in price is extended.

Toward the close of the year, the talk of the department engineers in both New York and Pennsylvania, ran in favor of still heavier steel. No one had, however, screwed up courage to go the limit and ask for the 11 lb. per square foot needed if a truly reinforced pavement for truck traffic is to be expected. In other eastern states no greater tendency to add weight to the steel has been exhibited and western states generally have not passed the chicken fence stage of reinforcement.

To highway engineers who have large mileages of macadam, either waterbound or bituminous, the widening of the road by border strips of concrete is in many respects the most interesting development of the year. Practice in Maryland best exemplifies the idea. Here 3-ft. strips of concrete were added to the sides of the old macadam. Widening was the primary object of these strips, but they serve the supplementary purpose of curbs. These curbs, it was found, reduced raveling of the macadam at the edges and added to the service of the pavement

In New York State, in place of the narrow strips used in Maryland, single-track pavements eight and nine feet wide, are employed relegating the macadam part to the subordinate service of giving passing room for vehicles. This is more nearly a macadam reconstruction practice than a macadam widening practice, as in Maryland. The underlying purpose in both practices is to prolong the service of old macadam road. The one, as far as a short experience discloses, giving this longer life.

Technically, the most interesting development of the year is undoubtedly pavement constructed as two slabs, edge to edge. In some designs a constructed joint seperates the slabs; in other designs the separation is marked only by the construction joint formed by building one slab before the other, and in still other designs there is no physical separation, but a plane of weakness induced by a groove in the slab top and no reinforcement across, or in, a center zone under this groove. In the last design as in the first, the slabs are absolutely separate in structure.

Besides the joint type differences enumerated, there are differences in practice in constructing joints of the same type. In Illinois a corrugated iron plate forms the separating element and short dowel bars span the joint and in Massachusetts the joint is the ordinary bituminous fabric construction. New York has used a plain construction joint formed by building one slab against the other or else the plane of weakness formed by grooving the slab top along the center line and omitting reinforcement across the center. At the close of the year practice in New York appeared to be somewhat settled on establishing a monolithic slab, with a plane of weakness, as the standard construction.

It is the growing opinion of those who have had experience with the divided slab structure that it meets better the cracking hazard from warping of the slab and from subgrade changes. It is held to be an advantage also in construction and in handling and locating reinforcement, if the two slabs are constructed separately. With only half of the road occupied by construction operations traffic is only slightly interfered with and detouring, ordinarily, ceases to be a problem.

Other Innovations

Besides the outstanding developments described two or three isolated innovations in concrete road design attract attention. Possibly the most notable of these is the Wyoming experiment in precast slab road using slabs about 9 x 10 ft. The results are said by the state highway department to have been satisfactory both in construction and in service and some 16 miles more of precast slab road are planned for 1922. In Arizona, also a far-western state, about 150 miles of concrete road have been built with edges 3 in. thicker than the center. Also it should not be overlooked that the Bureau of Public Roads has built as an experiment a slab and girder road and is studying the possibilities of this type with much hope that it will prove practicable.

No striking developments of the design of other than concrete roads were recorded in 1921. There was shown a disposition to increase present standard widths and to thicken gravel surfaces. Where penetration macadam was constructed there was evident a pronounced disposition to thicken the base. Other changes were minor.

High above all the things that have been mentioned, in its promise that thought in paved road design may be kept virile, stands the research work of the Bureau of Public Roads and of leading state highway departments. This is the truly creative accomplishment in highway designing in 1921

The Status of Highway Research

Major Developments in the Field of Investigation Cited—Census of Research Planned

By W. K. Hatt
Director, Advisory Board on Highway Research, National Research Council, Washington, D. C.

IT IS ONLY through scientific research that the operations of Federal, state and county road officials, charged with the responsibility for the wise expenditure of vast public funds, can be adjusted in some reasonable measure to their responsibilities. The information must be gathered together in a systematic and disinterested way so that money spent on highway construction that is neither too cheap nor too expensive may represent capital wisely invested rather than capital consumed. These roads should be suitable to the physics of the situation, furnish economical transport and be adjusted to the present and future resources of the community.

The Advisory Board on Highway Research of the National Research Council is engaged in organizing committees to cover the various fields, including economics, operation, design of road, design of vehicle and construction. The object of the advisory board is to prepare a comprehensive program of highway research, to stimulate and support research therein, and to co-ordinate the efforts of the workers. The need is great and the economies in sight run high.

The advisory board has already established three main committees for the assemblage and study of research data. Committee 1, under Prof. T. R. Agg, of Iowa State College, covers Economics of Highway Improvements. Committee 2, on Design of Highways, under A. T. Goldbeck, of the U. S. Bureau of Public Roads, covers Mechanics of Road Design. Committee 3, under H. S. Mattimore, testing engineer, Pennsylvania State Highway Department, covers Character and Use of Road Materials. Other committees are in process of formation.

Plans are under way to begin immediately a census of highway research work, now complete or current, and to establish a highway research information service by which the results of research may be made immediately available to those officials who are constantly making decisions involving the expenditure of large sums of money.

Activities in Highway Research

At this early stage of highway research considerable boldness is required to describe the indications of researches or to determine those that are most important. At the suggestion of *Engineering News-Record*, however, the writer will do his best to summarize the present condition of the several departments of research, as presented in a chart published in this journal, Sept. 15, 1921, p. 450.

Relation of Highway to Other Transport—Freight is finding its way through new channels. Are they economical channels? Of the total freight between Bakersfield and Los Angeles, California, 63 per cent is carried over the well-known Ridge Highway rather than by the Southern Pacific Railway. Are these truck lines really profitable? The abandonment by the Boston & Maine R.R. of two branch lines in New Hampshire because of highway traffic is an indication of the growing use of the automobile for short hauls. It is, therefore, of increasing importance that the data underlying the economic disposition of traffic among the various agencies of transportation be obtained by trained research workers. Only in this way can an overhead view be obtained of the relation of highway transport to other existing agencies. The wealth of the nation which is now available for transport is limited and an over-extension of highway transport may not only starve other agencies but may wipe out existing assets. The U. S. Chamber of Commerce estimates that the investment in highway transport is equal to that in railway transport, both computed outside the boundaries of cities.

Economics—There is an important service to be rendered by the highway engineer in so locating his road that the cost of operation will be reduced, these costs including fixed charges, depreciation, operating costs, including maintenance of the vehicle as well as the road. It is hoped that within the course of a year the cost of operation of vehicles, as determined by location of highways, will be fairly well determined. Prof. Agg has accumulated a large amount of data in connection with the work of the experiment station of Iowa State College, and he is also directing work in New England in which Harvard Unversity, Yale University, Massachusetts Institute of Technology, the U. S. Bureau of Public Roads, U. S. Army, Society of Automotive Engineers and the highway commissions of Massachusetts and Connecticut are co-operating.

Traffic Studies

There is a live interest in traffic studies which have been planned in a large number of states. Something more than the count of vehicles is necessary. The proportion of truck traffic and the weight of the vehicles should be known in order that some estimate may be made of the proportion of the maintenance costs chargeable to truck traffic. It has been estimated that $12 are spent on the vehicle each year where $1 is spent on the road.

One of the most complete traffic studies is that now under way in the state of Connecticut (see p. 48 of this issue) in which not only the mechanical features of the traffic but the commodity value, the origin and destination are recorded.

One of the most complete studies of the laws of development of traffic is now about complete under the direction of Dean A. N. Johnson of the University of Maryland. Drafts have been drawn showing the development of traffic during four years from 150 stations on the highway system of Maryland.

J. H. Mullen, state highway engineer of Minnesota, estimates that one-third of the traffic on the main lines is regular business traffic which may be expected to appear on these lines and that the excess will be dispersed on other main lines when the latter are built. He shows that in Minnesota the proportion in truck traffic is increasing three to four times as fast as the increase in proporton to automobile traffic. He estimates that on a gravel road 20 trucks a day are as destructive as 300 automobiles.

In Rhode Island during six years the automobile traffic has increased 102 per cent whereas the truck traffic has increased 650 per cent.

The most important sources of information on traffic are the states of Connecticut under Commissioner Charles J. Bennett, the state of Maryland under the direcion of Dean A. N. Johnson, the state of Iowa under Prof. T. R. Agg, the state of Minnesota under J. H. Mullen,

state highway engineer, and the information gathered during the recent studies of highways in California by the U. S. Bureau of Public Roads.

The state highway departments take on very largely the aspect of traffic departments in our industrial centers. A striking suggestion by Mr. Mullen, of Minnesota, is that the speed on heavy passenger lines be limited to 40 miles per hour at the maximum and 25 miles per hour as a minimum between the hours of 8 a.m. and 8 p.m. This will force the truck traffic to the use of the roads in the night time.

The art of signaling highways needs study, and the recent paper by A. R. Hirst, state highway engineer of Wisconsin, indicates the growing importance of this portion of the operating field.

Maintenance costs, one of the most important elements entering into the economics of highway construction, have in the past not been properly allocated. A great deal of experimentation and research is needed to fix upon the correct theory of maintenance of the various classes of roads. An interesting experiment in the maintenance of a gravel road under the direction of A. R. Hirst of Wisconsin shows the possibility of useful research in this line.

The Michigan State Highway Department has under way an experiment to determine the efficiency of various dust preventatives.

Subsoil Research

A large volume of research is directed to the study of sub-soils, particularly that element of the soil which determines its properties and to the treatment of subsoils by drainage and the admixture of chemical additions. The most important agencies in this field are the Bureau of Public Roads, the Sub-soil Committee under the chairmanship of General T. C. Dupont, organized first as a committee of the now inactive Federal Highway Council, the work by Prof. Eno of the Ohio State University, by Clifford Older of the Illinois State Highway Department, and by the University of California. These researches include the mechanical and ultimate analysis of soils, instruments for determining bearing power and study of water movement and consequent volume changes. In California the soil is improved by mixing in coarse aggregate. In some states a layer of tarred paper is placed on the sub-soil to prevent the entrance and egress of water which it is thought results in harmful volume changes of the concrete slab. When the studies under way are complete we should have within the year a fairly satisfactory account of the action of sub-soils, the means of testing them and the implication which the data carry into the field of design. It is Mr. Older's observation that in the case of the soils of Illinois there is practically no supporting power under expected conditions, and that therefore the concrete slab must be designed as an overhanging cantilever with the load at the corner of the slab. The Bureau of Public Roads has treated some sub-soils by the admixture of additional materials such as portland cement which apparently renders a plastic clay granular in its nature and destroys the plasticity. Experiments are under way by the California state commission on various methods of treating adobe sub-soils.

The width of surfacing is closely related to the findings of traffic studies and the habits of drivers in effecting safety. Multiples of ten feet are advocated by some. The Committee on Standards of the American Association of State Highway Officials will be the source of authority upon questions of this kind.

As concerns the design of stiff slabs under a specified loading we have an interesting field of scientific experimentation on a large scale. Some of the experimental roads may be listed as follows:

(1) Bates experimental road, 2 miles long, built by the Illinois Highway Commission under the direction of Clifford Older, contains brick surface on concrete slabs of various mixtures and differently reinforced. All of this is described in the *Engineering News-Record* of Aug. 18, 1921, p. 274. Complete scientific observations on sub-grade conditions and volume changes in slabs are supposed to be applied in the spring of 1922, accompanying laboratory tests of the ability of plain concrete to withstand repeated stresses.

(2) Test road, 1,500 ft. long, oval in shape, built by the Columbia Steel Co. at Pittsburg, Cal., under the engineering direction of Messrs. Leonard and Aldrich of San Francisco, and with the co-operation of the Bureau of Public Roads and the California Highway Commission. (See *Engineering News-Record*, Dec. 29, 1921, p. 1048.

(3) Reinforced-concrete precast slab road built in 1920 at Caspar, Wyo., 2,400 ft. long, in desert. Units are 8 ft. long, 9 ft. wide and 6 in. thick.

(4) Experimental concrete highway 2 miles long under construction in Alexandria County, Virginia, under the direction of the U. S. Bureau of Public Roads. Sections of varying thickness and shape, with varying reinforcement. Preliminary scientific measurements. Normal farm traffic.

(5) Experimental road, circular track, concrete base and bituminous top, built by the U. S. Bureau of Public Roads at the Experimental Farm, Virginia. Various combinations of bituminous tops are to be tested under the action of a truck which is guided automatically.

There are several roads built containing variations in aggregate or reinforcing as part of state systems, the data and desecription of which are not now available.

We have also the remarkable impact investigations conducted by the Bureau of Public Roads under Mr. Goldbeck, at the Experimental Farm across the river from Washington. These researches have been reported quite completely in the technical press and need not be described.

Slab Reinforcement

The last word has not yet been said on the policy of reinforcing concrete roads. One theory demands a thick, heavy slab massive enough to withstand such loads as are found in the state of Washington, viz. 20 tons of logs. Another theory proposes a thin flexible slab which will deform under a load or under the action of frost and be brought back to its primitive shape by the working of the reinforcing steel. No doubt the adjustment in this respect would be determined by the conditions of supply of materials and by a comparison of the maintenance costs of heavy concrete roads and thinner reinforced roads. Those who are designing experimental roads should have this element of research in mind. The amount of reinforcing generally used is only sufficient to hold together the broken sections of the concrete slab. Research is needed to determine the amount of reinforcing which will be really effective under the different regional conditions of this country.

Restrictive legislation on truck load may result in a

redesign of vehicles with new tire equipment or new relations of sprung and unsprung weight or multiple axles to carry gross loads over the highways with less destruction of the road. The recently organized committee composed of representatives of the Society of Automotive Engineers and highway engineers will consider the mutual relations of the vehicle to the road. The highway engineer also, in conjunction with the automotive engineer, must conduct research upon the effect of the various road surfaces upon the operating cost including gasoline consumption and tire wear, and the operating departments must also consider the road surface and alignment in relation to the statistics of accidents. All of these efforts only come from a determined organized program of research. Roads must also be evaluated from the standpoint of tractive effort and safety. A reliable judgment on many of these issues cannot be reached until adequate and properly analyzed maintenance data are available.

One of the outstanding problems in the construction field in the sub-division of material, is the cause of surface waving, both in gravel and bituminous roads. Research is needed to determine the cause and remedy. H. S. Mattimore of the Pennsylvania State Highway Department and Major F. S. Besson, of the District of Columbia, are active in research upon the cause of waves in asphalt surfaces. The Bureau of Public Roads is making a special study of the corrugations of gravel roads.

A research into the efficiency of the operations of concrete mixers is much needed and also a further study of the product of central mixing plants.

The excellent survey of road materials by which bidders on highway construction may know the available sources of acceptable material, quarry conditions and freight rates, such as are conducted by Mr. Mattimore, of the Pennsylvania State Commission, result in an easily computable saving of money to the states. Mr. I. W. Crum, testing engineer of the Iowa Highway Commission, and Professor M. O. Withey of the University of Wisconsin have given special attention to the use of available aggregates. The Kansas State Agricultural College and the Texas Highway Commission are both active in the field of development of materials of construction.

A little later the National Research Council expects to issue the results of a census of research in which the many valuable studies under way in the experimental stations of the various state universities will be listed and described. It is difficult to mention a few of these investigations in a paper of this kind without doing injustice to the large number of devoted research engineers.

New Railway Bridge Specifications Published in Tentative Form

Specifications for railway bridges have been completed in tentative draft by a committee on bridge specifications of the American Society of Civil Engineers, and are to be presented for discussion at the coming annual meeting (Jan. 18-20). They have just been issued in printed form by the society. The new specifications follow closely along the lines of the 1920 A.R.E.A. specifications, with a number of minor changes, however, and without limitation to spans below 300 ft. Discussions will be received by the secretary of the society, 33 West 39th St., New York.

Handling Traffic During Highway Construction

Detouring Adds 25 Per Cent to Cost—Widening of Road Beds Suggested as Remedy

By Paul D. Sargent
Chief Engineer, State Highway Commission of Maine, Augusta, Me.

With double the number of vehicles and four or five times the number of construction projects, as compared with conditions five years ago, the traffic problem has grown out of all proportion to the increase in either factor. Road builders everywhere recognize these conditions and are making better provisions than ever before for the comfort and the convenience of traffic. Since the advent of federal aid, improved highway construction has been put on a much more substantial basis. Departments can now expend funds for handling traffic during construction without fear that they will be criticized for not getting every last mile of new road possible from the expenditure of funds in their hands. The work incident to handling traffic is fast coming entirely into the hands of state highway departments. When this is an accomplished fact and each department is fully equipped to handle this problem, much less criticism will be heard from the public.

Detour Division Favored

My own idea is that a special division to handle detours should be established, unless the organization of the department be such that the state is already divided into comparatively small administrative divisions so that the division engineer can keep closely in touch with the detour situation. In the department with which I am connected we have placed upon the resident engineer the duty of seeing that detours are put in good condition and kept so. At the same time we give each resident engineer more work than he can handle comfortably in looking after the new construction under his care. Naturally his first concern is to see that the new work is properly executed, and I am free to confess the detour road gets second attention. In some cases we have had our district supervisor, who looks after state-aid construction and all maintenance work, keep an eye to the detour. Under regulations now in force, if a detour is laid out over the ways in a town where we are building a state highway, the State Highway Commission sees that the detour is properly maintained during the construction season. This expense is shared equally by the town and the state. If we ordinarily have a patrol on the section under construction, we arrange to move the patrolman to the detour road. The expense of caring for that part of the detour located outside the town in which the improved road is being built is paid for wholly by the state and all detour expense is charged to the job under construction.

Signs are erected at each end of the detour and at all intersecting ways throughout the length of the detour, indicating the principal town or towns in either direction. Considerable difficulty is experienced, however, in keeping them intact. They are maliciously removed, taken down or destroyed.

The expense of caring for traffic over detour roads is larger than most people realize. For example, in 1920 the Maine department graveled 9 miles of road

to be used as a detour for the summer, with gravel only 4 in. deep and 12 ft. wide. The gravel was economically handled, being loaded and spread mechanically and hauled with trucks, yet the cost was nearly $1,000 per mile. The town widened and graded the road at its own expense.

The New Hampshire department reports one detour it is maintaining this year with a weekly payroll of $250 to $300 but the length of the detour is not specified.

The Division of Highways of the Department of Public Works of Massachusetts reports that the cost of maintaining detour roads has been from $300 to $1,200 per mile of detour. In one case the state expended $4,000 on a detour about 3 miles long.

Commissioner Bennett of Connecticut reports the case of a 7-mile detour over hard-surfaced roads, properly maintained and marked with signs, which were lighted at night, costing $3,000 for the entire job for one season.

Where detour roads cannot be located except at a very considerable increased length, some departments are now allowing traffic to go through the work. This necessitates building the surface one-half at a time and is objectionable from a construction point of view. In order to handle traffic in this way it is necessary to employ a watchman or flagman to pass traffic first one way and then the other. This is done in both Connecticut and Massachusetts.

Mr. Bennett, of Connecticut, cites this case: "We divided the construction work into two divisions longitudinally, and passed the traffic through by what is known as the one-way method—at first by the use of flagmen until it developed that on account of the numerous curves in the road, the expense of this method was prohibitory. We then hit upon the scheme of installing a field telephone set, with a small house at either end of the construction work, passing the traffic by a regular dispatch method, using no flagmen. The cost of this work varied from $60 per day, where flagmen were used for the 24 hours, down to about $12 a day by using the telephone."

The subject of passing traffic along or over work under construction is thoroughly treated in the last annual report of the Rhode Island State Board of Public Roads, which says in part:

"In general, a pavement which is cast, as is a concrete pavement, can more readily be built half at a time than can a pavement which must be rolled by a steam roller. Upon an 18-ft. bituminous-macadam road, unless there is a car track to confine the crushed stone laterally, almost inevitably there is a depression formed in the center of the road when it is built half at a time.

"The work of grading and laying foundations is also handicapped by this form of construction. If the excavation is to be accomplished so that traffic may always employ one-half of the road, hand work only can be employed, thereby increasing the cost. Frequently upon our projects at least 25 per cent more would be paid for building roads half at a time, and with some types of pavements inferior results would be inevitable."

I have discussed this question of increased cost incident to building pavements one-half at a time with a considerable number of contractors. Twenty-five per cent is the amount they have usually named as the probable additional expense. This is the amount assumed by the Rhode Island Board in their discussion. Even in the case of gravel-surfaced roads contractors have told me the added cost for constructing and finishing roads with traffic running over them is from $1,000 to $2,000 per mile, or from 8 to 16 per cent on the cost of the road.

Road Widening as a Solution

The ultimate solution of handling this traffic is, in my judgment, coming through the widening of present roads, which we shall surely see undertaken within the next ten years. If this work is done by first widening the grade before disturbing the present road surface, we shall have room to pass traffic on the original surface while the extra width of grade is being built. When subgrade and foundations have been completed on the new width of road, traffic can then be turned upon it while adjustments of grade and foundation work are being made on the original roadway. The surface or pavement can then be laid one-half at a time, for the width will be such as to make the laying of one-half at a time much more practical than is the case with a narrow pavement.

Traffic will be much better suited if allowed to pass along the highway under construction. Would it not be good business then to expend money, now used upon detour roads in paying the extra cost of constructing pavement or surface one-half at a time, in widening present roadbeds and temporarily surfacing them so that traffic can pass along the highway without unduly interfering with construction work? This would give us additional widths of shoulders, which is the greatest single element of safety, and would make room for future widening of the surface proper. The expense of such work, taking one mile with another throughout any considerable system of state highways, would not, I believe, average much more per mile than the expense of constructing and maintaining detour roads.

Corrosion of Buried Pipes To Be Tested

AN EXTENSIVE investigation of the corrosive action of soil on pipes used for gas and water mains and service pipes has been undertaken by the Bureau of Standards, in co-operation with the Bureau of Soils, the research sub-committee of the American Committee on Electrolysis, and the pipe manufacturers. Forty locations have been selected as representative of the principal families of soils to be found throughout the United States, and at each will be buried a number of samples of every kind of iron and steel pipe in commercial use, pipe coated with representative pipe coatings, and pieces of lead sheath cable, both plain and armored. Some of the samples will be uncovered and examined from time to time to determine the rate of corrosion. These fields tests will be supplemented by laboratory tests that will give complete data on the physical and chemical properties of the soil. Other laboratory tests will give the microstructure, complete metallurgical history, and chemical analysis of the pipe specimens. Extensive laboratory experiments will be conducted to determine the effects of variations in individual characteristics of both soils and pipe materials. It is expected that some data will be obtained within 2 or 3 years, but the experiment will probably continue over a period of 8 or 10 years.

"Serve Traffic" Is the Detour Slogan in Wisconsin

Policy Which Has Been Adopted Considers Detour, in Respect to Marking and Maintenance, as Main Route

By A. R. Hirst
State Highway Engineer of Wisconsin

MODERN highway practice has reached the point where it includes not only the construction and maintenance of roads, but the giving of traffic service during the necessary construction and maintenance processes. Until recently, when a road was under construction or under extensive repair, or a bridge was out, it was standard practice to throw bars across the route and let traffic seek an outlet wherever it could find one. It did not seem to enter the minds of any of the state highway officials that this traffic should be cared for as thoroughly as normal traffic.

Wisconsin possibly recognized the newer phases of the traffic situation a little sooner than most of the other states. While we are far from reaching a stage of perfection, we have for some years past made an at least earnest effort to accommodate traffic during construction and maintenance processes.

Upon any piece of construction there are two options open to the engineer in charge. He may (1) close the road to traffic and provide satisfactory facilities for getting around the closed section; (2) keep the road open to traffic and get the traffic through the work as best he can. There are no other practicable means of doing the thing which must be done, that is, getting the traffic through day after day.

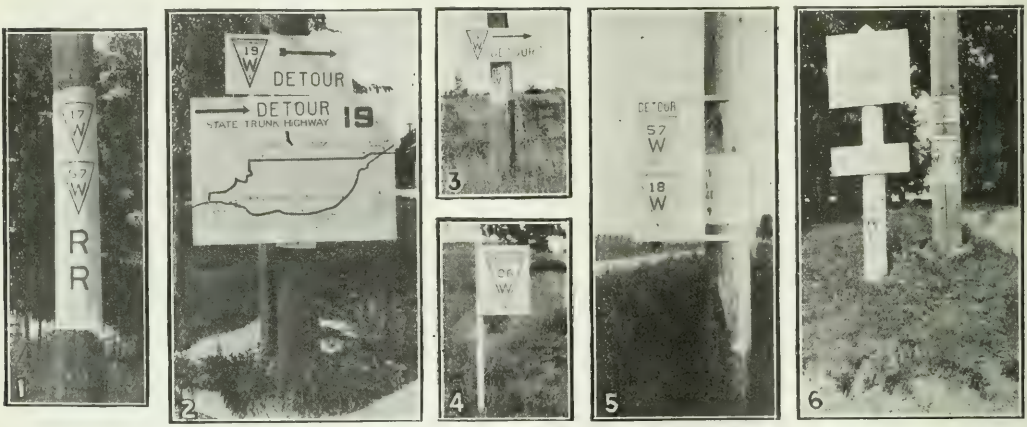
Whether a road should be closed to traffic, or whether traffic should be allowed to go through, depends so much upon the type of construction, the character of the soil and the roads available for detouring, that no fixed rules can be made. Undoubtedly where other roads are available which are travelable under all weather conditions, it is better to detour the traffic than to carry it through work where, in spite of everything which can be done, there is bound to be inconvenience, delay and possibly danger.

Decision to detour a road should be made as far in advance as possible so that the road to which traffic is to be diverted should be prepared for that traffic. This preparation should take place the year preceding the construction, if plans can be made that far ahead. Wherever the detour is necessarily narrow and dangerous and not much better than other roads in the neighborhood, the system of double detouring is very advisable. That is, traffic in one direction should be carried along one detour, and traffic in the contrary direction along an entirely different detour. Each case stands by itself and should be determined after careful consideration of all the factors.

It is often necessary and advisable to spend hundreds, and even thousands of dollars in preparing a detour from a main-line road, if the detour is to be in operation for a considerable period. Money so spent is not wasted, because detoured traffic is saved trouble and expense, and the improvements remain when the road reverts to its local use.

When the detours have been prepared and construction started on the main road, good stout barricades should be placed across the main road at the points of departure of the detour, with the necessary detour signs and arrows indicating the detour route. The detour route should be clearly and thoroughly marked from beginning to end, with the turns indicated and the dangerous points posted just as if it were the main traveled highway—as it actually is, for the time being. Detours should be as well marked in every way as the main roads, although the marking may lack some of the permanent features of the main-road markings.

The detour should be maintained daily because, since



WISCONSIN PRACTICE OF MARKING DETOURS AROUND ROAD CONSTRUCTION WORK

(1) Wisconsin route marking shown to indicate relationship between route marking and detour marking.
(2) Characteristic detour sketch placed at each end of long detours. Often these detour sketches at the beginning and ending of detours are miles away from the construction to be detoured.
(3) First type of Wisconsin detour sign.
(4) Second type of Wisconsin detour sign. Two roads are detoured on this same highway. Where right or left turns occur the "R" or "L" is used, just as on the regular routes.
(5) Latest and now standard detour marking, consisting of board bolted to angle irons driven in the ground. These are readily removable, can be placed near the roadside, and were so popular in 1921, due to their visibility at night, that the state will probably use this type of marking on all routes, both regular and detours, as soon as the change to this type of marking can be financed.
(6) Patrol section, direction sign, and route numbering on telephone pole.

it is usually an inferior type of road it will need this daily maintenance even more than did the main road. In brief, it is our practice in Wisconsin to put in effect on detours exactly the same practice for the same type of road as we employ on our state trunk highway system.

But even with the best principles and practice a detour is seldom as good as the regular route and is almost universally longer, sometimes dangerous and sometimes almost impassable. It is important, therefore, that the amount of traffic on detours be kept to the minimum, and about the only way this result can be accomplished is by the dissemination of information telling the public where detours may be expected. Given a proper distribution of this advance information much traffic will avoid the badly detoured roads, the situation will thus be relieved, and traffic served by being kept out of trouble. For some years the daily papers of Friday or Saturday have covered the detours existing for that week end in the neighborhood. This service has been an effective help in limiting travel on bad detours.

The Wisconsin Highway Commission this year tried further to meet this need of information as to detours by publishing weekly a blueprint map showing the location of all detours on the principal highways of the state, and also the location of all jobs under construction but which were not detoured. This map, a tracing on a scale of 1 in. equals 6 miles, was corrected each Wednesday in accordance with information received from the division headquarters that morning and the blueprints were mailed out to all subscribers to this detour service not later than Thursday night, so as to be available for the week end. The detour map service was furnished for sixteen weeks at a cost of $10; there were about 90 subscribers to the service in 1921.

Answers from a questionnaire to these subscribers indicate that the public was greatly served by these maps, and practically every subscriber indicated his intention to take the enlarged service along the general line which we expect to offer in the season of 1922. The map used is on a large enough scale so that the inquirer can tell approximately the location and length of the detour and where it starts, and can readily pick it up on the ground and follow it.

In 1922 when a road is kept open to travel, in addition to the care we have previously used in keeping the grading as smooth as possible, we will either build all culverts in halves or bridge the openings and new culverts with timbers so there will be no detouring through fields around culverts under construction, which has been the worst feature of our roads open during construction.

The accompanying photographs with their legends tell something more about the detour methods used in Wisconsin. We are not at all satisfied with our previous results. We are expecting to improve them materially in 1922 and succeeding years, but we believe that we have established some general principles which, if carried out to a logical conclusion, will enable us to give our people and our visitors really effective traffic service, despite the large mileage of road which we must necessarily have under construction each year.

The detour problem is of much greater importance than engineers have so far recognized. We are confidently expecting that one of the greatest advances made in American highway practice within the next few years will be made in the amount of care and attention and money spent in establishing and maintaining adequate detours.

Traffic must be served!

From the Producer's Viewpoint

Commercial and Technical Developments in the Asphalt Paving and Bituminous Road Fields

A Survey Based Upon Interviews With Representatives of the Principal Producers of Asphaltic and Tar Products Employed in City, County and State Highway Work

WITH 68,000,000 sq.yd. as the estimated area of roads and pavements of asphaltic types constructed or reconstructed during 1921, producers of asphaltic products regard the volume of this year's business as satisfactory and are looking forward to a substantial increase in the use of their materials on city streets and state and county highways during 1922. This prediction rests upon a more solid foundation than mere optimism. It is supported by a number of direct and indirect influences:

In the first place, the enactment of the Federal-Aid Highway Bill, which was signed by the President Nov. 9, and carries an appropriation of $75,000,000 to be matched by an equal amount from the states, assures a continuity of the road-building programs which all of the state highway departments have initiated. Bituminous types of construction will receive their share of the general road-building activities insured for 1922 by the new legislation. Second, the market for bonds, within the last few months, has shown a decided improvement and many issues which had been authorized but which could not be disposed of, except at a great sacrifice, are now finding a fairly ready sale. In general, it is felt that the improved credit situation will make its influence felt next year in the consumption of bituminous products for road construction. Third, the campaign, initiated by Secretary of Commerce Hoover, in favor of the fall letting of highway contracts as a means of relieving the unemployment situation, has been productive of results, especially in localities where winter work is possible, and an increase in the volume of next year's business is traceable, in part, to the acceptance of the principle, by many state highway departments, of advance planning. Fourth, reports received from city and state engineers indicate a marked expansion of activity for 1922. Such states as North Carolina, West Virginia, Missouri, Alabama, Florida, California, and others contemplate a substantial increase in the use of bituminous products in road construction next year. Fifth, the wider use of bituminous concrete foundations or "black base," instead of portland cement concrete, augurs well for an increased volume of sales of asphaltic materials for the coming year. Sixth, the endorsement of asphaltic filler for brick pavements by the National Paving Brick Manufacturers Association furnishes definite ground for the prediction of more

extended use of such products. Seventh, a considerable mileage of badly worn roads will undoubtedly be improved by the application of wearing courses of tar and asphaltic products by the penetration method and of asphaltic hot mix types such as asphaltic concrete and sheet asphalt. Producers report an increased demand for their materials in both penetration and mixed bituminous types of construction.

Larger Output Predicted

The foregoing is a composite summary of the views of representatives of leading manufacturers of asphaltic and tar products for road work as collected by *Engineering News-Record*. The following notes deal more specifically with certain phases of this year's operations in the bituminous road field, and are based on interviews with W. H. Kershaw, manager, Asphalt Sales Department, The Texas Co.; Herbert Spencer, Asphalt Department, Standard Oil Co. (New Jersey); J. R. Draney, general sales manager, Bitoslag Paving Co.; L. Wittenberg and J. S. Crandell, Tarvia Department, Barrett Co.; H. T. Macfarland, Barber Asphalt Paving Co.; and J. E. Pennybacker, secretary, The Asphalt Association.

The year 1920 was an unusually successful one from the point of view of the asphalt producer and showed a tremendous gain over 1919, following the termination of the World War. While the volume of the 1921 work is generally estimated to be in excess of that of 1920, the percentage increase is not so great as that between 1920 and 1919, for during the latter period a gain of about 40 per cent in total asphalt consumption was recorded by the U. S. Geological Survey. The 1921 output, however, is expected to show an increase of from 5 to 10 per cent over that of 1920. This is the Asphalt Association's estimate of the situation.

For one of the asphalt companies 1920 was a big year, the volume of business having been two and one-half times larger than during any other year; the 1921 sales, while they may not reach last year's mark, will compare favorably with it. A 20-per cent increase in business for 1922 is anticipated by this producer and by the Asphalt Association for the industry as a whole. Exceptionally large tonnages were shipped in October of this year, being several thousand tons in excess of the monthly shipments for any previous year. This increase is accounted for largely by the threatened railroad strike.

Credit Situation and Freight Rates

During the greater part of 1921 difficulty was experienced in disposing of highway bonds, particularly for improvements in the West. One of the asphalt refiners ascribes this as the cause for a slight falling off in its 1921 business. A number of bad accounts developed, due to the practice of paying road-building contractors in bonds and then having the value of these securities depreciate. Some contractors refuse to undertake construction work on the basis of bond issue payments. Nor are the refiners of asphaltic products eager to accept bonds in payment for their materials. Of late, however, the credit situation has shown a decided improvement, particularly in the Southeast, and unless unforeseen conditions arise this improvement should be reflected in increased road-building activity.

In the distribution of bituminous products the producers agree that no single locality during the year has developed a demand greatly in excess of that found in other sections of the country. In other words, the distribution throughout the states has been fairly uniform. One encouraging feature of this year's distribution has been the greatly improved railway service, offering a marked contrast to conditions in 1920. Freight rates, the producers believe, are unjustly high on asphaltic products. A comparison of the freight rates on asphalt with those on other road-building materials shows, in the opinion of one producer, a decided discrimination against the bituminous type of highway construction. One refiner, speaking of freight rates on asphaltic products now as compared with half a dozen years ago, cited a rate of $2.20 between Baltimore and Pittsburgh in the old days as against $5.20 a ton now.

The future trend of asphalt prices, as some of the producers see the situation, will depend to some degree on developments in the Mexican oil fields. By far the largest volume of asphaltic materials for road construction in the United States comes from Mexico and if the supply from that source should be curtailed, because of the inflow of salt water into the wells or by reason of political interference, asphalt prices in this country will stiffen unless other sources of raw material are developed in the meantime.

All of the producers were queried as to developments in materials, equipment, or construction methods during the past year. No far-reaching changes were indicated by their replies. In city paving work, due to the increased volume and weight of motor vehicle traffic, there is a tendency toward the use of a harder asphaltic cement in surface mixtures to prevent shoving and creeping of the surface. Another factor justifying the employment of a harder cement is the increased volume of oil drippings on pavements from motor vehicles, tending to soften the surface.

Bituminous Foundations

The producers believe that the next year or two will see a much wider use of bituminous concrete for foundations, instead of portland cement concrete. California is cited as a large user of "black base," while in repairs to the asphalt pavement on Fifth Ave., New York City, according to C. M. Pinckney, chief engineer, bureau of highways, Borough of Manhattan, the policy has been adopted, where cuts are necessary through the concrete foundation, of employing asphaltic concrete exclusively for the new foundation. Such practice is particularly advantageous in cases where the demands of heavy traffic require that a pavement, under repair, be put back in service at the earliest opportunity. It is noted, also, that the city of Providence, R. I., has employed black base for both sheet asphalt and granite block construction. It is understood, also, that North Carolina, in its plans for an extensive program of highway construction next year, is now considering the use of a sand-asphalt type of construction in localities where stone is scarce. In sheet asphalt paving work standard practice now requires, generally, the use of a 1½-in. binder and a 1½-in. top course. The close binder is almost universally used and the open binder abandoned.

In general, the refiners are in favor of uniform specifications. Some state and city officials, however, call in their specifications for asphalt of special consistency which cannot be met by the refiners' standard grades of material. The demand for these variations, it is pointed out, is a source of trouble to the asphalt pro-

ducer and involves increased cost at the refinery to provide storage for the special grades called for. The tendency toward the drafting of such specifications may sometimes be traced to the employment, by cities, of consulting chemists for whom variations of the standard specifications mean a larger volume of business. On the whole, however, the producers find no serious objection to the specifications which they are called upon to fulfill in supplying asphaltic materials.

Better Storage Needed

Contractors, to a much greater extent than in former years, are now calling for tank-car shipments of asphaltic materials instead of shipments in wooden barrels or metal drums. The manufacturers are endeavoring to secure a still wider use of bulk shipments and in many cases are co-operating with contractors in providing proper storage facilities within reach of the work. It is pointed out that tank-car shipments effect savings, for the contractor, of from $5 to $10 a ton exclusive of demurrage charged by the railways for tank cars remaining on sidings, involving additional costs of from $2 to $5 per day.

Many contractors have cut the cost of their work by installing storage tanks of their own. There are a wide variety of such containers on the market, including steel, concrete, and wood construction. Sometimes it is profitable, outside of city paving work, for contractors to construct temporary storage tanks and collapsible units for this purpose are obtainable. The refiners of asphaltic products find that there is opportunity for constructive work in educating contractors in proper methods of storing and handling asphaltic materials. In storage tanks, for example, it is important not to have too high a heat, which burns the asphalt. Ideal conditions demand a temperature just sufficient to allow the material to move freely. Steam in heating coils is expensive and with proper tank design it is believed that great economies in fuel consumption can be made.

In some cases contractors have repaired old railway tank cars which had outlived their usefulness as transportation units, by setting them up, calking them and repairing the steam coils. Such tanks may be rehabilitated and used as stationary installations.

Research

Research work in the asphalt and bituminous road fields includes two main lines of investigation—the shoving of asphalt surfaces and the effect of impact. The studies on shoving, now under way, are a co-operative effort by the U. S. Bureau of Public Roads, the Asphalt Association, and the cities of New York, Philadelphia, Baltimore, Washington and Detroit. Samples are being cut from city pavement in various localities, tested and analyzed with respect to consistency, amount of compression, grading of mineral aggregate, etc., in order to determine the best type of construction under given traffic conditions. Last year a service of impact tests on beams and slabs conducted by the Asphalt Association developed a number of significant facts regarding the design of pavements and demonstrated that asphaltic paving mixtures are highly resistant to impact. Impact tests on bituminous surfaces are now being conducted by the U. S. Bureau of Public Roads but the results have not as yet been announced. Another subject being studied is the relative wear of automobile tires on concrete and on bituminous surface roads.

According to the figures of the U. S. Geological Survey, asphalt production in the United States for 1920 was as follows:

ASPHALT PRODUCTION, 1920

	Short Tons
Domestic native	198,197
Imported native	128,111
Domestic petroleum	706,106
Mexican petroleum	1,045,770
Total	2,078,186

This output for 1920 compares with a total of 1,483,497 tons produced in 1919. The following are the 1919 figures, from the U. S. Geological Survey reports:

ASPHALT PRODUCTION, 1919

	Short Tons
Asphalt from domestic petroleum	614,692
Asphalt from Mexican petroleum	674,876
Domestic natural asphalt	53,589
Other domestic native products	34,692
Asphalt imported from Trinidad and Tobago	51,062
Asphalt imported from Venezuela	47,309
Other imported asphalts, including bituminous rock	7,277
Total	1,483,497
Asphalt exported from the United States	14,208
Approximate asphalt consumption in the United States	1,443,289

Alaska Railways, Roads and Harbors

PROGRESS on the U. S. Government railway in Alaska was delayed by lack of labor during the fiscal year ending June 30, 1921, according to the annual report of the Governor of Alaska. On that date there was a 72-mile gap between the north and south sections of the line. Since the report was made, however, the work has progressed so rapidly that the tracklaying gangs of the Alaskan Engineering Commission met on Nov. 19.

A 10-year program for highway development, including a system of feeders to the railway has been prepared by the Alaska Road Commission, which since 1905 has expended about $6,004,052 for about 5,000 miles of wagon roads, sled roads, trails, bridges, ferries and tramways. About 750 miles have a gravel surface and are suitable for light automobile traffic. A highway available for automobiles in summer is now completed from Valdez and Chitina to Fairbanks and is to be extended to Circle within the next two years. Of $666,789 spent in the above fiscal year, $432,244 was for construction and $234,545 for maintenance.

In the work of improving rivers and harbors a great advance was made, says the Governor, by the re-establishment of the Juneau district, in April, 1921, by the Chief of Engineers, U. S. Army. The president of the Alaska Road Commission was appointed district engineer, with the other two commissioners as his assistants. Nome harbor and the Apoon mouth of the Yukon river are the only works now authorized. The former includes two jetties at the entrance and the dredging of a basin. Ten new lights were established during the year by the U. S. Lighthouse Service. Better shipping facilities are said to be needed urgently, but the report states that the operation of government lines is not desirable.

The territory of Alaska shows no growth in population since the war, according to the governor's report. Mining is in a healthy condition and an agreement has been made between the Department of the Interior and the Navy Department for developing a coal supply for the Navy. This will require a coal washing plant. In oil prospecting there was great activity, and there is said to be an encouraging outlook for the early development of wood supply for the pulp and paper industry.

A Symposium and An Analysis

Large Mileage Highway Contracts

Reasons For and Against Developed by a Wide General Inquiry Among Highway Builders—Outstanding Arguments by Two Engineers and Two Contractors

LARGE mileage highway contracts are being advocated again, (1) to reduce the cost of construction and (2) to bring about quantity production. This renewed interest has developed from successful experience in southwestern states where, during the last year, single contracts have been completed for county highway systems of 50 to 150 miles.

Except in these few instances contracts for more than 20 miles of paved road are rare. Most contracts are less than 10 miles. The thought, in this practice, has been to limit the mileage of a contract to the length of road that can be constructed in one season with a single paving outfit.

Large mileage contracts would be the antithesis of present practice. The idea is to group improvement projects; award a single contract for the group, and carry on work with a number of outfits operated under common direction.

With the differences between large-mileage and small-mileage contracts stated in this simple manner the question appears plain. Will the large-mileage contract simplify engineering, increase production, improve quality and reduce cost? There are not enough facts to give the engineer a definite answer. There have been too few large-mileage contracts. Those that we have, have been undertaken under conditions of labor, railway service and materials supply which do not give the results normal significance. In a sentence, experience thus far with large-mileage contracts is merely indicative—not even tentatively conclusive.

With the facts inconclusive, what is the opinion? Here again the inquiry made leaves us uncertain. There is no agreement of opinion regarding large-mileage contracts. Contracting organizations large enough to handle such contracts advocate them; small contractors oppose them. A count of state highway engineers shows a small proportion strongly opposed, another small proportion moderately in favor and a large majority willing to grant a theoretical advantage but certain that conditions as they personally have them are not proper for success. A few manufacturers of equipment and producers of materials are vigorous advocates but in general the trades are indifferent. The value of large-mileage contracts is consequently affirmed on one hand and denied on the other.

Affirmative Opinion

It is contended that more efficient engineering, both in the field and in the office, is practicable with large mileage contracts. The mileage under construction is concentrated and fewer engineers per mile will serve the work than when several scattered small contracts make up the same mileage. Also fewer engineers are required because with the skilled superintendence provided by large contracting organizations less personal supervision by the engineers is required. By being longer engaged on one operation the men work faster and with less lost motion than where frequent shifts from one operation to another are necessary. As direct evidence, R. J. Windrow, state highway engineer, reports from Texas, where large-mileage contracts have been most employed, that there is a "reduction in the engineering cost per mile of construction."

Speed of construction will be increased because large contractors are financially able (1) to accumulate large stocks of materials (2) to provide the largest and best equipment and (3) to secure the most capable superintendence. They possess an organization trained in quantity production and, by practice, geared up to high speed operation. The direct evidence is several contracts in Texas where single high powered organizations are paving a mile a week. Particular reference is made to the Maricopa County contract in Arizona (*Engineering News-Record*, May 26, 1921, p. 882) for 150 miles of concrete road where the contractor is producing his own materials and is distributing them to three proportioning plants which serve three paving outfits averaging each a mile a week of completed pavement.

Better construction follows from the greater skill and proficiency of organizations able to handle large contracts. They have the means to employ the best methods and machinery; they have greater market resources and, therefore, a wider choice of materials, and they command the most experienced superintendents.

Cheaper construction is possible because (1) the investment in equipment is less per mile of construction, (2) the plant operating costs are less per mile of work and (3) overhead expenses are reduced. An unloading plant (crane, charging bins, storage facilities, track) capable of handling 20 cars costs considerably less than two 10-car plants. Also it does not require many more men for its operation than does each of the smaller plants. Overhead is less because of smaller bidding expenses, smaller labor turnover, less superintendence and accounting.

There is finally a broad constructive purpose in fostering the large mileage contract. It will develop large organizations specializing, and becoming highly expert, in highway construction much as the great railway organizations of past years were developed. No large road building program, it is contended, is possible without such large organizations and they cannot operate without contracts which engage their full resources in money, plant and personnel.

Negative Opinion

Reliable contractors able to finance only eight to ten miles, or a one-unit outfit, would be eliminated by large mileage contracts as direct bidders and forced to become subcontractors. This deprives the small contractor of the opportunity to do original work and puts the community to the disadvantage of dealing indirectly with its contractors actually doing the construction. These small contractors personally in touch with the actual construction are doing as good work and often cheaper work than large organizations. Finally contractors able to undertake large mileage contracts are too few in many states to complete the mileage desired.

A large mileage of continuous or connecting road is torn up in one season and excessive local interruption of traffic is caused if contracts are let in large mileages.

Large mileages under construction on the same line of railway complicate materials deliveries. Railways have a limit of service which they can render a section of territory in any one classification of freight and when this limit is exceeded the service is not efficient.

Contracts for large mileages, if forfeited, cannot so easily be recovered and relet or completed by force account. Effective pressure cannot so easily be exerted on a dilatory contractor.

Too much mileage under construction is carried over into the succeeding year and clean cut yearly programs so desirable in securing legislative action on appropriations are difficult to arrange.

Law and custom in initiating and developing highway improvements, curtail in almost every state the freedom of the highway engineer in locating new construction and planning the contracts. The more common of these limiting conditions are:

(1) In some states improvements are initiated and carried out only by "districts" created by the residents without regard to county or township boundaries and responsible to no one but themselves.

(2) In many states road [illegible] is initiated and carried out by the coun[illegible] laws which require approval of plans by the state highway department but which deny any initiative to the state.

(3) In many states previous county control of highway improvements has left for state construction only short gaps between county systems.

(4) In all states "distribution" of annual improvements is "politically" desirable in securing appropriations and favorable legislation.

(5) The "habit" of the people is to build from year to year, cleaning up each year's work and planning independently for the next year.

The obvious conclusion from the information presented is that the large-mileage contract cannot be analysed purely as a problem in engineering planning and construction. The appraisal of its possibilities as general practice on this basis alone is, therefore, largely academic. About all that can be affirmed is that:

1. In actual practice large mileage contracts have given satisfactory results in speed, quality of work and reasonable cost when handled by contractors of means and ability.

2. Until they have been far more widely used under more nearly normal conditions no exact measure of their value can be made compared to small-mileage contracts.

3. Their employment is, in any event, an engineering and business question to be decided in each case by the conditions governing the operation.

There follow four short articles giving the opinions of two contractors and two engineers on this subject.

* * * * * *

Finish Each Season's Work That Season

By Clifford Older
State Highway Engineer, Illinois

THERE is no advantage in letting in a single contract a section of road which may be longer than that which a contractor can economically construct from one set-up of his plant.

Just how many miles of road may be built with a single plant installation depends upon the character of the equipment used; but ordinarily, it varies from eight to a maximum of perhaps sixteen miles, although in the experience of Illinois there is but one instance where a contractor constructed sixteen miles of road with one set-up. Also under Illinois conditions, a single set-up usually means a season's work for an outfit.

The advantage to a contractor of having two sets of equipment close to each other is comparatively small and may easily be offset by the advantage to the public in advertising for contracts in such manner that competition may be secured from a greater number of contractors than would be possible were 40 or 50 miles tied up to one bidder.

Under the conditions prevailing during the past several years there is nothing to be gained in awarding contracts we may not reasonably expect to be completed in one season.

It is therefore my judgment that in advertising for proposals on road work it is the best policy, from the point of view of the public, to provide as nearly as may be for contract sections having such location and magnitude as to permit of a season's work for a well balanced outfit.

Further provision may well be made that proposals may be submitted for adjacent contract sections in combination so that an organization with several outfits may compete for the whole work and, if it is the successful bidder, will have its various construction outfits in a comparatively restricted territory.

Consideration should be given to the fact that where very long continuous projects are located along a single railroad, rail transportation difficulties may be involved which might otherwise be avoided.

Large Contracts Cut Plant Costs

By H. H. Wilson
Managing Partner, Winston & Co., Contractors

LARGE and highly developed contracting organizations can operate successfully only on extensive contracts. Quantity production means reduced cost; furthermore, where a contractor is awarded sufficient work in one locality to give him employment for as much as two years time, great economies can be effected in the cost of freight on plant, depreciation on plant, camps, and other structures.

Generally, it is also possible to assemble on long term contracts a more experienced, efficient and economical organization (both as refers to skilled and unskilled labor) than is possible to assemble for a few months' work.

Under existing freight rates, the item of freight on plant alone (where the portable railway and other extensive and modern road building equipment is used) will average more than $500 per mile of road.

To "plant" a six-mile road contract requires a heavy investment in equipment. In buying this the average contractor has no assurance as to the amount of depreciation he will be able to earn. If, however, he is awarded sufficient work and allowed sufficient time, within which to complete it, to admit of earning two years' depreciation on his equipment, he will be willing to compute his plant depreciation on a lower annual percentage than he would be willing to do with the assurance of only one year's work.

Offsetting the above considerations a small outfit on a small contract has little or no overhead expense, and, given ample time, can produce economical results.

However, when the efficiency and reliability of a large and intelligently conducted organization is contrasted with that of an organization of the "wheel-barrow" and "sidewalk paving" type, there are further equities in favor of the large organization, both for the State and for the taxpayers.

Small Contractors Underbid Large

By F. F. Rogers
State Highway Commissioner, Michigan

THE Legislature of 1913 established a trunk line road system for Michigan which has practically been doubled by subsequent Legislatures up to and including the Legislature of 1921. Until 1919 the several counties had charge of the building of the trunk line roads and were encouraged by the state paying double the amount of aid on trunk lines that it

paid on non-trunk lines. In addition the state took charge of and built all bridges of more than 30 ft. clear span on the trunk lines providing the local subdivisions would build at least three miles of road including the bridge.

Very naturally, under such a law, the roads in the various counties were built out from their most important towns and there were many gaps left which it became necessary to fill in in order to get anything like a continuous system of trunk lines over the state.

Therefore in 1921 when the Legislature placed the construction and maintenance of trunk lines entirely with the State Highway Department, but still with some local financial co-operation, the work of the state was evidently a gap filling program. For this reason, it has been impossible, say nothing about being impracticable, to place large transstate trunk lines under contract at one time. The longest single pieces of road that we have been able to let are from ten to fifteen miles.

There is still considerable argument as to whether large companies may be able to step in and compete with the smaller contractors, working on smaller pieces of public highways. In fact we have usually found it necessary to divide our roads into sections for letting in order to allow the smaller contractors to bid; otherwise a few large contractors would bid off the roads at prices unduly high. At least that has been the experience of Michigan.

It is a literal fact that the smaller contractors have underbid the larger ones and I know that a careful study of the unit prices on all contracts awarded in Michigan during the past two years would not show that there is any advantage in letting very large contracts, if the only object is to get reduced prices.

Railway Experience Supports Large Contracts

By J. C. Baxter
General Superintendent, A. Guthrie & Co., Inc., Contractors, St. Paul, Minn.

THE greatest amount of construction ever performed of a character in any way similar to modern highway work, was the construction of the American railway system. This work, carried on through three-quarters of a century, was largely performed under a plan that gradually became standardized and was almost universal until the combination of the Great War, the Adamson Act and the War Labor Board put a damper on the extension and betterment of railways. This plan was applied to work performed for private owners whose first consideration was economy, and it may safely be assumed to have been the most efficient that could be devised by the group of brilliant minds who planned, financed and constructed the American railway system as it exists today.

The plan in question as applied to the construction of new lines of railway, undertakings in their general physical characteristics very similar to modern highways, was, for the railway company to request bids on the entire amount of work contemplated, requesting such bids only from firms of known experience and financial resources. After one of these firms had been selected and a contract entered into, the successful bidder immediately proceeded to sub-let various portions of the work to other firms who were each especially equipped to handle the piece of work in question, and these sub-contractors executed certain portions of the work with their own forces and equipment and sub-let certain other portions to so-called, "station men" who were in reality "piece workers."

This plan resulted in an almost perfect organization. The general contractor was financially responsible for the entire work and directed and supervised it, strengthening financially and with equipment, any weak spots that developed. The sub-contractors were financially responsible for small portions of the work and gave this work their personal supervision, and finally a large portion of the work was performed on a piece work basis, than which a better plan for paying workmen has never been devised.

That this plan of contracting work was successful from an economic standpoint, is shown conclusively by the results obtained in the years from 1880 to 1910:

In 1880, common labor was receiving approximately $1.50 per day and earth work was let by railway companies to general contractors at about 18c. per cubic yard.

In 1910, common labor had advanced to $2.25 per day and earth work was still being contracted for at about 18c.

In other words, while wages increased 50 per cent in thirty years, the skill of the contracting firms bidding on large units of work during that period was sufficient to improve methods so that the cost to the owners did not increase.

So much for the historical aspect of the case; now as to the direct economies:

First, Economy in Manpower: The writer's firm recently constructed thirty miles of rather heavy highway under one contract and on this work, one superintendent supervised the entire job; one paymaster paid the entire job; one bookkeeper kept accounts for the entire job; one purchasing agent made all purchases for this job as well as several others; two general supply trucks served the entire line for miscellaneous supplies; one set of office and store buildings served the entire line; one employment manager secured labor for the entire line, and finally, and most important of all, the work apportioned to each sub-contractor, was of such character and magnitude that his equipment and organization were kept employed throughout the entire season, and no unnecessary moving of men and machinery was entailed.

[illegible] to go into detail as to the increase [illegible] have occurred had the work been awarded to [illegible] separate firms with five local organizations covering the ground. As a matter of fact, our bid for the work in question, was substantially lower than the lowest combination of bids on the four separate sections into which the work was divided, and we completed the work on time with a small but satisfactory profit.

Second, Economy in Use: The writer is familiar with the following condition and there are many more like it scattered over the entire country: Twenty miles of highway grading was let in four separate contracts, all for completion this fall. One of these contracts was for the reconstruction of the old highway in a location where six miles of additional distance was required in the detour. As was to be expected, this piece of work, (an unattractive job) fell to a new and unseasoned small firm which has failed to complete the work and has also failed financially, the result being, that it will be well into the middle of next summer before this portion is completed, and some fifty automobiles a day will be required to travel some six miles a day for six months, which at 10c. per car mile amounts to about $5,400.

Third, Economy in Use of Public Money: This is an economy that follows automatically from economy in manpower and economy in use. The writer's opinion is, when highway work is consolidated into projects containing from fifty to one hundred miles of work, that from 3 per cent to 10 per cent would immediately be saved in the first cost of the work, besides gaining the additional advantage of having large, well seasoned firms responsible for the completion of the work on time.

Proposed Pueblo Flood Remedies

In speaking recently before the Denver Civic and Commercial Association on "Flood Prevention in Pueblo," Arthur E. Morgan stated that the flood last June was probably more than half of the maximum flood that could occur according to investigations so far carried out. On the several methods which present themselves as a solution he commented as follows: Construction of a dam just above Pueblo is feasible but very expensive. Diversion of the channel of the river to the west bluffs would probably involve too much of a change in city properties. Increase of the present channel to more than twice its size would also probably be too expensive and involve too many property changes. Construction of a levee on the east bank of the river would be the least expensive.

Relation Between Molded and Core Concrete Specimens

Pennsylvania Test Show Concrete Drilled From Highways Higher in Compressive Strength —Specimens Often From Same Batch

By H. S. Mattimore
Engineer of Tests, Pennsylvania State Highway Department

FOR MANY years compression strength of concrete has been determined, to a large extent, by the strength obtained on specimens molded of a mix proportioned the same as that used in the structures under consideration. These specimens, at first, were made entirely in the laboratory under ideal laboratory conditions. Further development along this line was the molding of specimens at the construction site.

A study of the comparative results of these tests on laboratory- and field-molded specimens revealed, in numerous cases, a considerable difference in strengths in mixtures of the same proportions. Studies to determine the reasons for these differences have resulted in considerable progress towards rational design of concrete mixes. This is due mainly in determining many factors which have their effect on field-mixed concrete.

The ideal condition in all concrete tests is to develop methods by which we can pre-determine the strength in the structure by preliminary tests and thereby truly design the mix to meet conditions. At the present time I do not believe the art has progressed to this stage, especially as tests along this line have indicated that the general tendency of concrete drilled from the structure is to show a higher test in compression than the preliminary molded specimen would indicate.

TABLE I—COMPARISON OF MOLDED AND DRILLED CONCRETE SPECIMENS—1:2:3 MIX

Compression Strength Lb. per Sq. In.

Series No.	Molded Specimens Age Days	Max.	Min.	Mean	Drilled Specimens Age Days	Max.	Min.	Mean	No. of Spec.
1	28	4,740	2,690	3,545	330	6,061	4,210	4,728	5
2	28	4,054	2,211	3,095	300	6,070	3,980	4,543	13
3	28	3,315	2,115	2,788	300	5,452	3,860	4,706	5
4	28	4,357	2,229	3,368	300	6,585	4,185	5,288	8
5	28	3,896	2,646	3,397	320	5,001	3,047	3,907	7
6	30	3,928	3,215	3,505	300	5,672	3,868	4,966	9
7	7	1,992	1,405	1,721	60	4,599	3,402	4,044	4
8	7	2,486	2,123	2,285	90	5,454	4,769	4,993	4
9	7	2,914	1,374	2,016	150	6,598	3,930	5,304	11
10	28	3,525	1,884	2,524	400	5,468	3,539	4,669	8
11	28	3,566	2,234	3,055	460	5,468	3,676	4,954	4
12	7	2,420	1,947	2,042	80	6,286	3,517	4,561	8
13	7	2,960	1,876	2,241	140	5,613	3,664	4,399	9
14	7	3,118	1,847	2,233	150	4,423	3,345	3,634	5

Table I is a summary of data on molded and drilled concrete specimens, obtained during construction and from the finished pavement of the Pennsylvania highways. The molded specimens were cast in the field and cured under the same conditions as the pavement. These were tested either at 7- or 28-day periods. The drilled specimens are cores taken from the finished pavement by a field core drill. It was found difficult to secure these latter at given ages due to the geographic situation of the highways. Molded specimens were cast from concrete being laid in the pavement and accurate data were recorded of the exact spot where the batch was placed. The drilled specimens were taken at the same place and from the same batch as near as practicable.

It will be observed that the general tendency is toward considerably higher strengths in the drilled specimens. This is affected to some extent by the difference in age but the variation in age in the drilled specimens of the different series also indicates that other factors exert a greater influence than the age. Further, the strength of the molded specimen is not a positively reliable indicator of the strength of the concrete in place, as determined by the drilled specimen. This fact further demonstrates itself in Table II, which illustrates the detail test of one of the series from which the summary is compiled. It is also especially notable in this table that the drilled cores of the highest strengths are not always opposite the molded specimens of the highest values.

TABLE II—DETAIL DATA OF SERIES NO. 2 (Table I)

Molded Specimens Age	Strength	Drilled Specimens Age	Strength	1:3 Sand Mortar Tension 7 days Lb. per sq. in.	Cement Tensile Strength Ottawa	7 day	28 day
28	3,526	360	4,757	367	133	280	393
29	4,054	330	5,353	313	105	280	393
28	3,331	330	5,141	318	103	280	393
28	3,061	240	5,070	312	121	280	393
28	3,304	240	6,070	442	161	280	393
28	2,783	240	3,980	315	124	380	393
28	2,211	210	4,650	428	178	280	393
28	2,821	240	3,931	...	102	280	393
28	2,489	270	4,640	383	147	280	393
28	3,152	270	4,025	317	125	280	393
28	3,146	300	4,405	312	113	280	393
28	2,528	300	5,024	314	118	280	393
28	3,834	330	4,008	311	107	280	393

The taking of the molded and drilled specimens from the same batch reduces, to a large extent, the effect of a difference in consistency; in fact, special efforts were made to control the consistency in all concrete construction and determinations on this at various periods during the laying of concrete have demonstrated that it is controlled within narrow limits. This does not only refer to the one project but throughout all of the construction work.

Research work on the comparative strength values of laboratory- and field-molded concrete specimens has led investigators to seek the factors which affect the compression strength and this has resulted in valuable contributions toward this solution. Further research on the comparative strength of molded and drilled specimens should guide us toward determining the variables which affect these strengths, the ultimate result being progress towards rational design of concrete mixes. In other words, we could design mixes of known strength in a structure by preliminary tests on molded specimens. We must arrive at this stage to design mixes, either by eliminating the variables or ascertaining their value and allowing for them.

Present Value of Compression Tests.—Although preliminary tests on molded field specimens are not a positively reliable indicator of the strength of the concrete in the finished structure, they have a great value on individual projects and such control should be encouraged. Molded specimens taken at regular periods on any concrete construction will indicate any great difference in strength and lead to an investigation of causes. So far as I know, this is the only method of detecting these defects and an experience of six or seven years of this method of control has proved an economic procedure.

At the same time, I believe extensive tests should be carried on to determine the comparative relations between molded and drilled specimens. The drilled specimens furnish us with an assurance of the actual strength obtained. The test on these latter has been of inestimable value in our work. Reference to Tables I and II gives us convinci[illegible] proof th[illegible] our pavements have an excellent factor of safety so far as compression strength enters into the design.

Multiple-Batch Charging Plant for Truck Haulage

Shuttling Measuring Hoppers Under Twin Bins Charge Four Batches of Sand or Stone in One Operation

ON CONCRETE road construction late last fall, remarkably fast charging of four-compartment motor trucks with proportioned batches was accomplished by using a central proportioning plant consisting of twin bins of steel, with eight measuring hoppers so mounted on a rolling frame underneath the bins that sand or stone could be charged into four hoppers at once and four hoppers at once could be discharged into the truck compartments. Specifically, on the maximum day's run of 511 ft. of 18 ft., 6-8-6-in. slab, the outfit loaded 62 trucks with 248 six-bag batches in 9¾ hr. actual operating time. This output of material was below the practicable capacity of the charging plant as is reported by the contractor elsewhere in this article.

The plant was used by the Chas. H. Fry Construction Co., of Erie, Pa., on the Crowley Road just east of

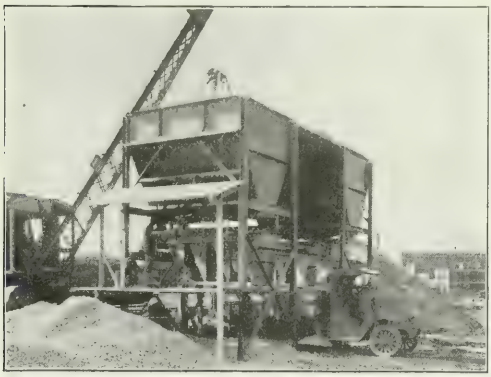


FIG. 1. CENTRAL AGGREGATE PROPORTIONING PLANT WITH TRUCK BEING LOADED

Erie. This road was 5,375 ft. long, of one-course reinforced concrete. Bids were not opened until Sept. 27 and it was several weeks before the contract was signed. However, the contractor was able to get enough grading done to start pouring concrete on Oct. 16. Due to the lateness of the season, bad weather interfered with the progress of the work, reducing the morale of the crew, and preventing its working at the efficiency which could be obtained on a longer job, or in mid-season.

The work was done under Pennsylvania State Highway Department standard specifications, and under the supervision of F. E. Winter, district engineer. Among the principal requirements of the specification were the following: A 1:2:3 mix, using coarse sand and crushed stone; the aggregate cannot be dumped on the subgrade; the aggregate must be accurately measured and each box struck off level full; the batch-meter must be set so that the concrete is in the mixing drum 1¼ min. from the time the loading skip starts down until the dumping chute is opened.

At one time the mixer crew caught up to the graders, but with this exception the progress of the work was entirely up to the mixer, where it properly belongs. City water supply was used at first, but the pressure was inadequate and caused delays until a pump was installed. At one place the pavement was laid through a subway under the main line of the New York Central and Nickel Plate railroads, and as the head room was not sufficient for the mixer, this part of the work was slow. Due to the weather conditions, the mixer crew worked only 107⅔ hours in 14 days, and under these conditions averaged 44 lin.ft. per hour. The paving organization consisted of four crews composed as follows:

Proportioning and Loading Plant: 1 crane engineer, 1 fireman, 1 man operating aggremeter and 2 men on cars.

Mixer Crew: 1 engineer, 3 men placing concrete, 1 man finishing, 2 men dumping cement, 1 water boy, 1 fireman, 2 men on tamping board, 5 laborers, 2 men setting forms and 1 pump man.

Handling Cement and Reinforcing: 1 driver with team drawing two wagons and 3 men unloading cement cars to wagons.

Hauling Aggregate: 3 truck drivers.

With these gangs of 31 men and 2 foremen, and the equipment listed in Table I, the average output was 440 ft. in 10 hours or 2.67 sq.yd. per man hour. The grading crew of nine laborers, one team and driver, and one roller engineer is not included in the above figures, as the grading was considered a separate item of the contract.

TABLE I—MAJOR EQUIPMENT LIST, CROWLEY ROAD, ERIE, PA.

1 —Type "B" Erie Crane, boom 32 ft., with ¾ cu.yd. Blaw clam shell bucket.
1 —Erie Aggremeter having two 35-ton bins and aggremeters arranged for four-compartment trucks, six-bag batch, 1:2:3 mix.
1 —21-E Foote Steam Paver with gravity chute.
3—5-ton Mack Trucks with four compartment steel bodies.
1—10-ton Buffalo-Springfield Steam Roller, with pressure cylinder scarifiers.
1—Fresno Team Scraper on fine subgrade.
1 —Electric driven Pump for furnishing water for mixer, etc.

As indicated, the central proportioning plant, Fig. 1, consisted of a revolving crane and a ¾-cu.yd. clam shell bucket; all-steel hopper bins and measuring boxes, and a cement unloading plant. The crane unloaded coarse and fine aggregate into the hopper bins or onto stock piles. Rail deliveries and stock pile space were ample and no delays resulted from lack of stock at the proportioning plant, or of material at the mixer. The outfit for measuring aggregate and loading trucks was called on to load only 2,331 six-bag batches, Table II, or 680 truck loads of three or four batches each, whereas the contractor states that it was capable of loading 2,700 trucks, or 10,800 batches in the same number of days, working 10 hours per day, enough to have laid 4 miles of the same road which would put the progress of the job up to the capacity of mixer.

TABLE II—LOADING PLANT RECORD ON CROWLEY ROAD, 5,375 FT. ONE-COURSE, REINFORCED CONCRETE

Date, Started, Oct., 1921	Lin. Ft. Concrete Placed	Batches Loaded	Truck Loads	Mixer Pouring Time, Hr.	Delay, Hrs	Cause of Delay
16	314	162	54	8		Late start
17	400	209	70	10		Planked subgrade
18	421	207	69	10	1	Snatch team on each truck for 300 ft., going
19	371	183	61	8½	1	under bridge and bursted water line
20	...	...	...	Rain		...
21	432	221	67	9	1	Going under bridge and engine trouble
22	368	168	42	8	2	Many delays repairing and replacing cable on mixer
23	256	124	36	6½	3½	Broken mixer
24	124	61	21	3½	..	End of section and moving mixer
25	345	168	43	7½	..	Late start
26	417	204	51	9½	½	Water trouble
27	202	96	24	4	..	Held up on account of grade
28	511	248	62	9	½	Mixer trouble
29	375	181	47	9	1	Held up on account of grade
30	200	99	33	4½	5½	Grading delay 2 hr. Broken mixer ½ hr.

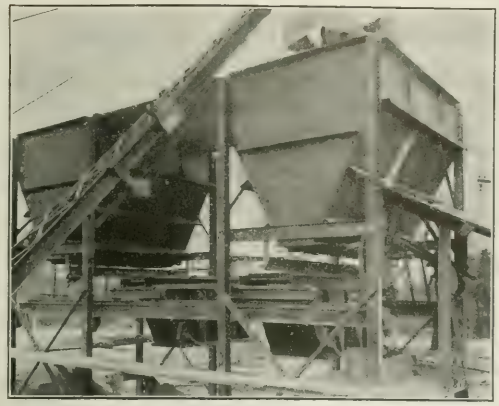


FIG. 2. BINS AND CARRIAGE WITH MEASURING BOXES

Three five-ton trucks, Fig. 3, were used to haul the aggregate to the mixer and only one laborer was required to operate the plant, exclusive of the crane and car crew. This laborer loaded the measuring boxes and moved them out over the truck for loading. The time consumed after the truck was backed under the measuring boxes, loading both fine and coarse aggregate, and until the truck pulled out, was from 60 to 75 sec. per truck. Four batches were dumped into the truck body simultaneously by the truck driver.

In detail the proportioning plant, Fig. 2 consists of two principal units: the bins of which there is one for sand and one for stone, and the "aggremeter," or measuring device, of which there is one under each bin. The bins are of all-steel construction and are so designed that they can be taken apart and shipped from one location to another. Their capacity is about forty tons each of stone and sand. This capacity allows a temporary shut-down of the equipment used in filling the bins, but it assumes that a storage pile will be used in addition.



FIG. 3. FOUR BATCH BODY WITH HINGED PARTITIONS

At the bottom of the bins are gates for discharging the material, the number of gates depending on the number of batches which are to be hauled at once. For example, if the motor truck is divided into four compartments, there will be four gates at the bottom of the bin. The bins are located side by side with a space between them into which the truck runs for loading. An operator's runway extends underneath one bin, across this space, above the truck and under the other bin.

The measuring device consists of a carriage on which are mounted the measuring boxes of the proper cubical capacity which it is desired to measure; in the above case four boxes were mounted on each carriage. The carriages are tied together so that when one carriage is being filled from the loading bin, the other carriage is in dumping position over the truck; while sand is being loaded into the measuring boxes of one carriage, for example, stone is being loaded into the truck from the other. The carriages are propelled in either direction on the runway by a single-drum, geared, reversible hand winch.

Carried under each bin at one side is a strike-off plate so located that as the measuring boxes roll along the track from underneath the bin to the loading position of the truck, they must pass underneath the strike-off plate. By this means the boxes are all struck off level full. The motor truck drives under the track extension, or runway, the carriage with each box containing the exact amount of material required for one batch is rolled out on the runway over the truck, and the material is discharged from the bottom of the boxes to the compartments of the truck.

The doors of the boxes in each carriage are all opened and closed by means of one handle operated through a spur gear reduction so that the operator can easily control the speed of opening the doors and drop the material gradually into the truck. This eliminates hammering action on the truck springs. The weight of material dropped at one time is 7,000 lb. when hauling four batches for a six-bag mixer, with a 1:2:3 mix, and if this material were dropped suddenly, the life of the truck would be greatly reduced. The effect of this blow is further lessened by the fact that the cab of the truck does not have to clear the bottom of the boxes since the boxes are rolled out into place after the truck is in position. Otherwise the material would drop three or four feet further than it does.

A plant having four-batch boxes can be quickly changed to load trucks having two or three compartments by a simple latching device, which enables the contractor to use trucks of different capacity without delay. The size and proportions of the batch can be changed quickly by bolting fillers to the vertical plates of the measuring boxes.

This new proportioning plant was built by the Erie Steel Construction Co., Erie, Pa.

Philadelphia Urged to Hasten Sewage-Works

In urging that the city of Philadelphia expedite its program of intercepting sewer and sewage-works construction, for which the Commissioner of Health granted a permit Aug. 30, 1915, Dr. Edward Martin, the present commissioner, made the following statements in a letter sent to the City Council late in December, 1921: "Since 1912 the city of Philadelphia has made examinations of the water of the Delaware River to determine the amount of dissolved oxygen which it contains, and each year shows decreasing amounts. Observations made last September show that the water of the Delaware is now polluted to a serious extent, as evidenced by the almost complete exhaustion of oxygen in certain samples. The excessive sewage pollution of the river is also shown by the practical cessation of the shad fisheries at Gloucester, as the water is so polluted by sewage that the shad no longer come up the Delaware River for spawning purposes."

Alternating-Stress Fatigue Restricted to High Stresses

First Report of Joint Committee on Fatigue of Metals—An "Endurance Limit" Discovered, Below Which Stress Repetition Is Borne Indefinitely—Limit Appears Related to Ultimate Strength

DEFINITE results of great significance have been brought to light by the co-operative joint investigation of the fatigue of metals which has been under way during the past two years in direct charge of Prof. H. F. Moore at the Illinois Engineering Experiment Station, Urbana. After the early discovery that the test technique produced highly uniform and comparable results, it soon developed that no fatigue failures occurred so long as the extreme fiber stress applied in the reversal was kept below a certain fixed limit. This limit ranged from about 25,000 lb. for the softest steels to nearly 100,000 lb. for the strongest. Further, on comparing the values of the endurance limits for the different steels tested with the values of the other physical properties of these steels, no relationship could be found with any except ultimate strength and Brinell hardness. In other words, the ultimate strength and the hardness of a steel appear to be (roughly) representative of the endurance strength of the metal, or the stress which may be applied *without development of fatigue*. Roughly, the endurance limit appears to be about *one-half the ultimate strength*, and 250 *times the Brineli hardness number*. A report of the work to date is just being issued by the Engineering Experiment Station as Bulletin 124, by H. F. Moore and J. B. Kommers.

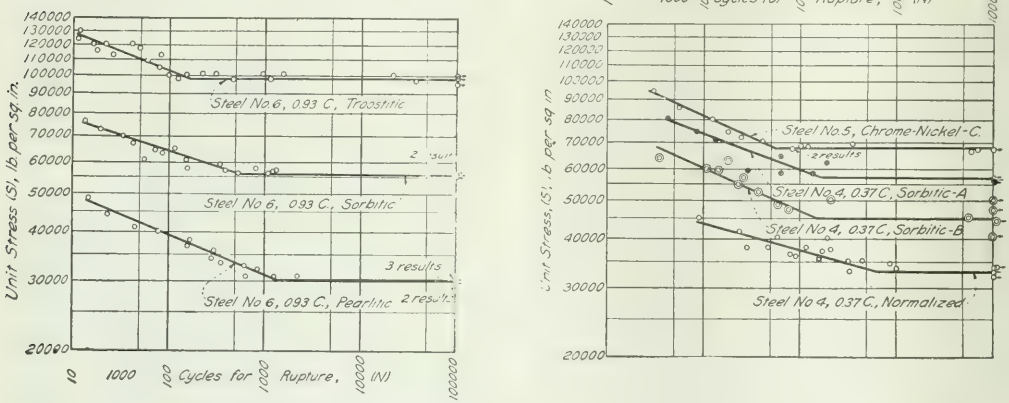


FIG. 1. RELATION OF UNIT STRESS TO NUMBER OF STRESS REPETITIONS FOR SEVEN TEST SERIES, EXHIBITING THE ENDURANCE LIMIT PHENOMENON

General Scheme of Work Done

Steels only were tested in the work so far reported. These ranged from very-low-carbon ingot iron to steel of 1.20 C, and to 3½ per cent nickel and chrome-nickel steels. Most of the metals were subjected to several different heat treatments. Thus a large range of steel grades was tried, with ultimate strengths ranging from 42,000 to 188,000 lb. per sq.in., yield point from 19,000 to 130,000, and elongation from 8 to 48 per cent. Cylindrical test specimens of each material, of 0.30-in. minimum diameter (ends slightly enlarged to insure breakage near center) and 13-in. lengths were tested in reversed bending by rotation when supported in a small machine arranged like a lathe and loaded by a weight hung from two ball-bearing collars clamped on the specimen; the specimen was rotated by electric motor. The test apparatus is a development of those devised by Wöhler, Sondericker and Farmer.

For any one test, the loads on the rotating beam were adjusted to produce a predetermined extreme-fiber stress at the middle of the specimen, and the machine was started rotating; the revolution count was taken when the specimen broke. It should be remarked that all specimens were polished by a definite process, identical for all, in order to minimize the influence of surface imperfections or roughnesses on fatigue fracture.

When the number of reversals required for fracture at one stress had been determined, a slightly lower stress was tried, and so on until a series of values was obtained. When numerous readings of this kind were plotted (to logarithmic scale), sloping lines as seen in the left half of the curves in Fig. 1 were obtained, these lines representing an exponential relationship between stress and number of reversals. Below a certain unit stress, however, failure did not occur even at 100,000,000 cycles. In the neighborhood of a certain critical value quite variable numbers of cycles were obtained in different tests with substantially the same unit stress, as indicated in the plotted points in the first curve of Fig. 1. The phenomenon indicates the existence of a limiting stress defined by a sharp break in the curve from inclined to horizontal, below which stress the faitgue action which causes failure at higher stresses appears to be absent.

Curves of exactly this character were obtained for all of the tests (covering steel only). Seven of them are represented in Fig. 1, of which the last four represent typically consistent results, departing but little from the mean curve, while the first three contain somewhat

more erratic results. In the plots, each point generally represents a single test.

Fatigue Also Measured by Heating—Various other methods of measuring fatigue were tried, such as bending on an Upton-Lewis machine, reversed torsion on an Olsen-Foster machine and measuring the temperature rise produced by a very small number of repetitions. The last named method, worked out by J. W. Harsch and W. J. Putnam, gave very definite results as represented in Fig. 2, in which the abscissas, representing galvanometer divisions of a thermocouple current, represent a temperature rise after 30 sec. rotation of the loaded specimen at a speed of 1,000 r.p.m. (for the two right-hand curves in Fig. 2 the time of run was 2 min.). There is a sharp break in each of the curves of heating, unmistakably present, indicating a suddenly increased heat development when the stress applied in the reversals passes a certain value. The assumption that this limiting stress value corresponds with that obtained in the failure test is borne out by the tabulated figures and by the graphical comparison in Fig. 3, where the plotted curves for rotating beam endurance limit and heating endurance are seen to be in excellent agreement.

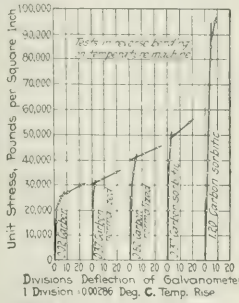


FIG. 2. THE HEATING LIMIT OF STRESS REPETITION

In Fig. 3 are plotted also the curves for the other mechanical properties of the various metals tested. Except for hardness and ultimate tensile strength, they do not seem to be related to endurance; this applies to impact, repeated impact, and proportional elastic limit. The lack of any correspondence of these qualities with endurance, as contrasted with the close agreement of endurance with tensile strength and hardness, makes the two latter properties and the heating (which is determined by a test requiring only a few minutes) only the more significant as giving a simple index of endurance of steel to stress repetition or reversal.

Minor Influences on Endurance Limit—The experiments were so directed as to furnish also a few data on the influence of shape of test piece and surface finish on endurance limit. It was found that a semicircular groove of ¼-in. radius at the smallest part of the section reduced the strength about 8 per cent, square shoulders about 51 per cent, and a V-notch about 60 per cent. The effects on the softest steel and on fairly hard steels were quite similar.

Various degrees of ground and polished finish were tried in comparison. A high rouge polish gave only slightly higher endurance strength than the standard finish adopted for the main series of tests, while specimens with a ground finish were slightly weaker and smooth-turned specimens still weaker. The difference between rough-turned and rouge-polished specimens was about 18 per cent.

Overstress ranging from 10 to 35 per cent applied several hundred times (10 per cent overstress applied 5,000 times) did not affect the endurance limit appreciably, though 29 per cent overstress applied 5,000 times (the regular series of repetitions then following) reduced the endurance limit 11 per cent. This indicates that a few repetitions of relatively high stress preceding or interspersed among the regular repetitions of stress below or up to the endurance limit are of no significance with respect to the life of the piece.

Raising the elastic limit by cold working did have a slight effect on the endurance limit, both in the case of a 0.18 per cent steel and in the case of cold drawn screw stock of 0.20 per cent carbon; in the case of the latter the effect was noticed by slight reduction of the endurance limit by annealing. The effect of hardening and tempering appears to be represented quite accurately by the increase in tensile strength and hardness caused by the treatment. It follows that if a material is given a sorbitic structure by heat treatment its endurance limit may be greatly increased without much sacrifice of ductility.

The interesting fact is revealed by the figures that the endurance limit may be higher than the tensile elastic limit. This was observed most markedly in the case of the softest steel tested, a material which was almost pure ferrite.

Further work now under way in this fatigue investigation includes: (1) Work on stress repetition (as distinguished from alternation); several steels have already been tested, and there are indications that the results will be similar to those obtained for alternating stress, though showing a somewhat higher endurance

RESULTS OF ALTERNATING STRESS ENDURANCE TESTS ON STEEL

Steel	Tension: Elastic Limit	Tension: Proportional Limit	Tension: Yield Point	Tension: Ultimate	Tension: Elong. per Cent	Tension: Reduction of Area per Cent	Brinell Hardness	Endurance Limit Rotating Beam Machine	Endurance Limit Heating Method
0.02 Carbon—as received	14,400	16,100	19,000	42,400	48.3	76.2	69	26,000	26,000
Hot-rolled, 0.18 C—as received	37,600	38,200	40,300	61,500	41.0	66.7	.	28,000	27,000
Reduced to 0.48 in.	60,100	60,000	63,300	67,600	22.3	63.3	.	35,000	38,500
Reduced to 0.44 in.	70,500	69,600	None	73,400	14.2	59.5	.	41,000	40,500
Heat-treated and straightened	.	.	.	.	.	.	.	30,000	.
Cold-drawn, 0.20 C—as received	52,200	55,200	None	86,800	13.8	49.3	.	41,000	41,500
Annealed at 1300° F.	25,000	26,700	29,500	56,600	41.3	65.5	.	29,000	27,500
Annealed at 1550° F.	24,600	28,000	30,000	57,700	40.8	63.2	.	25,000	.
0.37 Carbon—Normalized	44,000	44,000	44,000	71,900	29.4	53.5	132	33,000	31,000
Sorbitic—Treatment A	82,000	80,000	84,000	102,600	23.3	65.1	209	57,000	.
Sorbitic—Treatment B	60,000	61,000	64,000	94,200	25.0	63.0	.	45,000	45,000
0.49 Carbon—Sorbitic	67,000	67,000	69,000	96,900	23.5	57.8	197	48,000	48,000
0.52 Carbon—Normalized	47,000	45,000	47,000	98,000	24.4	41.7	193	42,000	41,500
Sorbitic	79,000	80,000	84,000	111,400	21.9	56.6	237	55,000	55,000
0.93 Carbon—Pearlitic	27,000	28,000	33,000	84,100	24.8	37.2	163	30,500	28,000
Sorbitic	59,000	60,000	67,600	115,000	23.0	39.6	237	56,000	55,000
Troostitic	112,000	97,200	None	148,000	7.7	23.6	430	98,000	90,000
1.20 Carbon—Normalized	49,000	58,000	66,000	116,000	7.4	11.6	229	50,000	44,000
Sorbitic	119,000	120,000	144,000	179,900	9.0	15.2	369	92,000	88,000
Mixed—Treatment B	85,000	82,000	91,000	111,000	23.6	60.2	242	63,000	60,000
Chrome-nickel—Treatment A	117,200	115,000	128,100	158,200	18.2	61.8	321	68,000	70,000
Treatment B	99,700	101,700	103,700	161,000	24.2	68.7	247	65,000	65,000
Treatment C	86,300	86,200	100,500	114,200	23.2	69.1	248	67,000	70,000

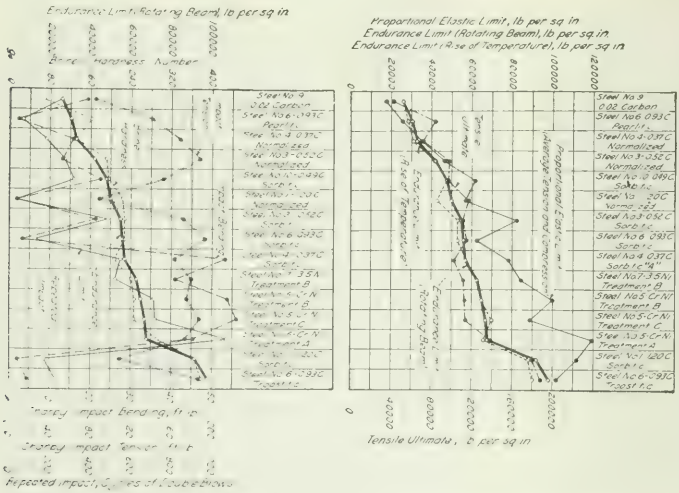


FIG. 3. ENDURANCE LIMIT PARALLELS VARIATION OF ULTIMATE STRENGTH AND HARDNESS

limit. (2) Apparatus for tests in reversed torsion and in reversal of direct stress (tension and compression) is being developed. (3) The investigation is being extended to some non-ferrous metals and to a fuller study of heat treatment.

Sydney Harbor Cantilever Bridge Design

ACCORDING to the official design for the proposed Sydney Harbor bridge, connecting Dawes Point on the south and Milson's Point on the north, a cantilever structure with a main span of 1,600 ft. c. to c. piers and a width of 98½ ft. between truss centers is required. The suspended span is to be 600 ft. long and the cantilever arms 500 ft. each; the anchor arms being of the same length as the cantilever arms, the total length of the cantilever structure between centers of anchorage becomes 2,600 ft. There is an approach at either end of three spans of about 200 ft. each. The total length of the steel structure is 3,816 ft.

Rock is at relatively shallow depth at all the pier sites. The main piers require to be built in tight cofferdams (or by compressed air), but the excavation for the anchorages and approach piers is entirely above sea level and should cause no difficulties from water.

The main cantilever structure, which is to have a clearance height of 170 ft. above high water at midspan, has a straight bottom-chord line, following the side gradients of 2½ per cent merging into the level line of the suspended span. The trusses are 270 ft. deep at the piers, and 100 ft. deep throughout the length of the suspended span; the top chord drops from the tops of the main posts to tangency with the central portion along a parabolic arc, and in somewhat similar outline, but with a circular arc, to the tops of the end batter posts over the anchorages. There are only two trusses. The web system is subdivided Warren, with main panels of 200 ft. adjacent to the piers and 150 ft. elsewhere, each subdivided into four sub-panels by means of main verticals and a sub-post system. The roadway is to consist of a railway section carrying four tracks spaced 12 ft., and a 35-ft. highway section protected on each side by a steel balustrade. Outside the main trusses, carried on floorbeam cantilevers, there is to be an 18-ft. motor roadway on one side and a 15-ft. footway on the other.

Four lines of trusses are used in the approach spans. These are deck trusses, also of the subdivided Warren type, with four sub-panels per main panel. Here as well as in the main span the motor roadway and footway are carried on floorbeam extensions.

Alternate designs may be offered by bidders, according to the call for bids. The plans prepared by the chief engineer, J. J. C. Bradfield, must be followed in their salient features, but length of spans, outline of trusses, web system, and other features may be changed for the sake of economy and improved appearance. No limitation is made as to the grade of steel to be used or the design details. Bids must be delivered to the under secretary for public works at Sydney by Oct. 31.

Bronze Versus Steel as Material for Waterwheel Buckets

IN THE early days of hydro-electric development the buckets used in impulse waterwheels were usually made of bronze. Now the majority of impulse wheels are being equipped with steel buckets. Reasons cited by Western engineers in explanation of this apparent change in standard practice are as follows:

The average size of impulse units built ten or twelve years ago was comparatively small; the usual requirements for buckets being such as would best suit jets 2 or 3 in. in diameter. Because of rapid cooling of metal in molds, it was hard to get first-class steel castings in such small sizes and the high percentage of rejections on account of poor castings made bronze buckets considerably cheaper than steel.

The trend toward larger sizes in recent years is shown by the fact that impulse wheels recently built are driven by jets 10 or 11 in. in diameter and have buckets 28 to 30 in. wide that weigh up to 2,200 lb. apiece. In these large sizes the average of steel castings is greatly improved and because the present steel bucket will outwear the bronze bucket, steel has become the more satisfactory material and is also considered cheaper in the long run.

One Reclamation Project Pays Up

The sixth building installment was due the U. S. Reclamation Service on Dec. 1, 1921, by the Orland Unit Water Users' Association. It paid all of the $44,388.63 except $3,741.54 on time. Practically the whole amount was collected and paid by Jan. 1. When so many projects are clamoring for a suspension of payments the record established at Orland is considered especially gratifying to the Reclamation officials.

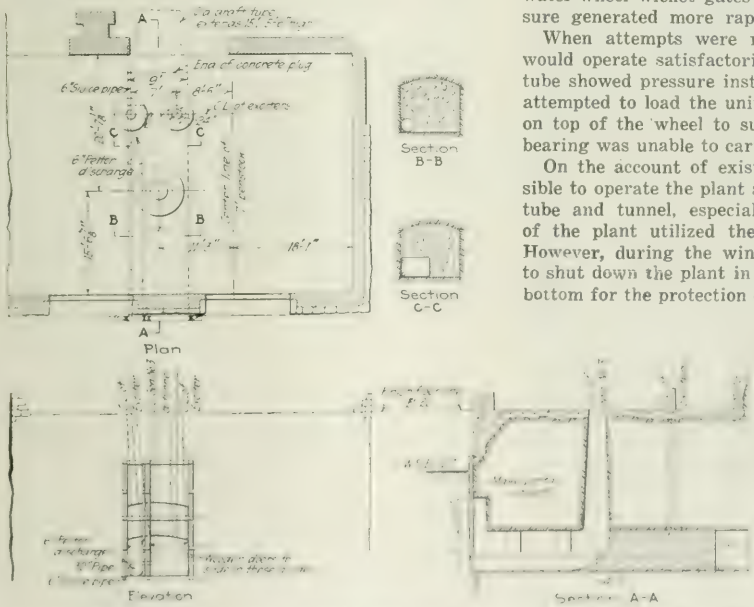
Draft-tube Back Pressure Cured at Roosevelt Power Plant

Tail-Race Discharge From Exciter Units Set Up Pressure in Main Unit Draft Tube in Same Tunnel Opening

By C. C. Cragin
General Superintendent and Chief Engineer, Salt River Water Users' Association, Phoenix, Ariz.

AT THE water-power plant located at the Roosevelt Dam a peculiar back pressure in the draft tube of one of the vertical water-wheel units developed which, due to bearing trouble, has kept the unit out of commission most of the time since its installation.

The conditions as they existed were about as follows: This draft tube discharged vertically into a tunnel which also carried to the tail race the discharge from two exciter unit water wheels, two small Pelton wheels driving oil pumps and also the drainage from the sides of the cliff into which the power plant was partially built. All of these discharged into the tunnel back of main unit draft tube. The water discharged from the Pelton wheels and the drainage discharged from the cliffs had considerable fall into the tunnel through pipes and both carried considerable air into the water in the tunnel.



DETAILS OF REPAIR WORK ON DRAFT TUBE AT ROOSEVELT DAM POWER PLANT

With the main unit standing idle and the gate to the water-wheel case closed, an air pressure would build up in the wheel case which reached a maximum of about 15 lb. per sq.in. When the air was allowed to escape through a 2½-in. connection, then water from the draft tube would flow continuously through this pipe. If the manhole cover on the water-wheel case located at the level of the wheel was removed, water would pour out of the manhole for several hours gradually falling off in amount until it ceased. The tail-water level was about 9 ft. below the bottom of the wheel, and the total vertical height of the draft tube above the tunnel roof was about 20 ft.

The action that was evidently going on was about as follows: The drainage discharge conduits which entered the tunnel at an angle of about 75 deg. to the horizontal was probably not filled with water and consequently the water that was flowing therein at high velocity was carrying large quantities of air into the tunnel. Also the discharges from the two small Pelton wheels were carrying considerable quantities of air, as was evidenced by a suction around their bearing housings, the tail-water conduits being enclosed. This air entered the tunnel, then, about 12 ft. back of the main unit draft tube. The tunnel roof being level, this air probably moved slowly along it and probably collected in large bubbles and rose in the main unit draft tube which was the first opening in the tunnel roof to be encountered. The continuous collection of air and the surging of the water due to wave action and probably other conditions inside the tunnel caused the compression of the air and the support of the water column in the draft tube even after the top of the draft tube was partially open to the atmosphere when the manhole cover was removed. Under this latter condition it is probable that the water-wheel wicket gates were closed so that the pressure generated more rapidly than it was discharged.

When attempts were made to operate the unit it would operate satisfactorily without load but the draft tube showed pressure instead of vacuum. When it was attempted to load the unit the pressure would build up on top of the wheel to such an extent that the thrust bearing was unable to carry the load.

On the account of existing conditions it was impossible to operate the plant and do any work on this draft tube and tunnel, especially because the exciter units of the plant utilized the same tunnel for discharge. However, during the winter of 1920 it was necessary to shut down the plant in order to do work in the river bottom for the protection of the Roosevelt Dam. At the same time this tunnel was reconstructed, and the discharge from each of the separate sources using the tunnel was brought to the tunnel portal in separate conduits. The main unit draft tube was connected into the tunnel with gradually curved surfaces. In order to do this work it was necessary to construct a coffer-dam in front of the tunnel portal, as the leakage from the reservoir was in excess of the pumping capacity installed for unwatering. The coffer-dam was constructed of lumber forms and concrete as the bottom was rough rock through which it was impossible to drive piling. The tunnel was unwatered by a motor-driven pump. Stop-log slots were constructed at the tunnel portal for future use.

Since completion of the work the unit has operated satisfactorily for nine months with a vacuum of approximately 10 in. of mercury.

Paving Slab and Subgrade Studies in Illinois

Rational Design of Rigid Slab Roads Made Possible by Research Conducted During Two Years by the Division of Highways—Abstract of Paper Before State Highway Officials Association

By Clifford Older
State Highway Engineer, Springfield, Ill.

SINCE October, 1920, ten investigators have been engaged in research work for the Illinois division of highways. Investigations have been made of (1) subgrade moisture; (2) subgrade bearing power; (3) subgrade uniformity; (4) frost action; (5) temperature effects; (6) impact; (7) repeated loads and (8) position of load for maximum stress. Based on the results *a rational method of designing paving slabs has been arrived at.*

Subgrade Moisture:—Fig. 1 is the moisture content curve of the subgrade of the Bates Road (*Engineering News-Record*, Aug. 18, 1921, p. 214) expressed as a percentage of the dry weight of the soil, which is the brown silt loam of the Mississippi valley corn belt, a finely divided material that ordinarily would be called a clay soil. The moisture content of the soil in proximity to edges and cracks was at no time materially different from that observed elsewhere. At a point where a tile drain, with a cinder backfill, was laid 30 in. below each edge of the pavement for a distance of 200 ft., the moisture samples show no variation from those obtained elsewhere. A trench about one foot from the edge of the pavement, leaving the shoulder undisturbed between the edge of the trench and the slab, was kept filled with water for three weeks. Although the nearest sampling stations were only 30 in. from the edge of the trench, the moisture content of the subgrade at these stations showed no increase and no variation from that at other points under the pavement.

Blocks cut out of the subgrade so as not to disturb the natural compaction and then frozen and thawed out, were immersed in water; most of them fell to pieces upon immersion. Samples not frozen remained practically intact and absorbed moisture slowly. From these tests, it seems that although a clay subgrade may resist, markedly, saturation from an occasional rain fall, yet the same soil may quickly become saturated after a freeze.

Subgrade Bearing Power:—An apparatus was devised by which loads up to 50 lb. per square inch could be repeated indefinitely on subgrade soils in place. The results point strongly toward the conclusion that a soil, having a given moisture content, may under repeated loads have a fairly definite elastic limit. This for Illinois soil containing at times 40 per cent moisture is very low, probably less than 1 lb. per square inch.

The general behavior of subgrade soils as determined on small areas by this machine were closely confirmed by loading concrete slabs having areas of several square feet, which were cast on the same subgrade; the first few light loads caused permanent depressions.

Different points on the same subgrade soil, although having the same moisture content, did not exhibit uniform results. This is considered to be due most likely to inequalities in compaction.

Subgrade Uniformity:—There were installed in the Bates Road many subgrade cylinders each having a brass disk in contact with the subgrade, and a reference plug screwed in the cylinder in such a manner that measurements taken from the plug to the brass disk would show the relative position of the subgrade and the pavement slab at any time. Readings were taken once each week. They show distinctly a periodic separation of the pavement slab and the subgrade due to the warping of the slab under temperature changes. They show, also, to a very marked extent erratic variations due in all probability to uneven settlement of the subgrade due to uneven compaction. Some show a separation of as much as ½ in. over areas of considerable magnitude. At practically all a separation has occurred at one time or another.

Frost Action: Observations of frost heaving on the Bates Road were made during the winter of 1920-21. Precise levels showed a heaving or lifting of the edges of the slab throughout the entire length of the road, at a much more rapid rate than at the center. On sections where a longitudinal joint was provided, the edges of the pavement slabs lifted about ⅝ in., while the center lifted about ¼ in. Many sections not provided with longitudinal joints showed approximately the same behavior; all such sections when examined in the spring were found to be cracked longitudinally.

Temperature Effects: Tests undertaken to determine whether or not the subgrade under a corner of a slab would be compressed under repeated loads to such an extent as to afford no definite support to the pavement, disclosed that at night the slab corner under load might be at a higher elevation than the unloaded corner during the day.

Fig. 2 shows the air temperature and the vertical movement of the corner of a 9-in. plain concrete slab loaded and unloaded. This diagram is typical of several hundred. Hourly elevation readings to thousandths of an inch were taken by means of Ames dials. The 6,000-lb. load was applied to the corner for three minutes each hour. Under this load the computed fiber stress in the slab was 220 lb. per square inch. For about two-thirds of the 54-hour period the 3-ton load did not depress the corner to its unloaded afternoon position. It is obvious that the subgrade offered but little if any support for two-thirds of the time.

Fig. 3 shows the curvature of a 7-in. slab on a line bisecting the corner angle. The upper solid line, diagram A, shows the upward warped position of the surface of the slab along a 45 deg. line from the corner to the center of the pavement. The upper dashed line shows the position of the slab while a load of 6,000 lb. was applied on an area of 2 sq.in. at the corner. The lower solid lines show the position of the unloaded slab at the point of maximum downward deflection. The lower dashed line shows the position of the slab under the 6,000 lb. load when applied during the

TEST FACTS THAT AFFECT DESIGN

1. The moisture content of subgrade soil is only slightly influenced by the proximity of cracks and joints in the slab or by drains or by ponding.

2. A soil, for a given moisture content, under repeated loads, has a fairly definite elastic limit—for saturated Illinois soil it is less than 1 lb. per square inch.

3. There is continually a separating and a coming together of the slab and the subgrade owing to movements of both.

4. Under frost action—heaving due to freezing—the slab edges rise faster and more than the center of the slab.

5. Under temperature action the slab curls up or down at the edges, the action being periodic, sufficiently to render subgrade support ineffective.

6. Slab corners formed by cracks or joints, to resist breaking must be designed as unsupported cantilevers.

7. Slabs designed to carry maximum loads at unsupported right-angled corners are of ample strength throughout.

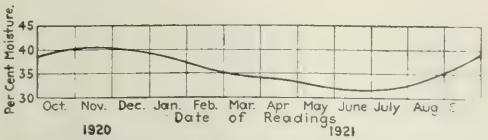


FIG. 1 SUBGRADE MOISTURE CURVE, BATES EXPERIMENTAL ROAD

day. It is obvious that the slab corner acted purely as a cantilever in supporting the night load. It is also obvious that, as the increased deflection was not as great when the load was applied during the day as when applied at night, subgrade support had some influence on the amount of deflection. The computed fiber stress of the concrete, considering the corner as a cantilever under the night load,

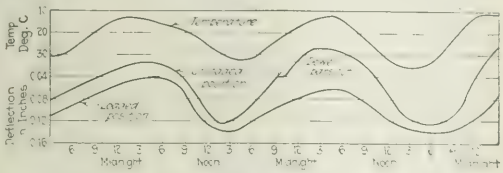


FIG. 2. DAILY VARIATION IN DEFLECTIONS OF SLAB CORNER UNDER LOAD

amounts to 368 lb. per square inch which is certainly not too low for the working stress of plain concrete. It is obvious that a much greater load with a correspondingly high fiber stress would be required to deflect the corner to contact with the subgrade at night.

Diagram B, Fig. 3, shows the effect under similar conditions of a longitudinal crack or joint. The warping effect does not pivot about the center of the half slab as defined by the longitudinal joint. Even in this case the upward warping of the slab due to temperature effects was greater than the downward deflection of the slab, under the 6,000 lb. load producing a fiber stress of 368 lb. per square inch.

Fig. 4-A shows the edge of an 8-in. pavement slab and the subgrade below. The white card on the left is rigidly attached to the slab. The card at the right is fixed to the subgrade at some distance below the base of the pavement.

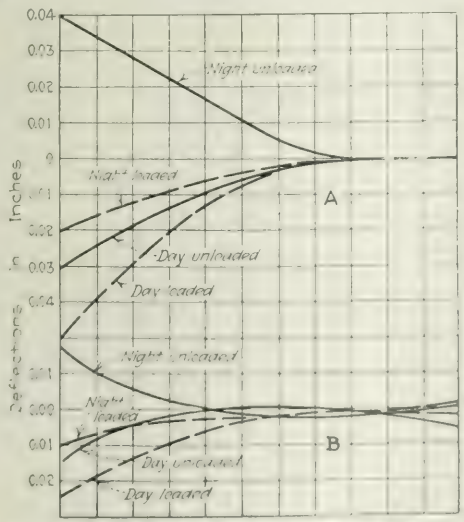


FIG. 3. CURVATURE OF SLAB ON LINE BISECTING CORNER ANGLE

The black line was drawn across the two cards at mid-day while the sun was shining. Fig. 4-B taken at midnight, shows a distinct crack in the earth subgrade a short distance below the bottom of the pavement; and shows the offset in the line caused by the upward movement of the slab. A load of four tons on the edge of the pavement failed to close the offset or the visible crack in the subgrade.

By means of the brass disks of the subgrade cylinders located in a row across the pavement slab, the relative movement of the slab and the subgrade was confirmed. In many cases these measurements indicated positively that the downward curling of the edges during the day lifts the center of an unbroken slab entirely free from the subgrade

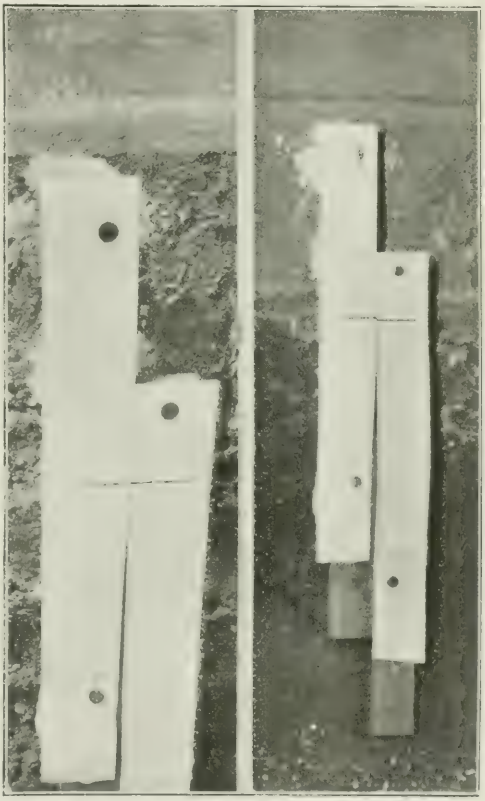


FIG. 4. OFFSET IN MARKED LINE SHOWING LIFT OF SLAB EDGE

near the center. They indicate also a permanent depression of the subgrade at the edges of the pavement under this condition, although a partial recovery occurs at the edges curl up at night.

Monolithic brick pavements exhibit practically the same degree of warping as concrete slabs. The effect is much reduced when a bituminous concrete surface is applied. It is similarly reduced when a brick wearing surface has a bituminous joint filler is used on a concrete base. Fig. shows the edge movement of various slabs. All readings were taken practically simultaneously for 24 hours.

Special attention is called to the slight warping of [illegible] paving plates surface materials of considerable thickness. Attention is also called to the comparatively small warping of the concrete slab having a longitudinal joint.

Warping of rigid slabs away from the [illegible]

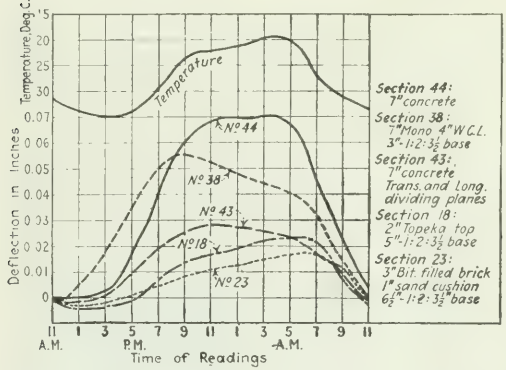


FIG. 5. EDGE MOVEMENTS OF VARIOUS PAVEMENTS

open channels for the free passage of surface water to all parts of the subgrade. This was observed many times. Throughout the year with distressing regularity, free water was found in the subgrade cylinders after heavy rains.

Position of Loads for Maximum Stresses: Fig. 6 indicates conditions which may apply along the edges of a pavement slab. Diagram A represents the deflection readings of an Ames dial placed at the edge of the pavement during the passage of a four-ton wheel load along the edge of the slab as close to the dial as feasible. The dial in this case was placed at some distance from the nearest transverse crack. It is of interest to note the shape of the curve showing the deflection of the edge at the dial as the wheel passed and the total amount of this deflection.

Diagram 6-B shows the curve of deflection when two dials were placed on the corner formed by a transverse crack.

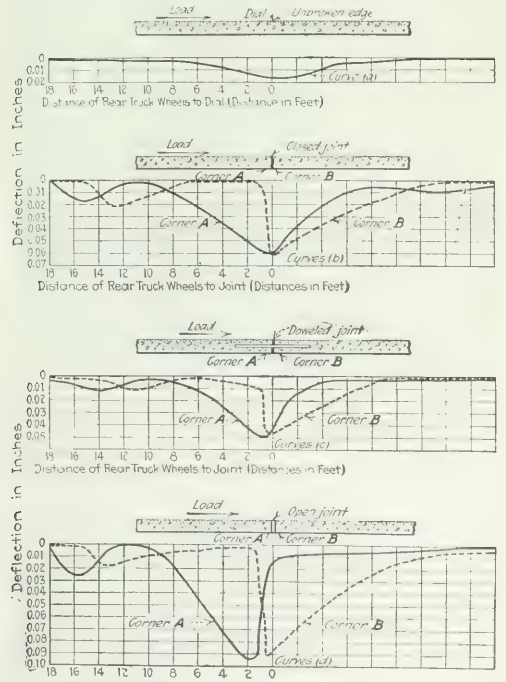


FIG. 6. DEFLECTION OF DIFFERENT JOINTS UNDER MOVING LOAD

In this case the crack was very fine, the observations having been made during a period of high summer temperature when the slab was expanded and apparently all cracks closed very tightly. Note that the total deflection is much greater than shown in Diagram A, although it is apparent that the closed crack prevented each corner from acting independently. Diagram C shows a similar condition in which, although the crack was open, short dowell bars passed across it. Note that the deflection is approximately the same as that which occurred at the closed crack.

Diagram D shows the very marked effect occasioned by an open crack or joint with no dowell bar or other means for causing both corners to act together. Deflections of the center of a slab under load were two small to be platted to this scale. While deflections only are platted in these diagrams, yet strain gauge measurements show the same proportionate results. As stresses are in proportion to strains the position of loads to produce maximum slab stresses are easily apparent from these diagrams. All of these deflections are platted from observations on slabs of

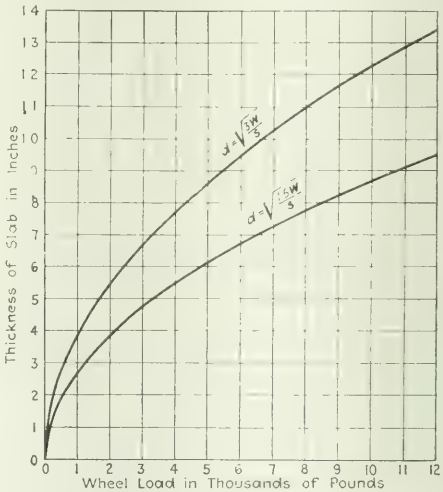


FIG. 7. REQUIRED SLAB THICKNESS FOR DIFFERENT LOADS

the same thickness and taken during the night when the edges of the pavement were not in contact with the subgrade.

Design of Rigid Pavements: In the light of conclusive evidence that an uncovered rigid slab may become warped by temperature effects so that it will, for from 8 to 12 hours out of every 24, be completely unsupported along the edges by even the best of subgrades, and considering the probability that at least on clay subgrades at certain seasons of the year the soil may have an exceedingly low supporting capacity, and further considering the fact that during the period of greatest subgrade saturation which no doubt occurs immediately upon the thawing out of the ground in the spring when low temperatures prevail, the cracks are open the maximum amount, *it would seem that to resist local breaks it is necessary to design the corners of the pavement as unsupported cantilevers.* Unbroken edges are far less susceptible to traffic breaks than corners, as is clearly illustrated by Fig. 6.

It is the belief that if the pavement be designed to carry the maximum load at the corners in accordance with the formula $d = \frac{3W}{S}$ which covers conditions at unsupported right-angled corners, the remainder of the pavement will be well able to carry the same load without breaks which would damage its usefulness as a pavement surface.

If means could be found to make both corners act to-

gether by placing longitudinal shear bars along the edges of the pavement, or by some other means and the corner weakness thus be reduced by one-half, the design formula $d = 1\frac{1}{2}W/S$ could be used with a reasonable degree of safety.

In order that all possible corners might be taken care of, it is believed that the position of the longitudinal crack should be controlled by constructing a longitudinal joint and the adjacent slabs held in close contact by transverse tie bars. The interior corners, being held in close contact along the longitudinal joint by the transverse tie bars, should be fully as safe as the edge corners. The shear bars along the edges should also be continuous in order to take care of corners formed by transverse cracks regardless of their position.

Fig. 7 shows the thickness of slab required if designed in accordance with the formulas heretofore given, assuming a safe working stress for 1:2:3½ concrete in tension of 200 lb. per square inch. The upper line is platted from the formula $d = \frac{3W}{S}$ and the lower line the formula $d = \frac{1\frac{1}{2}W}{S}$. The result of our fatigue tests although not yet complete seems to indicate that a working stress higher than 200 lb. per square inch may be safe for concrete of the quality ordinarily used in road construction.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Turkey Creek Sewer Design

Sir—In an exceedingly interesting description of the Turkey Creek Sewer, in the *Engineering News-Record*, Nov. 17, page 825, I was greatly surprised to note the method of design of the box section. To quote the author of the paper: "The top and bottom were each assumed to act as a continuous beam of two spans. * * * Side walls were computed as a simple beam * * * "

Why was the section analyzed along such lines, when the complete analysis of the box section could easily have been obtained and would give results much more consistent than those obtained by the methods used? Thus the effect of the loading on the roof is carried into the side wall and conversely. It seems strange to think that more exact methods were not followed since the proper reinforcing of the rigid box is vitally dependent upon the computation of all the moments and not only upon those obtained by breaking up the box into separate units.

Bulletin 8 of the Engineering Experiment Station, University of Illinois, has completely analyzed the stress system in various types of frames and its seems both a matter of economy and of efficient design to employ the results conveyed in the *Bulletin*.

GEORGE PAASWELL,
New York, Nov. 19, 1921. Consulting Engineer.

[This letter was submitted to Mr. Ludlow, who has reported as follows.—EDITOR.]

Sir—Among the many bulletins of the University of Illinois in my library I fail to find *Bulletin 8*, and acording to the list of bulletins in their more recent publications it is marked "none available." I was also unable to find it at our public library so that I do not know to what Mr. Paaswell refers.

Without knowing what the method is of which he speaks I have no doubt that it was used as the structure was analyzed by all the methods that seemed at all applicable and the results compared.

Before the section shown was finally adopted it was submitted for checking as to strength to the engineering departments of the various railroads under which the sewer will pass and was approved by all of them. As they were interested both in getting a structure of ample strength and at the same time in keeping down the cost so as to make the amount they would have to pay as small as possible it is evident that their methods of analysis, whatever they were, must have agreed closely with my own.

I regret that I cannot at this time furnish Mr. Paaswell with a comparison of results obtained by the method criticised and the various other methods used. When I severed my connection with the sewer division of Kansas City 2½ year ago, I left all these calculations in the office and have none of them in my possession at this time.

Kansas City, Dec. 10, 1921. A. D. LUDLOW,
Consulting Engineer.

Strength of Suspension-Bridge Cable Wire Definitely Known

Sir—The Delaware River Bridge Joint Commission recently made a highly important and far-reaching decision relative to the construction of the new Philadelphia-Camden suspension bridge. Acting on the report and recommendation of the chairman, Ralph Modjeski, the commission unanimously decided that the cables of this bridge should be made of parallel, galvanized wires with independent suspended stiffening trusses rather than of eyebars or any other form of cables. This decision was based first on past experience in the use of wire cables for long-span suspension bridges as exemplified in the Niagara, Brooklyn, Williamsburgh and Manhattan bridges as compared with the experimental character of eyebar cables, and second on the comparative cost, which is estimated to be for wire cables about one half that of eye-bar cables.

To this might be added another reason which was no doubt considered by the board (though not mentioned in the press report of their decision) and which appears to the writer to be of great importance, namely that the strength and properties of a wire cable are much more accurately known than is possible in any other form of cable. In ordinary structural steel work one or more tests are made on the finished material from each heat of steel and it is assumed that all the rest of the steel from this heat will develop results substantially the same. Steel from the same heat, however, may be and often is reheated at different times and sometimes at different places and may be rolled into different forms, with the possibility, notwithstanding every known precaution, that the finished material may vary considerably from the sample tested owing to different heat treatment or rolling conditions. A full-size test is also often made, particularly in the case of eyebars, and it is assumed that similar full-size members will give results similar to this test. Thus the strength and characteristics of the material in all ordinary steel construction as far as can be known are based on assumptions; reasonable and probable, to be sure, but assumptions nevertheless. And there is no known way to do otherwise. With wire cables, however, it is different. Aside from the fact that wire-drawing in itself is a good test of every inch of the steel and that any material oversight or error in heat treatment, annealing or mechanical operation is pretty sure to be disclosed by the breaking of the wire in drawing, we have besides the evidence of two tests made on every coil, one from each end, where it is known as the result of a great number of experiments that the wire is always poorest. And these tests are made after all heating, mechanical processes and annealing are finished and the wire is ready to go into the cable. In other words, in a wire suspension bridge we have the record of two full-size tests on every individual wire in the cables. Our knowledge of the strength and characteristics of the material in a wire cable therefore approaches more nearly absolute certainty than is possible in any other form of steel construction.

CHAS F. STOWELL,
Albany, N. Y. 68 State St.
Jan. 4.

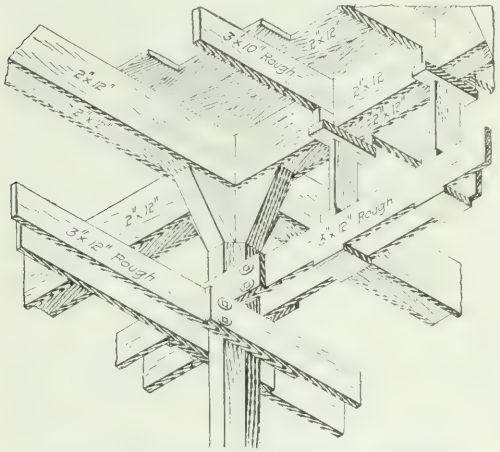
[Criticisms of wire cable construction have not questioned the strength of the wire, but only the definiteness of knowledge concerning the strength secured in assembling the wire in a large cable.—EDITOR]

HINTS FOR THE CONTRACTOR

Pile Braces and Staging for Forms Combined on Manila Pier

By H. H. Braun
Engineer Constructor, Manila, P. I.

ALMOST satisfactory set of forms was used in building a large concrete pier which has just been finished in Manila Bay. The structure is a slab and girder deck founded upon precast concrete piles. As indicated by the sketch, 3 x 12-in. pieces, which are bolted to the piles, furnish a framework to hold the piles on centers; give intermediate support to the beams; support the haunch forms, and furnish a working platform.



PILE BRACE AND FORM SUPPORT COMBINED

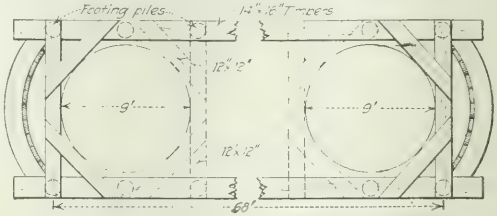
Few things in concrete wharf buildings are more difficult or more necessary than to locate and drive the piles in their exact position, particularly if the penetration is deep in firm bottom, and the distance from the bottom to the deck be small. If the water is deep considerable play can be had by springing the piles. Owing to the hard bottom and rough water at the site it was particularly difficult to drive the piles true to center.

The piles were driven in succession from the shore outward, and immediately braced by bolting on a pair of 3 x 12-in. plank, both in a longitudinal direction and across the bent. When a pile was found to be the least bit out of center, as was the case with most of them, a line was snubbed to the pile head, rove through a snatch block attached to the adjacent braced piles, and pulled by the "nigger head" on the pile driver. A steady strain, assisted by vigorous jetting quickly centered the post. It was then braced by the 3 x 12-in. plank placed just below the level of the haunches.

As all the panels were uniform throughout, the forms were made in sets which could be quickly stripped and re-erected. Each set of pile bracing and forms were used four times. The details of the bracing and form work are shown by the drawing.

Timber Frame Resting On Piles Guides Pier Cylinders in Sinking

PIER cylinders used in the construction of the Long Beach bridge, a highway structure of steel spans encased in concrete and which connect Wreck Lead with Long Beach, Long Island, were sunk to their exact positions with the use of a heavy timber frame which rested upon the tops of the footing piles.



TIMBER FRAME FOR PIER CYLINDER SUPPORT

As shown in the accompanying sketch the timber frame was made of 14 x 16-in. timbers longitudinally placed and 12 x 12-in. timbers forming the cross and diagonal bracing. The frame was just wide enough to rest on the pile centers and long enough so that the two cylinders could be sunk into place with the same frame. Steel sheetpiles of an approximate length of 65 ft. and weighing 45 lb. to the foot was driven against the end of the frame in the arc of a circle so that the bell ends of the cylinders in sinking were flush against the piles.

Those parts of the frame indicated in the sketch by dotted lines were set in place and bolted only after the first section of cylinders had been sunk. This procedure was necessary because of the greater diameter of the bell ends of the cylinders.

As the cylinders were lowered, sections were riveted on at about the level of the timber frame. The cross-braces of the frame came in contact with the cylinder as it went down and allowed the cylinder to be suspended while additional sections were placed. When the cylinders were sunk they were jetted into final position.

The work was done by the McLean Contracting Co. of Baltimore. The bridge is being built by Nassau County, New York, with W. Fred Starks in charge as county superintendent of highways.

Strength of Manila Rope from New Tests

From a series of 368 tests of Manila rope in sizes from ½ in. to 4½ in. diameter carried out at the Bureau of Standards during the past three or four years (reported in Technologic Paper 198) it has been found that the average breaking strength of the rope is very closely represented by the formula $L = 5{,}000\ d^{\frac{1}{2}}(d + 1)$. The minimum and maximum strengths that may be expected in such tests correspond to a range of the coefficient in this formula from 3,700 to 6,300. Tests of "hard-laid" rope were included in the series; no separate figures for the strength of this kind of rope are given, but its stress-strain curve is stated to be concave to the load axis, the rope showing decreased rate of stretching as the load on it increases.

NEWS OF THE WEEK

New York, January 12, 1922

"Transportation" Is Feature of Am. Soc. C. E. Meeting

Technical Program Provides for Many Addresses by Members and Non-Members

Supplementing the general outline of the program for the annual meeting of the American Society of Civil Engineers, to be held in the Engineering Societies Building, New York City, Jan. 18-20, as announced in this journal Jan. 5, p. 34, the following list of speakers and subjects for the technical sessions dealing with the general topic "Transportation" has been issued by the acting secretary of the society:

Jan. 19 at 9:30 a. m. Subject, "Water Transportation." Speakers:

Dr. Emory R. Johnson, Dean, Wharton School of Finance and Economy, University of Pennsylvania, Philadelphia, Pa.; R. H. M. Robinson, president, United American Lines, New York; Winthrop L. Marvin, vice-president and general manager, American Steamship Owners' Association, New York; Samuel O. Dunn, editor, *Railway Age*, Chicago, Ill.

Jan. 19, at 2 p. m.—Subject, "Railroad Transportation." Speakers: Howard Elliott, chairman, Northern Pacific Ry. Co., New York; George W. Simmons, vice-president, Simmons Hardware Co., St. Louis; William N. Doak, vice-president, Brotherhood of Railroad Trainmen, Washington, D.C.; Col. F. A. Molitor, chairman, Board of Economics and Engineering, National Association of Owners of Railroad Securities, New York; Edgar E. Clark, formerly chairman, Interstate Commerce Commission, Washington, D. C.

Jan. 19 at 8 p. m.—Address, "World Activities and their Effect Upon the Engineer," by Frank A. Vanderlip, formerly president, National City Bank, New York, (to be followed by Smoker.)

THREE HIGHWAY SESSIONS

Jan. 20 at 9:30 a.m.—Subject "Highway Transportation." Speakers on "Inspection": Thomas H. MacDonald, director, U.S. Bureau of Public Roads, Washington, D.C.; Fred W. Sarr, first deputy, Commission of Highways, Albany, N.Y.; Col. William D. Uhler, chief engineer, State Highway Department, Harrisburg, Pa.; William G. B. Thompson, formerly state highway engineer, Trenton, N. J.; Paul D. Sargent, chief engineer, State Highway Commission, Augusta, Maine.

Jan. 20, at 2 p.m.—Subject "Financing and Bonding." Speakers: John N. Cole, commissioner, State Department of Public Works, Boston; Robert S. Parsons, general Manager, Erie Railroad Co., New York; Jeremiah C. Finch, secretary, Commission of Highways, Albany, N. Y.; E. A. St. John, vice-president, National Surety Co., New York; Edward C. Lunt, vice-president, Fidelity and Casualty Co., New York; Frederick Stuart Greene, formerly commissioner, Commission of Highways, New York; Harry Meixell, Jr., secretary, Motor Vehicle Conference Committee, New York.

Jan. 20, at 8 p. m. — Subjects "Administration," "Relation of Highway to Other Transportation Systems," "Motor Vehicle Control." Speakers: Lewis S. Sadler, commissioner, State Highway Department, Harrisburg, Pa.; William D. B. Ainey, chairman, Public Service Commission, Harrisburg, Pa.; Herbert S. Sisson, commissioner, Commission of Highways, Albany, N. Y.; John N. Mackall, chief engineer, State Roads Commission, Baltimore, Md.; Harry Meixell, Jr., secretary, Motor Vehicle Conference Committee, New York.

HONORARY MEMBERSHIPS

At the morning session of Jan. 18 honorary membership in the Society will be conferred on Charles Prosper Eugene Schneider, Paris, France; Luigi Luigi, Rome, Italy; Samuel Rea, New York; Ambrose Swasey, Cleveland; and Howard A. Carson, Boston.

State Sues to Compel Trenton, N. J., to Build Sewage-Works

On behalf of the State Department of Health the Attorney-General of New Jersey has applied for an injunction against the City of Trenton, N. J., to prevent the discharge of untreated sewage into the Delaware River. The city was ordered several years ago to build sewage-works.

Two More Muscle Shoals Offers Are Made

In addition to the proposition for the completion of the Wilson dam and appurtenances at Muscle Shoals on the Tennessee River, made some time ago by Henry Ford, two other offers have been made to the government. The first is by the Construction Co. of North America, which is now building the Hetch Hetchy tunnel aqueduct for the San Francisco water supply. This company offers to complete the dam, power house and appurtenances, maintain the auxiliary steam plants, build new dam No. 3, and operate the nitrate plants, if the government decides they can be operated successfully in competition with other sources of supply. The company proposes to finance the project by issuing bonds to be bought at par by the government and to be paid back out of the earnings within 25 years. The leasehold would be for 50 years with option for another like period.

The other proposal is from Frederick E. Engstrum, of Wilmington, N. C. This is also for a 50-year lease with large privilege of control by the government but provides that the operating company shall be paid $36,000,000.

Secretary of War Weeks is reported to have said that the Ford offer is the only one which gives proper provision for future operation of the nitrate plants.

Federation Holds First Annual Meeting

Twenty-eight Societies Now Members—Budget Reductions Follow Cut in Assessments

The American Engineering Council of the Federated American Engineering Societies held its first annual meeting in Washington, Jan. 5 and 6, Dean Mortimer E. Cooley of the University of Michigan, president of the Council, presiding. A leading event of the meeting was a dinner in honor of Herbert Hoover, who, addressing the members and guests, praised the work of the Committee on Elimination of Waste in Industry as a great and lasting public service.

After commending the report on the investigation of Waste in Industry, Mr. Hoover cited the problem of electrification as one of the biggest ones confronting the country and suggested a waste survey in this field. Great possibilities lie in the consolidation of the nation's electrical power supply, he said.

NO AGREEMENT ON LICENSING

The Council engaged in a long discussion of the question: Does the American Engineering Council approve of the principle of licensing or registering engineers? Prof. Donald Derickson, of Louisiana, was a leader of the affirmative side. Gano Dunn, of New York, in a spirited speech opposed action by the Council at this time, saying the whole question should be carefully studied before a definite policy was embarked upon. Major F. J. Miller, of New York, Dean Perley F. Walker, of the University of Kansas, and Philip N. Moore, of St. Louis, supported this view, Mr. Moore expressing pronounced opposition to licensing. The Council finally directed the appointment of a committee on licensing to report at the next meeting of the Executive Board.

The Engineers Club of Columbus, Ohio, was admitted to membership at the meeting and there are more than 20 active prospective members, according to Secretary L. W. Wallace, who urged an active and aggressive campaign to secure a much larger membership, stating that "it is evident that the Federation cannot reach the maximum possible attainment until virtually every engineering society is a member." The secretary's report showed that on Jan. 1, 1921, the membership of the society was composed of 6 national and 14 state and local societies, a total of 20. On Dec. 31, 1921, there were 8 national and 20 state and local societies, a gain of 8 member societies representing 1,414 member engineers.

BUDGET REDUCED

Conditions in the mining industry, as stated by Edwin T. Ludlow, president of the American Institute of Mining and Metallurgical Engineers, and Major Arthur S. Dwight, were responsible for a reduced contribution by the societies to the Council for its

year. As a consequence, the assessments levied upon the other member societies were cut down proportionately by constitutional amendment. Reductions in the budget were thus made necessary, and, though the Council begins the year with a scarcity of funds, assurances have been given of additional financial aid.

The balloting for officers resulted in the re-election as vice-presidents of Dexter S. Kimball, dean, college of engineering, Cornell University, and J. Parke Channing of New York. W. W. Varney of New York was again chosen treasurer. L. W. Wallace was re-elected executive secretary by unanimous action of the Executive Board.

The Council made provision for a continuance of its national publicity work under the direction of James T. Grady, Director of the Department of Public Information of Columbia University, New York.

The Council voted to co-operate in the movement to prepare for cyclical industrial depressions and unemployment by resort to public works projects. On this subject the Council received a proposal from Mr. Hoover, and it was decided to open conferences with him to ascertain in what way the Council could best provide effective aid.

Topographic mapping and the establishment of a Department of Public Works were other legislative matters in which the Council decided to continue its support.

Considerable discussion was provoked by the plan to establish a Federation journal which would be sent to every engineer enrolled in the Federation. The Publicity Committee made no recommendations and the Council took no definite action. It was generally agreed that some such contact should be established between the Federation and its enrolled membership, but there was sharp diversity of opinion as to its form.

NEW REPRESENTATIVES

New representatives on the Council were announced as follows: American Society of Mechanical Engineers—Francis Blossom, Charles A. Booth, Gano Dunn, H. H. Esselstyn, W. S. Lee, I. E. Moulthrop, John H. Stevens, A. E. Walden; Society of Industrial Engineers—Prof. Joseph W. Roe; American Institute of Mining and Metallurgical Engineers—C. H. MacDowall (succeeding Prof. Richards); Louisiana Engineering Society—Prof. Donald Derickson; Iowa Engineering Society—Lloyd B. Canfield; Duluth Engineers Club—W. H. Hoyt; Milwaukee Engineering Society—Albert Blatz, Jr.

The executive Board of the Council for 1922 is made up as follows: H. E. Howe, Washington, American Institute of Chemical Engineers; Prof. C. F. Scott of Yale, L. B. Stilwell and Calvert Townley of New York, J. H. Finney of Washington, William McClellan of Philadelphia, and L. F. Morehouse of New York, representing the American Institute of Electrical Engineers; J. Parke Channing and A. S. Dwight of New York, Charles H. MacDowall of Chicago and Philip N. Moore of St. Louis, the American Institute of Mining and Metallurgical Engineers; L. P. Alford of New York, E. S. Carman of Cleveland, Dean D. S. Kimball of Cornell, Prof. A. M. Greene of Troy, Dean Perley F. Walker of Kansas, W. S. Lee of New York, Dean M. E. Cooley of Michigan, American Society of Mechanical Engineers; Prof. Joseph W. Roe of New York, Society of Industrial Engineers; Morris L. Cooke, Philadelphia, Taylor Society; W. E. Rolfe, Associated Engineering Societies of St. Louis; and W. W. Varney, Baltimore, treasurer.

Regional directors chosen for 1922 are: District 1, W. B. Powell, St. Louis; District 2, Gardner S. Williams, Ann Arbor, Mich.; District 4, W. J. Fisher, York, Pa.; District 5, Paul Wright, Birmingham, Ala.; District 6, Lloyd B. Smith, Topeka, Kansas; District 7, O. H. Koch, Dallas, Texas.

Dean Cooley announced that he would begin an extended trip to the Southwest in February.

Indiana Plans Expansion of State Highway System

Seven principal roads may be added to the Indiana state highway system this year, according to Lawrence E. Lyons, director of the department. The new inclusions will connect parts of the system not heretofore connected, or will provide more direct routes between cities or towns. The commission, Mr. Lyons states, will add approximately 300 miles to the system, which now includes 3,600 miles.

300,000-Acre Irrigation Project Under Survey in Nebraska

Surveys of a 300,000-acre irrigation project in Nebraska along the Platte River from North Platte to Kearney, 100 miles long and 4 to 14 miles wide, have been started by the U. S. Reclamation Service, funds to the extent of $30,000 being furnished locally. A number of reservoirs of from 40,000- to 90,000-acre-ft. capacity and 200 miles of main canal are included. No difficult problems, aside from a lack of rock for structures, have been encountered. F. F. Smith is the engineer from the U. S. Reclamation Service in charge.

Propose Uniform Contract Clauses

At a meeting of the Engineering Association of Nashville, Dec. 19, 1921, the following suggestions as to a uniform construction contract was forwarded to the American Engineering Council and Associated General Contractors, to be considered by them in the drafting of a general uniform engineering condition to a contract.

1. A satisfactory arbitration clause should be adopted and should be legally binding on both parties.

2. A definite policy of inspection should be adopted and if two or more separate interests are concerned in payments for work, one authority shall act for all.

3. The contract should specify results, or the method to be followed, but not both.

4. The time of acceptance should be as early and period of maintenance as short as practicable.

5. The contractor should not be held responsible for contingencies beyond his control, and contingencies should be defined.

6. Reasonable limits should be placed upon the engineer's power to increase, or decrease the amount of work to be performed by the contractor.

Arkansas Road Bonds Sell at Par

On Dec. 22, 1921, M. W. Elkins of Little Rock, Ark. purchased an additional $50,000 issue of Spring Lake road bonds at par. This is the second issue of Arkansas bonds within thirty days to be sold at par or better.

City Engineer Sues to Remove His Successor

Suit has been brought in the Circuit Court by Arthur Schneider, who was removed from the office of city engineer of West Allis, Wis., last April, for the purpose of ousting his successor William A. Darby. Mr. Schneider claims that he was appointed city engineer on March 18, 1920, at a salary of $2,500. On March 15, 1921 he was reappointed for the coming year but the appointment was vetoed on April 7, 1921 by Mayor Miller. The veto was upheld by the city council and Mr. Darby was given the position. It is contended that Mr. Darby is not a resident of West Allis and therefore cannot hold office, in which case his appointment becomes illegal.

Iowa Society Six Sections Meet at Sioux City

The Iowa Society of Engineers, composed of four sections and two proposed sections all of which will hold a set of simultaneous sessions, meets Jan. 17-20 at Sioux City. The drainage section will occupy the program at the first day's sessions discussing tile districts, open ditch districts, assessments, subsoil, drainage, laws, levers and pumping plants and the drainage engineer's compensation. The highway section will discuss 1922 bridge specifications, tests, progress records, gravel road construction and maintenance. The mechanicals and electricals have power plant and electrical transportation papers scheduled. Sewage disposal, refuse disposal and activated sludge as applied to the Mason City packing house waste are topics on the program of the municipal section, along with a round table discussion on house connection sizes, sewer grades, and newer pavement types. The proposed railroad section will discuss early days, relation of the engineer to operation and fireproofing of wooden bridges. For the proposed structural-architectural section the program covers building code problems and recent concrete investigations.

At the general sessions much of the time will be given to committee reports on legislation, publication, professional practice, construction costs, standard contracts, services and fees. Other topics are financial problems of the railroads and hydraulic research at the State University. The various engineering clubs in Iowa which are the local units of the society will report on engineering educational requirements.

Coincident with the state society meeting will be a joint session dinner Jan. 18 with the Iowa Section of the American Society of Civil Engineers to which all practising engineers in Iowa and adjointing states are invited. On Jan. 16 the State Board of Examiners will meet in Sioux City.

British Shipyards Plan Bridge Building To Avert Shutdown

(*London Correspondence*)

Cancellation of warship construction in Great Britain as a result of the Washington conference is a serious thing for the majority of the large naval construction yards. The proposal has been put forward, therefore, that these great works shall devote themselves to the construction of bridges, of which there is a great shortage throughout the country.

Says the Road Board: "There is a very large number of bridges in all parts of the country which will require reconstruction. In every country there is a large number of bridges vested in highway authorities or owned by railway and canal companies which are scheduled as capable of carrying vehicles of only limited tonnage, with the result that a very large mileage of roads, often important roads, are closed to traction-engine and heavy motor traffic until such time as these bridges can be reconstructed."

A recent decision of the House of Lords will have the practical effect of throwing in most cases upon the highway authorities the cost of the reconstruction of weak bridges carrying public roads over railways and canals. It may be roughly estimated that the expenditure necessary to reconstruct bridges on important roads so as to support the motor traffic legalized by Parliament will not be less than £10,000,000; and this is a very conservative estimate.

There is at present a great shortage of adequate bridges on the main arterial roads throughout the country, and several schemes have been put forward recently for additional construction so as to alleviate unemployment. The great armament plants in the country are said to be very interested in the proposal, and there is a movement among local authorities and civil engineers to secure for this branch of construction the expenditure at present allocated to the naval program which would otherwise be absorbed in one of the less remunerative projects proposed by the government for the relief of unemployment.

Would Make River and Harbor Funds on Continuing Basis

Unusual significance is attached to a bill which has been introduced by Senator Jones of Washington, which provides that many of the important river and harbor projects are placed on a continuing contract basis. The bill authorizes the Secretary of War to enter into contracts for such materials and work as may be necessary to complete the following projects:

Ohio River locks and dams, $33,000,000; Southwest Pass Mississippi River, $2,900,000; Los Angeles Harbor, Cal., $1,060 800; Honolulu Harbor, $750,000; Hilo Harbor, Hawaii, $374,000.

Other Important Projects

The bill also provides another group of important projects which are to be formally adopted by Congress and appropriations authorized as follows:

New York and New Jersey channels, $10,400,000; Milwaukee Harbor $4,000,000; Green Bay Harbor, $110,000; Galveston Channel, $670,000; Sabine-Neches waterway, Texas, $1,580,500; Columbia and Willamette Rivers, $1,750,000; Mamaroneck Harbor, New York, $103,000; San Diego Harbor, $225,000; Illinois and Mississippi Rivers, $1,930,000; Calcasieu-Sabine waterway, $500,000; Wilmington Harbor, Delaware, $630,000; Cape Fear, River, N. C, $525,000; Red Lake and River, Minnesota, $15,000; Charlotte Harbor, Florida, $100,000; Wilamette Slough, Oregon, $46,700; Pawtucket River, Rhode Island, $50,000; Plymouth Harbor, Mass., $51,000; Clatskanie River, Oregon, $4,620; Goose Creek, Texas, $5,500; Calcasieu River, Texas, $25,800; Noyo River, California, $16,000; Turtle Bayou, Texas, $16,000.

The secretary of War is authorized by the bill to enter into a contract for the construction of six sea-going hopper dredges for use in harbor work. These dredges are not to cost in excess of $4,500,000.

Authorization also is provided for an annual maintenance appropriation which is not to exceed $17,000,000.

Miami Conservancy Completes Hydraulic Dam Filling

On Dec. 31 the last hydraulic fill was placed in the Englewood dam of the Miami Conservancy District. This is the largest and highest of the Conservancy flood-protection dams, and is the last to be completed; hydraulic filling at the Huffman dam was completed early in December, leaving only two or three thousand yards of team fill to be placed at the south end of the dam. All five of the dams of the district are now finished except for trimming work. The dams have been completed nearly a full year ahead of the original schedule.

The Huffman dam is 3300 ft. long and has a maximum height of 73 ft., an embankment volume of 1,350,000 cu.yd., and a concrete yardage of 40,000. It is located in the Mad River valley, 8 miles east of Dayton. C. C. Chambers is division engineer, J. S. Gena assistant and Verne Clawson superintendent of construction. The Englewood dam 4,700 ft. long and 125 ft. high, contains 3,600,000 cu.yd. embankment. During each of the last two seasons more than 1,000,000 cu.yds. hydraulic fill was placed in this dam. H. S. R. McCurdy is division engineer, H. W. Horne assistant, and Richard Byers superintendent of construction.

Synura Causes Tastes and Odors in New York Water Supply

A growth of synura in the Catskill water supply, New York City, is giving rise to considerable trouble from taste and odors. It is believed that the organisms alone, in the numbers present, would cause no trouble if the water were not being chlorinated; and that the chlorine combines with the oily product of the synura to produce taste and odor, as is the case where waters containing gas works and similar wastes are chlorinated. The matter is being studied by the engineering and laboratory staffs of the Department of Water Supply.

National Housing Problem Before Am. Soc. C. E.

Four Sessions on Economic, Financing, Legislative, City Planning and Zoning Phases

In continuation of its policy for the year 1921-22 of having protracted monthly meetings for the discussion of questions of broad, national scope, the American Society of Civil Engineers, at its meeting in New York City, Jan. 4 and 5, held four sessions at which 17 speakers were scheduled to discuss "The National Housing Problem." The sub-topics and the speakers were as follows:

17 Speakers Scheduled

Broad Economic Phases — Lawrence Veiller, secretary, National Housing Association, New York City; Lawson Purdy, general director, Charity Organization Society of the City of New York; John M. Gries, chief, Division of Housing, U. S. Department of Commerce, Washington, D. C.; John J. Murphy, former tenement house commissioner, City of New York.

Property Improvement and Landscaping—Charles W. Leavitt, civil and landscape engineer, New York City. *Planning and Zoning*—Joseph C. Wagner, assistant director of public works, Philadelphia, Pa.; B. A. Haldeman, chief, Division of City Planning and Municipal Engineering, Pennsylvania Department of Internal Affairs, Harrisburg, Pa.; Charles M. Reppert, chief engineer, Department of Public Works, Pittsburgh, Pa.

House Design — Andrew J. Thomas, architect, New York City.

(3) *Transportation*—Ernest P. Goodrich, consulting engineer, New York City. *Water Supply*—H. M. Pirnie, consulting engineer, with Hazen, Whipple & Fuller, New York City. *Sewage Disposal*—W. L. Stevenson, assistant chief engineer, Pennsylvania Department of Health, Harrisburg, Pa. *Lighting*—F. G. Hibben, representative of the Illuminating Engineering Society, New York City. (4) *Legislation and Financing*—Edward M. Bassett, counsel, Zoning Committee, New York City; Allan Robinson, president, City and Suburban Homes Co., New York; John Ihlder, manager, Civic Development, Chamber of Commerce of the United States, Washington, D. C.; William H. Ham, general manager, Bridgeport (Conn.) Housing Co.

Attendance Ranged from 90 to 15

Notwithstanding this extensive program and the fact that 5,000 invitations had been sent out, the attendance at the first session was only about 90, of which number a large percentage were nonmembers of the society. Each of the three following sessions opened with about 25 present and had a maximum attendance of from 35 to 50, dwindling to 15 before the Thursday afternoon session closed.

New York's housing crisis, according to Mr. Purdy, is most keenly felt by the lowest paid wage-earners, who are forced into crowded, undesirable tenements, now renting for $15 per room per month, as against $5 per room 20 years ago. If the population were distributed, he said, the total taxable values of the city would be increased and living conditions improved.

Figures presented by Mr. Gries showed that, according to the 1920

census, there were 20,000,000 dwellings in the United States (regardless of the number of families housed in each). Roughly 1,000,000 additional dwellings are now needed be believes, to make up the shortage and 350,000 to 400,000 a year are necessary to take care of growth in population and replacements of buildings burned. Standardization of building supplies is much needed; there are now hundreds of sizes and styles of door hinges, window sash, etc. It is reported, Mr. Gries said, that 75 per cent of the houses erected are put up by contractors who build not more than ten houses a year. Under such conditions there cannot be much scheduling of material. Everything is on a small scale basis of production. Building codes also need studying, and this is being done under the direction of secretary Hoover.

TAX EXEMPTION INCREASED HOUSING

Speaking of conditions in New York City, Mr. Murphy said that between 1910 and 1918 there were 40,000 apartments and tenements vacant, equivalent to 5 per cent of the total. The State of New York first passed rent-control legislation which deterred the building of houses and then applied a stimulant in the form of exemption from taxation. Since the latter went into effect March 1, 1921, plans have been filed for dwellings to house some 56,000 families in New York City, or five to six times the number filed in the previous year. The reported cost of these houses is $260,000,000. Three-fifths of the new housing being provided in New York is one and two-family houses, and the rest tenements. The recent advance in freight rates, according to Mr. Murphy, has added some $250 to the cost of the average house in the United States.

Mr. Veiller dealt particularly with the slum which, he says, prevails in cities, large and small, throughout the United States and is worse here than in other countries.

CITY PLANNING AND ZONING

Mr. Leavitt reported a strong tendency in the Borough of Queens, New York City, and in Westchester County, N. Y., to build a good grade of one-family houses on small lots.

The three papers on planning and zoning by Messrs. Wagner, Haldeman and Reppert pointed out that zoning provides the maximum of benefit for the minimum of effort and cost in city planning work and is rapidly growing in favor. Zoning has an important effect on the economy of street layouts and the design of utilities. The industrial area requires an altogether different street layout, with fewer but more capacious streets, than other areas of the city. The business area needs more streets than the industrial. Heretofore subdivisors of property have acted wholly in the interest of landowners in order to give them the most profit. There is need now for city planning that will give the greatest benefit to the greatest number. Existing conditions cause strangulation of traffic.

In his talk on house design, Mr. Thomas presented an old style and a new style plan for housing 32 families on a lot 100x100 ft. The old style dumb-bell plan occupied 79 per cent of the area of the lot and the new style, or approximately U-shaped plan, occupied only 62 per cent and could be built for $40,000 less than the old style and would rent better. Nevertheless, he found it impossible to secure financing of the new style plan because all the loaning institutions were following the arbitrary practice of basing loans on cubical contents of tenement blocks.

TRANSPORTATION AND OTHER UTILITIES

Under the topic "Transportation," Mr. Goodrich laid stress upon the possibility, by the aid of zoning, of enabling the majority of city dwellers to get from their homes to places of work and amusement by walking, or at least without the need of rapid transit facilities.

The addresses on water supply, sewerage, and lighting by Messrs. Pirnie, Stevenson, and Hibben necessarily went over familiar ground though with particular regard to the relation of these services to the house and householder.

Under the subtopic, "Legislation and Financing," Mr. Bassett said that the lowest cost of decent homes for working men in the Borough of Queens, New York City, today is $6,000.

Mr. Ham said that housing today is in disorder, especially as to financing, in which double protection to those who loan money is demanded. House construction itself is on a very uneconomical basis. Excavation work is done mostly by hand labor. Small machines adapted to the work are needed. Foundations should be of unit construction material. The timberwork design of houses is bad. Studding is still placed 16 in. c. to c. because of the limitations in the length of lath cut from poor lumber. Plastering by the wet process is wrong because it brings moisture into the building and does damage. In this and other ways present methods of plastering are one of the greatest causes of house depreciation. A dry plastering method should be adopted and more paneling should be used. Pipe for plumbing is cut by hand on the job whereas by means of standardization it could be simplified and lessened in cost. There should be more fabrication of house parts in shops near the site of building operations.

Mr. Ham proposed that the American Society of Civil Engineers, the American Institute of Architects, the American Society of Mechanical Engineers, and various financial and other institutions should appoint a joint committee to study the whole housing problem and that the American Society of Civil Engineers should employ a high-class man as director of the study.

Consolidation of N. Y. State Engineer and Other Offices Urged

Constitutional amendments enabling the Legislature of New York to consolidate and reorganize two or more of the state departments having to do with engineering and allied work are recommended in the annual message of Governor Nathan L. Miller. He declares it his opinion that "economy and efficiency would be promoted by a consolidation of the department of public works and the state engineers' office and possibly by including . . . the department of highways, state architect and department of public buildings." The first two departments of those named are prescribed by the state constitution.

American Concrete Institute Announces Convention Program

Preliminary announcement has been made of the tentative program of the convention of the American Concrete Institute to be held at the Hotel Winton, Cleveland, Ohio, Feb. 13 to 16 inclusive. Sessions in the afternoon of the first day, Feb. 13, will be on concrete roads and in the evening on concrete houses. Feb. 14, the morning session is devoted to research work and the afternoon and evening to concrete products.

On Feb. 15 the morning session will be devoted to practical field problems and the afternoon to design.

On Feb. 16 there will be a general discussion of the report of the Joint Committee on Concrete and Reinforced Concrete, which will be taken up by major subjects and will be specially discussed by the chairman of the Institute standing commimttees whose work involves special consideration of the subjects covered in various sections of the Joint Committee report. The discussion will be continued in the afternoon. In the evening of the 15th there will be an informal entertainment and get-together meeting.

The secretary of the Institute is Harvey Whipple, 314 New Telegraph Bldg., Detroit, Mich.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; Annual Convention, Cleveland, Ohio, Feb. 13-16.

AMERICAN ROAD BUILDERS ASSOCIATION, New York; Annual Convention and Good Roads Show, Chicago, Jan. 17-20.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Meeting, New York City, Jan. 18-20.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual Conference, Cleveland, Ohio, Jan. 17-19.

The Illinois Section, American Society of Civil Engineers, at its annual meeting Dec. 21, elected the following officers: President, A. J. Hammond, new vice-president, T. L. Condron and secretary-treasurer, W. D. Gerber. The hold-over vice-president is J. N. Hatch.

The Kansas Engineering Society elected the following officers at its annual meeting held Dec. 22: President, Lloyd B. Smith; vice-president, P. L. Brockway; secretary-treasurer, J. M. Averill; directors, H. S. Putney; P. J. Ruckel.

The Idaho Chapter, A. A. E., the Idaho Society of Architects and the Idaho Irrigation Congress, will hold a joint convention in Rupert, Idaho, January 16-21. Names of speakers and topics will be announced later.

The Seattle Engineers Club at a recent weekly luncheon listened to an address on "Aircraft from an Engineering Standpoint" by J. W. Miller of the J. W. Miller Aircraft Co.

The Seattle Post, American Society of Military Engineers recently elected

the following officers: President, Major O. A. Piper, Seattle; vice-president, Major Charles Wild; secretary, Captain K. M. Dean, Seattle; treasurer, Major A. B. Cutter, Everett.

The Engineers' Society of Pennsylvania will hold a reunion of all members and former members on January 14, at 8 p. m. at the club house in Harrisburg.

The Providence Engineering Society will hold a regular meeting Jan. 18 instead of Jan. 17, as planned. The change in date is being made to accommodate L. W. Wallace, vice-chairman of the Hoover Committee on Elimination of Waste in Industry, who will summarize the results of this work of the Federated American Engineering Societies.

The Western Society of Engineers' January schedule of meetings includes the following papers: Jan. 9, "The Design of the Akron (Ohio) Viaduct," by Louis R. Ash, consulting engineer; Jan. 14, "Sources of Technical Information," by Miss E. V. Savage, librarian of the society; Jan. 16, "Co-operation between State and Consulting Engineers," by C. M. Baker, engineer, Wisconsin State Board of Health; Jan. 25, "Experience with Treated Timber in Bridges," by A. F. Robinson, bridge engineer, Santa Fe System. The last is a joint meeting with the American Wood Preservers' Association. An inspection of the Underwriters' Laboratories to witness special tests of fire resistive material is planned for Jan. 24.

Celebrate Start of Work on Delaware River Bridge

The starting of construction on the Delaware River bridge at Philadelphia was celebrated on Jan. 6 by formal first-spade exercises, in which Governor Sproul of Pennsylvania, Governor Edwards of New Jersey, and Mayor Moore of Philadelphia joined. Earth was not available for actual spade work but planks were pried out of structures to be demolished, with the aid of silver-plated picks and crowbars wielded by the officials.

The contract for the two main piers was awarded last week to Holbrook, Cabot & Rollins and the Keystone State Construction Co. on their joint bid, which was the lowest of those submitted, as reported in Engineering News-Record, Dec. 22, p. 1040.

Bids have been asked for the demolition of buildings on the site of the Philadelphia anchorage. They are to be opened Jan. 11.

The superstructure plans are practically complete, it is understood. A slight modification of the roadway construction is the only essential departure from the plans presented in tentative form at the time the Board of Engineers rendered its preliminary report last May (Engineering News-Record, June 23, 1921, p. 1086).

PERSONAL NOTES

W. L. SAUNDERS, New York City, representing the American Society of Mechanical Engineers, has been appointed a member of the board of trustees of the United Engineering Society for a term of three years, expiring in 1925. He succeeds Irving E. Moultrop, whose term expired.

JAMES E. GILLESPIE, formerly division engineer for the Wisconsin Highway Commission has entered private practice as a highway engineer in Oshkosh.

J. WALTER ACKERMAN, formerly city engineer of Auburn, N. Y., has been appointed city manager of Watertown, N. Y., succeeding C. A. Bingham, resigned. Mr. Ackerman has been superintendent of the water, light and power department in Watertown since June, 1920.

GEORGE M. COUGHLIN has recently been chosen director of public works of Bridgeport, Conn., succeeding Jacob A. Courtade.

JOHN H. BARR, of New York City, has been appointed to represent the American Society of Mechanical Engineers on the Engineering Foundation Board for the term expiring in February, 1925. He succeeds Dr. W. F. M. Goss.

JACOB A. COURTADE, for the past twelve years director of public works of Bridgeport, Conn., has resigned to accept a position as Connecticut manager for Warren Bros. Co., Boston.

JACOB RITTER, of Ft. Wayne, Ind., who for the past year and a half has been engineer in charge of production for the Visible Pump Co., has been appointed distributing manager for that company with headquarters at Detroit.

HAROLD R. HOLMES, city engineer and building inspector of Lockport, N. Y., has been reappointed by Mayor Crosby at a salary of $2,700 for the year.

ALFRED M. LUND and PHILLIP B. HILL, consulting engineers, Little Rock, Ark., have dissolved partnership. The business will be continued by Mr. Lund. Mr. Hill will practice engineering in Little Rock.

F. W. ULLIUS, JR., WILLIAM E. SKINNER and RALPH M. KIBBE have incorporated as consulting engineers under the name of The Associated Engineers, Inc., Milwaukee. Mr. Ullius, the president, is the village engineer of Shorewood and a member of the metropolitan sewerage commission of Milwaukee County. Mr. Skinner, vice-president and manager, was formerly with the electrical department of the Chicago, North Shore & Milwaukee R.R. Mr. Kibbe, secretary and treasurer, was with the Albert Trostel & Son Co.

LESLIE E. PROUTY has been appointed county engineer, Mobile Co., Ala., succeeding S. M. Adams.

NORMAN F. BROWN, director of the department of public works of Pittsburgh, Pa., has become vice-president of the Dravo Contracting Co. succeeding the late John J. Nolan.

JAMES LOGAN, for the past ten years county engineer of Burlington Co., N. J., has resigned to enter private practice at Mount Holly. E. HAROLD WILLIS of Mount Holly, N. J., has been appointed successor to Mr. Logan.

AMBROSE SWASEY, of Cleveland, has been selected to succeed himself on the John Fritz Medal Board for the term expiring in February, 1925.

GEORGE W. BATCHELDER, water commissioner, Worcester, Mass., has been re-elected by the common council.

J. C. HOLMAN, formerly in charge of the cost engineering department for the U. S. Housing Corporation at New Brunswick, N. J., has been elected vice-president of the A-J Contracting Co., Inc., New York.

GEORGE M. WISNER, formerly chief engineer, Sanitary District of Chicago, and retained for a time as consulting engineer, has been reinstated as consulting engineer to handle the lake-level problem.

CASPER D. SHAWVER has been appointed city engineer Cheyenne, Wyo. In 1905 he was with the U. S. Reclamation Service in Montana where he assisted on the Huntley and Blackfeet projects. Later he served as assistant city engineer in Sheridan, Wyo., for four years. From 1915 until 1920 Mr. Shawver was deputy state engineer of Wyoming. During the World War he resigned to serve at Camp Lee, Va., where he was commissioned captain. After the armistice he returned to Wyoming where he found his position in the State House awaiting for him. He resigned in 1920 to take charge of an irrigation project in Western Wyoming.

OBITUARY

CLIFFORD M. KING, assistant engineer in the sanitary department of the city engineer's office at Cleveland, Ohio, died Jan. 2 in that city. Capt. King was born in 1879, graduated from Western Reserve University in 1901 and as a civil engineer from Cornell University in 1904. His early practice was in the irrigation work in the Far West, but in 1908 he became city engineer of Sandusky, Ohio. He served overseas with the 528th Battalion of Engineers in 1918. On his return he entered the city engineering department of Cleveland. Capt. King was also in the Spanish-American War in the Ohio National Guard.

H. CLAY KELLOGG, construction engineer, died at Santa Ana, Cal., Dec. 23, at the age of 66. He was engineer for the Anaheim and Santa Ana valley water companies. He laid out the towns of Elsinore and Corona, Cal., and built a railroad from Riverside to San Bernardino. He also supervised dam construction work in Hawaii and had been consulting engineer on many irrigation projects, in which he specialized in later years.

JOHN ARMSTRONG GEORGE, formerly city engineer of East Liverpool and Wellsville, Ohio, died suddenly Dec. 5. He was born in Allegheny County, Pa., in 1839 and came to Wellsville 45 years ago to supervise the construction of the first water-works. Although 82 years old Mr. George was engaged in engineering practice to the day of his death.

WILLARD WELLS HERETH of Indianapolis, Ind., died recently at Butler, Pa. At the time of his death he was traveling as efficiency engineer for the American Water Works and Electric Co. He was a graduate of Purdue University, class of 1919

Business Side of Construction

Facts and Events that Affect Cost and Volume

New England Contracts Let in Last Quarter

Indicative of immediate engineering construction prospects in New England, *Engineering News-Record's* Construction News has announced contracts let to the value of over $20,000,000 in October, November and December, 1921. Contracts for commercial buildings worth $150,000 and over aggregated $15,313,753; industrial works of $40,000 and more, $2,890,000; streets and roads, $2,000,000; other public works, $124,000. These figures are of course for prospective actual construction and do not include the large amount of projected work that has not yet reached the contract-awarded stage.

Materials Stocks in Thirteen Cities

Stocks Restricted in Anticipation of Freight Reduction, but Sufficient to Meet Demands

New York — Common brick on hand to the amount of thirty-four barge loads within city limits. These are quoted on open market for immediate use and are not being held as covered cargoes. Small stocks of hollow partition tile on hand. Material shipped in by lighter in 100 ton cargoes from factories within 26 miles of city; 48-hr. deliveries to contractors within Metropolitan District. Not overstocked on sewer pipe but deliveries can be made on materials stocks sufficient to complete present contracts. Cement available at nearby mills.

Cincinnati—Ample stocks on hand in principal materials. Granite paving blocks not kept in stock but 50,000 daily can be supplied on three days' notice.

Boston—Fairly large supply of building materials. Ample supply of sewer pipe, all sizes, up to 24 in. All deliveries prompt.

Montreal—Stocks on hand larger

CONDITIONS OF MATERIALS STOCKS IN IMPORTANT CENTERS

Stocks on hand in approximate figures, example: cement, Boston, 8,000 bbl.; time required for delivery of carload lots to city job, example: cement, Birmingham, 1 to 2 days; and stocks on hand in general terms, example: (sewer pipe, Detroit, plenty

	New York	New Orleans	Denver	Detroit	Minneapolis	Cincinnati	Chicago	Boston	San Francisco	Birmingham
Sewer pipe	Sufficient Del. in 1 day	70 car loads	Ample	Plenty		6,000 ft.	200 carloads	Large supply	Good; del. 2 to 3 days	Plenty
Cement	6,000 bbl. one dealer alone	30,000 bbl	7,000 bbl. 48 hours	100,000 bbl.	3,000 bbl. 24 hr. from mills	8,000 bbl	Del. few hrs. 50 per cent normal	8,000 bbl.	6,000 bbl. del. 2 days	2,000 bbl del. 1 to 2 days
Lime (common)	Ample		4,000 bu.; del. Missouri lime 10 day	Plenty	Plenty		50 cars; can supply any job in few hours in the common or hydrated	2,000 bbl. 5 to 8 days	Limited 3,000 bbl. del. 2 to 3 days	4,000 bbl.
Lime (hydrated)	Ample		to 2 weeks Colorado one week	Plenty	Plenty			175 tons; 5 to 8 days		In readiness
Common Brick	34 barges	50 cars; produce 10 carloads daily	7,000 000 24 hours	Sufficient	3,500,000, 24 hour from yards	10,000,000	150,000,000	150,000	Small; del. 7 to 10 days	Plenty
Hollow Tile	Small, 48 hr. del. from factory			Moderate			Del. 1 to 6 days		Good; del. 2 to 3 days	Plenty
Lumber	Can complete del. on 300 M ft. in 9 or 10 days	Can deliver 1,000 carloads daily within 5 days	16,000,000 ft.	10,000,000 ft.	44,000,000 ft.	100,000,000 ft.	Large stocks; immediate delivery	Large stocks; spruce 10 to 14 days, pine 4 to 6 weeks	40,000,000 ft del. 30 days	Large mills within 250 miles

Year End Lumber Demand Steady

Reports for week ending Dec. 17 from producing lumber associations to the American Wholesale Lumber Association indicate that the demand after the previous week's increase has been maintained. The customary drop at the end of the year has not yet shown in the statistics. With production about 3 per cent of normal orders are running 64 per cent of normal and shipments 66 per cent of normal. The great demand for timbers in Japan increased water shipments in 1921 to 208,000,000 ft., 2½ times what it was in 1920.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for in Construction News, pp. 9@20 are the following:

A bridge for Sanitary District of Chicago, $1,000,000.

A hotel at Atlantic City, $5,000,000.

An office building for Chicago, $7,000,000.

Next week—Representative Public Bond Sales in December

in less than a day. Sufficient supply to meet all contractors' demands for the present. Dealers' stocks of sand, gravel and crushed stone, within city fairly large. Lumber yards able to complete delivery on quantities of yellow pine as large as 300,000 ft. b.m. in 9 or 10 days within Metropolitan district. Cement stocks fairly large; 5,000 to 6,000 bbl. kept on hand by one dealer alone. Deliveries in less than 24 hr.

Minneapolis — Lumber stocks lower than usual. About 3,000 bbl. of cement in local warehouses, but unlimited supply available in nearby mills, where cars are loaded the same day orders are received. Brick stocks as low as they are allowed to get, but supplies in any quantity can be had from yards within one day's shipment from the Twin Cities. Lumber stocks about 20 per cent below normal.

Denver — Cement shipments within 48 hr. from mills near city. About 1,000 tons of structural shapes on hand. Approximately 7,000,000 brick in stock; local plants can make 24 hr. deliveries. About 5 cars of asphalt on sidings. Lime stocks exceeding 500 bu. are not kept by any dealers. Sand and gravel delivered in 12 hr. from local pits.

Detroit — Plenty of sewer pipe on hand; very little demand. Other materials stocks sufficient to complete present contracts. Cement available at nearby mills.

Cincinnati—Ample stocks on hand in principal materials. Granite paving blocks not kept in stock but 50,000 daily can be supplied on three days' notice.

Boston—Fairly large supply of building materials. Ample supply of sewer pipe, all sizes, up to 24 in. All deliveries prompt.

Montreal—Stocks on hand larger than demand. Large retail stocks of lumber; mill deliveries from 1 to 2 weeks. About 15,000 tons of structural steel in stock; 24 hr. deliveries.

Chicago — Manufacturers' stocks of expanded metal lath larger than normal; dealers stocks lower. No stock of reinforcing bars carried, but manufacturers can supply any job, within city, in 10 days. Cement stock about 50 per cent normal. Immediate deliveries on lime, common brick and sewer pipe. Hollow tile delivered in 1 to 6 days.

San Francisco—Small stocks of common brick and cast-iron pipe. No railway ties on hand. Structural materials, lumber, cement and hollow tile kept in fairly large quantities. Unlimited amount of lime in stock. Deliveries in 2 to 3 days.

New Orleans—Ample supply of lumber on hand; one thousand car loads could be delivered daily within 5 days notice. Brick stocks unusually large. Cement stocks moderate but the daily consumption of 1,000 bbl. is equaled by the daily receipts from the mills. Sewer pipe stocks low; no demand. No stock of creosoted wood blocks on hand and none is expected until the 1922 paving program has gotten fully under way.

Philadelphia—Sewer pipe stocks kept low awaiting adjustment of freight rates. Asphaltum holding up better

than usual for this time of the year. Paving stone and wood blocks low. Brick and hollow tile very light. Lumber stocks below normal; but will be replentished beginning with the first of the year.

Baltimore — Plentiful supply of all materials excepting explosives. Deliveries on dynamite in about one week.

Atlanta — Plenty of pine lumber, cement and common brick. About 5 to 8 cars of lime on sidings and deliveries on tile made in 3 to 4 days.

Trend of Business

Bonds—Market duller than in previous weeks, probably owing principally to year-end adjustments. Resumption of high activity expected soon. The largest individual public bond sale last week was $20,000,000 of Ohio 4¾s. to yield 4.40 to 4 per cent, according to maturities ranging from 1923 to 1932. A large block of Michigan 20-year 5½s changed hands above 114, which is a 4.40 per cent basis. The 3½ per cent tax exempt Liberty bonds advanced to 96.28 on Jan. 9, the high mark last year being 96.7.

Stock Market—Dull, with prices lowering, despite cheap call money.

Money—Call loans were renewed at 4 per cent and finally at 3 per cent, on Jan. 9, the former rate being the lowest since the autumn of 1919. Time loans at 4½ to 5 per cent.

Foreign Exchange — Sterling, $4.22⅝, highest since Dec. 12; franc, 8.28½ cents; mark, .6 cent.

Iron and Steel—Pig iron production in December was 1,649,086 tons, against 1,415,491 in November; but steel production was 232,908 tons less in December, capacity in operation being only 45 per cent. Iron and steel output in 1921 was smaller in relation to capacity than in any previous year. About 19,000,000 tons of steel ingot were produced (on 38 per cent capacity), compared with nearly 40,000,000 in 1920.

Unemployment decreased in December in textiles, iron and steel, lumber, leather, paper and printing, metals and metal products, but for all industries decreased 4.7 per cent, according to the U. S. Employment Services and telegraphic survey of 1,428 firms in 65 industrial centers. The decreases were mainly in the food industries, beverages, chemicals, ceramic, vehicles for land transportation, and in railroad repair shops.

Large Contracts Let

Among this week's announcements of contracts awarded in Construction News, pp. 9@20 are the following large projects: A 12-story bank and office building in Los Angeles, Cal., to Lange & Bergstrom, Washington, Bldg., $1,500,000; a 15-story office building in Detroit, Mich., to M. Harrison and L. A. Turnock, 500 Board of Trade Bldg., Indianapolis, Ind., $1,650,000; a 12-story office building in Chicago, Ill., to Leonard Construction Co., 37 South Wabash Ave., $2,500,000; an oil refinery and asphalt plant in Linden, N. J., to J. Ferguson, United Bank Bldg., Paterson, N. J., $2,000,000; a freight terminal at Denison, Tex., to C. B. Cummins Co., Cleveland, O., $3,000,000.

Labor to Drop Restrictive Working Regulations

New York Building Trades Council to Accept Suggested Modification—Wage Schedule in Doubt

Interest in the building trades situation in New York City is centered about (1) a discussion of the wage schedule for 1922, and (2) the elimination from union regulations of certain objectionable practices. As to question No. 1, little has as yet been done. The elimination of certain practices from union regulations has been agreed upon by Samuel Untermyer, counsel for the Lockwood Committee, and the Building Trades Council.

Practically the only concrete thing so far in the settlement of the wage question is the plan set forth by the Building Trades Employers Association whereby a representative committee, which would form a public group, would negotiate a 1922 schedule of wages with the Building Trades Council. The employers association would agree to abide by the decision of this public group and the council. The employers suggested that such a public group be composed of one representative each of the American Institute of Architects, the American Federation of Labor, the New York State Chamber of Commerce, the New York City Merchants Assn., and one appointee of the governor of New York. The union objected to such a body on the ground that it would be practically all open shop or at least inimical to labor interests. So far no counter proposal has been made. In the meantime the employers association has circulated among its membership a notice that the 1921 schedule of wages shall endure until Jan. 31, 1922.

Objectionable Practices Cited

The elimination of certain objectionable practices from union regulations is the result of testimony brought forth in the investigation of building conditions in New York City being prosecuted by the Lockwood Legislative Committee on Housing. After rather a comprehensive survey of the situation had been made by the committee, Samuel Untermyer set forth nineteen of the practices which he considered most unreasonable and which should be immediately done away with. In general the regulations are to be adjusted along the lines of Mr. Untermyer's suggestions, which follow:

1. Membership restrictions in the various unions must be removed.

2. Membership dues shall not exceed $50.

3. Restrictions upon the number of apprentices in the various trades must be repealed.

4. The issuance of permit cards to non-union men so as to allow them to work with union men must be forbidden. The acceptance of such non-union men into union organizations will automatically eliminate this objection.

5. Accurate account books of the various unions and the general union organization must be kept, and must be certified at regular intervals by public accountants.

6. Unions must dispose themselves of the power to fine employers under penalty of refusing to supply them union labor. The investigation showed that employers have been fined for allowing painters to fill in plaster cracks when the latter were painting walls and ceilings, and that other employers have been fined for poor work done by union men.

7. There shall be no discrimination in supplying to members of the employers association labor over non-members of the association.

8. The activities of union organizations must be restricted to matters that legitimately concern themselves. There must, for instance, be no dictation from union men or from union organizations as to the character of the employer's contract. There shall be no insistence that a contract for labor call for a contract to supply materials.

9. There must be amendments to eliminate an extraction of penalty from employers, such as a requirement that an employer pay one-quarter of a day's wages to each man in a group because all were held up ten minutes when waiting for pay. This instance was testified to at one of the hearings before the Lockwood committee.

10. The restrictions upon the use of mechanical appliances must be removed as well as the restrictions against the fabrication of certain materials on the job instead of in the shop, where it is believed rightly to belong. The committee found that one of the most objectionable practices of this nature was the refusal of unions to install or handle the anti-siphon trap, although its use was authorized by both city and federal authorities. The committee also found that unions were not permitting the installation of plumbing with fixtures attached in the shops.

11. The penalties against employers for "rushing" or "driving" must be eliminated.

12. The power of unions to prohibit members from working more than 5 days per week, or to fine members for working any other day than Sundays and holidays is also found unreasonable.

13. Delegates or business agents convicted of extortion and who have served prison terms should be made ineligible to hold similar posts.

14. Regulations should be enacted prohibiting any union or business agent from outlining or enforcing a daily detail of work.

15. The following matters in relation to plumbing work should be abated:

a—That there be but one helper to two plumbers.

b—That no helper can use the tools of a plumber except when the mechanic himself is idle.

16. The provision of the cement masons that, where two men are used one must be a foreman, and in case four or more are used the foreman shall not use any tools, must be repealed.

17. The rule requiring employment of metal lathers wherever concrete is being poured by common labor that compels the employment of a foreman to look on while work is being done, although there are no lathers and there is nothing for the lather to do, is unreasonable. Also, that if one man is employed he must be a foreman, is an unreasonable regulation.

18. The regulation that the rate of wages paid to painters must be the same as the rate prevailing in the city wherein the contractor has his office, if that rate be higher than where the work is done, should be done away with.

19. The limitation of painter apprentices in shops is unreasonable as is the limitation on the size of the paint brush used on the job.

Although these are the basic objections it is possible that certain revisons will be made before a final settlement is agreed upon.

From time to time we will publish prices of materials and labor rates and conditions in cities other than those covered weekly and monthly in Engineering News-Record. Next week—the Buffalo market.

Some Costs in Colorado County, Tex.

B. H. Faber, County Engineer of Colorado County, Tex., advises that road gravel and wash sand cost 75 cents per cu.yd., wash gravel $1.50, f.o.b. county pits. Labor is plentiful—$1.50 for negro, $2@$3 for white, per 10-hour day.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of January 5; the next, on February 2.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products:									
Structural shapes, 100 lb	—$2.63	—$3.50	$4.00	$2.88	—$2.91	—$3.50	$3.45	$3.85	$4.00
Structural rivets, 100 lb	3.50	—5.00	5.50	3.43	—3.90	4.25	—4.50	—4.00	6.50
Reinforcing bars, ¾ in. and larger, 100 lb	—2.53	3.20	3.50	2.68	—2.81	3.57½	3.00	3.75	2.75
Steel pipe, black, 2½ to 6 in. lap, discount	61%	57 65%	45%	57%	61.9–5%	41%	53.7%	55%	35.10
Cast-iron pipe, 6in. and over, ton	47.30@48.30	45.00	—48.30	44.10	47.80	52.00	50.00	55.00	60.00
Concreting Material:									
Cement without bags, bbl	2.30	—2.55	2.55	1.97	—2.24	—2.90	2.84	—2.94	—3.10
Gravel, ¾ in., cu.yd	1.75	1.85	—2.00	2.00	1.50	2.50	2.25	1.50	1.50
Sand, cu.yd	1.00	1.25	—2.00	2.00	.50	1.10	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd	—1.75@1.85	2.00	—2.93	1.60	2.25	3.50	2.25	3.00	2.10
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	49.00	—35.00	31.00	—43.00	36.00	50.00	+32.00	—19.00	78.00
Lime, finishing, hydrated, ton	16.00	19.00	25.00	18.00	29.00	30.00	22.00	27.00	21.00
Lime common, lump, per bbl	3.00@3.49	1.50	2.75	1.40	1.40	2.95	1.90	2.75	11.00
Common brick, delivered, 1,000	—17.40@17.90	9.00	—12.65	11.00	—15.00	14.00	15.50	14.00	16.00
Hollow building tile, 4x12x12, block	Not used	.0675	.13	.0821	—.0752	— .08	.12½	.10	.08@.29
Hollow partition tile 4x12x12, block	.11120	.0675	.13	.0857		.10	.14½	.11	
Linseed oil, raw, 5 bbl. lots, gal	.72	.78	+.93	+.76	.80	.90	+.83	.79	.85
Common Labor:									
Common labor, union, hour	.75	.35		72½	.50	.50@.55	—.62½	.50@.60	
Common labor, non-union, hour		.20	.35@.45	.35@.40	—.40@.50	.35@.40	56¼	.50	—.20@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent, 45@50 means a range of 45 to 50 per cent. Charge of 15c. per 100 lb. for cutting reinforced steel into 2-ft lengths or over. **New York** quotations are delivered except tiles, which are "on trucks." Common lump lime per 280-lb net; both lump and hydrated quoted f.o.b. cars New York. Sand gravel and crushed stone are quoted alongside dock. Cement and steel pipe delivered to contractors on job. Gravel ready mixed $2 per cu.yd. **Chicago** quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. **Minneapolis** quotes on fir instead of pine. Brick and hollow tile delivered. Cement on cars; $2.45 delivered. Gravel, sand and crushed stone quote at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized. **Denver** quotes cement "on tracks"; gravel and sand at pit, stone on cars, lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. Common lump lime per 180-lb. net. **Atlanta** quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net. **Dallas** quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered. **San Francisco** quotes on Heath tile, 5¼ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to contractors in yards at San Francisco. **Seattle** quotes on Douglas fir instead of pine. Common lump lime per 180-lb. net. **Montreal** quotes sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile, per ft. Cement price is in Canadian funds (the Canadian dollar stands at 94 cents). Bag change is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net.

Changes Since Last Week

Reductions averaging about 18c. per 100 lb. on steel shapes, at the warehouse, are quoted in New York, Atlanta, Denver and Minneapolis; average drop of 25c. on structural rivets in Atlanta, Minneapolis, San Francisco and Seattle. Reinforcing bars down 15c. in New York and Minneapolis. Structural steel continues to be quoted at $1.50, Pittsburgh, in large tonnages; mill shipments, New York, at $1.88 for shapes and bars and $1.83@$1.88 for plates. Mill shipments, Denver, of structural shapes are quoted at $3 per 100 lb. Lower prices due principally to reduced cost of production.

Price of cement reduced 14c. in Atlanta; 20c. in Denver; 16c. in Seattle and 2c. per bbl. in Montreal. Dallas quotes reduction of 25c. per cu.yd. on sand, gravel and crushed stone; New York quotes ¾-in. crushed stone at $1.85 as against $1.90 and 1½ in. at $1.75 as compared with former price of $1.80 per cu.yd. Long leaf yellow pine, base sizes, has advanced $2 per M. ft. b.m. in San Francisco yards.

Common bricks are quoted in Minneapolis at $15 as against $17 and in New York at $14@$14.50 as compared with the recent price of $14@$15 per 1,000 wholesale. Slight drop in hollow building tile in Denver and Minneapolis.

Linseed oil up 5c. in Dallas, 2c. in Chicago and 1c. per gal, in San Francisco.

The decision of the Impartial Wage Board of the Industrial Association of San Francisco has rated union common labor at $5 per day or 62½c. per hr.; unskilled non-union at $4.50 per day or 56¼c. per hr. Although the regular rates for non-union common labor have been 50c. in Minneapolis and 30c. in Montreal, men are now procurable at 40c. in the former city and at a rate as low as 20c. per hr. in the latter.

The National Lumber Manufacturers' Association's report for the week ending Dec. 31, 1921 shows a total of 102,504,166 ft. cut; 113,113,745 ft. shipped and orders for 118,048,343 ft b.m. Mills reporting, representing all members of the Association, numbered 350. Production for the week was about 51 per cent; shipments 47 per cent and orders 43 per cent below normal.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, President

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. Mehren
Editor

Volume 88 — NEW YORK, JANUARY 19, 1922 — Number 3

Dragline Operation

THE comparison in this issue of steam and electrically operated dragline excavators indicates that (1) the costs of excavation are not greatly different, (2) the margin in favor of electricity is entirely saving in attendance, and (3) the superiority of the electric machine is its greater desirability as a place in which to work. A smaller crew and better working conditions for that crew are important advantages. Both help to reduce labor turnover and to increase the efficiency of labor. Men work better when their working conditions are cleanly and pleasant and they remain longer on the job. These are truths too well known to be questioned even by construction managers who generally have been more slow to appreciate their practical importance than have factory managers. They are important factors in bringing about the substitution on construction equipment of the motor and the gas engine for the steam boiler and engine.

Army Engineers Early Training

FEW civilian engineers regard West Point as even an elementary engineering school, much as they admire the basic quality of its instruction, and fewer still consider the early education of the army engineer officer—in the self-perpetuating Engineer School and as an executive under the orders of his superior in the district office—at all comparable in training value to that received by the civilian in the engineering school and in the close-to-the-job experience of the first years after graduation. The army engineer in his earlier years certainly needs more non-military engineering education and association. Judging from certain parts of the recent report of the Chief of Engineers, abstracted on another page, the Corps of Engineers now has some respect for these lay views, for it will be noted that for two years a considerable number (77 last year and 44 this year) of younger officers have been taking engineering courses at two of our leading technical schools—and in addition, some officers have been detailed to industrial concerns, though the number is not stated. We are advised, however, that three officers are with railroads. Lack of the common touch and superficiality have been charged against army engineers. If reformed methods of early training can remove the causes of these criticisms the Corps will find less opposition in the future.

Briand and Poincaré

LAST week we spoke hopefully of the prospects of an economic conference called to meet in Genoa in March. It seemed then that good must surely come from it. But what a change in the situation in one short week! Briand, who had learned the spirit of compromise, even though his demands regarding the method of securing French security did not accord with that of the rest of the world, has fallen and in his place is Poincaré, the irreconcilable. For the moment Europe fears that there is again dominant in France the spirit that caused the rest of Europe to declare many a time since the armistice that France was the greater obstacle in the way of European peace. The British, upon whom more than any one else depends the satisfactory working out of Europe's ills, are fearful of the attitude that the new premier may take. Hope is reposed, however, in the well known fact that the responsibility of office breeds conservatism and that the awakening of France to the fact that she is rapidly losing the sympathies of the great majority of the people in Great Britain and America may make for a more tolerant attitude and bring about in Poincaré, as it did in Briand, the spirit of compromise. The Genoa conference, despite Briand's fall, is to go forward.

Enjoining the Employer

EMPLOYERS no less than employees, must respect the sanctity of labor contracts. That is a generalization that could be made in the abstract at any time. It is pertinent now, however, because Justice Wagner of the New York Supreme Court last week enjoined the Cloak, Suit & Skirt Manufacturers Protective Association from "combining or conspiring in any way" to violate the contract with the International Ladies Garment Workers Union. The facts in this case have been spread before the New York public for some months and the opinion has been strongly formed that the employers were in the wrong. They and their employees are working under a contract that was to run until June 1, of this year. However, the employers decided to put their employees on piece work, instead of on a time basis, and to lengthen the working week. To this the employees objected, as being violative of the present contract. A strike ensued at the middle of November, and the court action here discussed was the result. The case has special importance because it is believed to be the first one in American industrial history in which a labor union has obtained an injuction to hold employers to a working agreement. Another interesting angle is that the union's president declared that it would instruct its counsel to "institute proceedings to recover from the Protective Association and its members the full amount of damages sustained by the workers on account of the strike which has been forced upon them." Obviously, there will be the point of law here that the employees actually went out on strike and were not locked out. Nevertheless, if in the Danbury Hatters case it was possible for the employers to recover damages from their men, it would seem, without minute inquiry into all the facts, that there would be liability for damages from the employers in the present case. In any event, the injunction is notice to all employers that they cannot violate their labor agreements with impunity

Responsibility for Corrupt Trade Practices

ELSEWHERE in this journal a correspondent expresses the belief that owners, not contractors, should bear the large measure of responsibility for corrupt practices in the building industry. It is his assertion that the owner, anxious that his work be completed rapidly, may be willing to wink at corruption. With such a position we must take issue. In the first place were the owner entirely to blame, and we certainly believe him not to be, the contractor would not be relieved of any responsibility. It is his duty to give the public—which must pay for expensive work made so through strike insurance or what-not levied against it—the least costly work consistent with good workmanship. Though the contractor be doing his job for a consideration, his ethical position is as clear as that of any other public servant. The stability of the industry is dependent upon the public's confidence. If the owner be tempted, the contractor has an opportunity to do real service that should not be passed by. The man who is paying the cost of the construction is usually too shrewd to pour needless dollars into the work for the sake of getting it done rapidly. Competition in letting space is usually too keen to admit such practice, unless the work be strictly speculative in character, or unless space to rent or lease is at a premium and the time element is the controlling consideration. In the second place, the contractor has been found guilty of complicity in corrupt practices. So let us reiterate the point that in the activities of trade associations and the building industry in general the contractor should point the honorable way.

Increase Patent Office Salaries

IN THESE days of enforced government economy, pleas of special interests for increases in appropriations fall on deaf ears. Every government expenditure has some one who thinks it necessary to the life of the nation. Congress, in despair of making just discrimination, is apt to throw out all requests for increased appropriations and particularly for increased salaries. The conditions in the Patent Office are so manifestly disturbing, however, that the salary increases there asked in H. R. 7077, which has just passed the House, should become the first order of business in the Senate. A self-supporting institution, dependent on its efficiency for the continuance and ability of its personnel, the Patent Office is now going daily further behind in its business and piling up more and more litigation because of the difficulty of getting and keeping trained examiners at the ridiculous low wage scale now in force. The bill now before the Senate does not add much to the expense of government but it does offer enough salary to enable self-respecting engineers and lawyers to live in Washington without an impossible sacrifice for the public good.

Stopping Bad Practices

IT IS quite apparent that costly limitations are placed upon building in New York City by union organizations. Their working regulations have been full of practices that have put penalties on the contractor and necessarily, therefore, on the owner and the tenant. Not alone have the money penalties been freely imposed, but restrictions in working conditions, the number of apprentices allowed in certain trades on certain jobs, the limitation of the use by the contractor of mechanical appliances, the insistence that work which rightly belongs in the shop be done on the job, the interference of unions with employers' business activities: all these have been extremely costly.

Certain of these practices are to be eliminated, if the promises of the Building Trades Council can be relied upon. Conferences between the counsel for the Lockwood Committee and the council have resulted in a decision as to what practices, in a general way, are to be dropped. A threat of legislative curtailment of power has led the unions to realize that the public has an immense interest in their deliberations and operations.

Though the objections to union practices are given in detail in a pamphlet issued from the offices of the counsel for the Lockwood Committee, and outlined in last week's News Section, no definite settlement has been reached. The public should know these practices and should take an active hand in getting rid of them and in seeing that they do not again creep into union operations. As we have pointed out before, here is a great work for local chambers of commerce or other strong civic bodies. That which the Lockwood Committee is doing in New York should be done wherever union practices are wasteful.

The American Concrete Institute

NEXT month the American Concrete Institute meets for the first time in many years outside of Chicago, if the two war meetings at Atlantic City be excepted. This selection of Cleveland is experimental, an attempt to attract a greater variety of attendance by successive meetings in different parts of the country, so that interest in the society now maintained principally by the *Proceedings* may be strengthened by the appreciation that attendance on the convention is bound to develop. The institute has taken on renewed vigor in the past two years. A permanent secretary, regular news-letters and a thoughtful program of intention and procedure have done much to spread among engineers and contractors the good work the society is doing and, what is more important, can do. Its membership has now reached as many as in the early days of enthusiasm in its predecessor, the National Association of Cement Users, and its committees are better organized than ever before.

The American Concrete Institute has a real place in our technical societies. In it are brought together all of those who are interested in the designing and building of concrete structures and they are united there in the single purpose of making better and more economical concrete. The contractor members are not in as business men but as concrete builders, the engineers not solely as the arbitrator between contractor and owner but as designers and supervisors of construction. The material men meet in it the users of their materials. The aim of all of them is identical—better concrete. In the Institute can be joined, as nowhere else, the divergent views into the compact whole, which is what concrete needs.

The Cleveland meeting is the first one after the reorganization of committee work, which was decided upon last year at Chicago. Intensive work in certain lines of activity, notably concrete products, contractor's methods and housing, was planned. These subjects, together with a discussion of the Joint Committee report, from the point of view of the Institute's committees, will form the nucleus of this year's program. It promises fruitful results, but it can be best carried out by a representative attendance, which it should have.

Endurance of Material

IN SO FAR as engineering may be described as the art of constructing for permanence, rather than merely constructing, those questions and problems that are concerned with the mortality of material, its inability to endure in service without limit, are among the ultimate problems of the underlying science. In the last analysis endurance failure is the controlling factor in every undertaking of constructive engineering; or, more accurately, it is one of two factors: The loss of matter through attrition and chemical attack, and the loss of strength through oft-repeated stressing. The latter, to which custom has limited the term "endurance failure," occupies a position of peculiar distinction among the mysteries of materials. Some definite knowledge concerning it has been produced in the laborious and careful researches on fatigue reported in last week's issue by Prof. Moore. The results obtained, limited as they are, open up the prospect that fatigue phenomena may in time be wholly divested of their cloak of mystery, and that we need then no longer make allowance for fatigue in our factors of safety, or try to provide for them by the empirical working out of designs.

It is now established that endurance failure under alternating stress—which occurs throughout a large range below the static failure point of the material, and in this range follows a simple mathematical law with great accuracy—suddenly ceases to occur when the stress is reduced to a certain definite limit. Stresses below this limit may apparently be repeated an endless number of times without causing fracture. It is established also that the heat generated in a piece of metal by alternating stress, which can be measured to sufficient accuracy after less than a minute of testing, is generated at a much more rapid rate per unit of stress when the stress is very high than when it is low, and that the rate abruptly changes at a certain limiting stress, identical in every repetition of the test series. It is shown further that, throughout a large series of comparative tests, the limiting stress thus determined by heating is the same as the endurance limit found from the long-time alternating-stress fatigue experiments. No relation appears between this limit of fatigue strength and the static properties which have usually been thought determinative, such as elastic limit, or ductility. On the other hand, the fatigue strength seems to bear a direct proportion to the ultimate strength as well as to the hardness of the material; but the correspondence is erratic enough to suggest that no simple physical law is in action here, and that perhaps the endurance limit is just as independent a variable as elastic limit, ultimate strength and toughness themselves. This point is of minor importance at present, however. The outstanding fact is that an endurance limit has been determined with great certainty, that means have been found—namely, the heating test—for determining this limit in an experiment of a few minutes' duration, and that by keeping service stresses below this limit we may expect to obtain permanent service from material, without any fatigue or "crystallization." These statements apply only to steel, as no other material was experimented upon.

Some, if not all, of these facts are new only in degree but not in kind. Wöhler, half a century ago, by his pioneer investigations on fatigue, was led to conclude that there is a definite endurance limit, below which no fatigue action takes place. Subsequent workers, mainly Stromeyer, have inquired into the generation of heat in repeated stressing of a test specimen. The dominating influence of surface imperfections on endurance failure has been known for a long time, from practical experience as well as from laboratory data, and together with the similar influence of sharp corners or abrupt changes of shape is the most definitely known and in some respects the most important fact concerning endurance. But Prof. Moore has made certain that which with Wöhler was nothing more than shrewd inference, and he has not only converted the heating test into a scientific method rather than a laboratory plaything, but he has positively identified the heating limit as the stress-endurance limit. Finally, in demonstrating a close correspondence between endurance and both strength and hardness, he has opened up a wide field for exploration.

All that he reports deals with alternating stress, that is, change from tension to compression of equal numerical value and back again. About other possible endurance-failure actions we are told nothing, although a few reversed-torsion experiments were made. For instance, shearing stress may perhaps be capable of producing fatigue failure. It is true that shear fatigue is practically negligible for either the civil or mechanical engineer's working needs, but the same is true of fatigue resulting from alternation of tension and compression in equal amount, since such stress occurs but rarely in practice. Repetitive stress of constant kind (for instance, tension ranging from zero to maximum or from a low tension to a high tension), the influence of small variations of stress superimposed upon a high steady stress, the influence of occasional very high or suddenly applied stresses upon the progress of fatigue under a moderate, oft-repeated stress, and similar points of inquiry are the ones that more directly correspond to service needs.

These sub-problems, of course, can be investigated only after the determination of the fundamental facts which the investigation so far has developed. But they are worth thinking about as indicating how vast is the field open for further fatigue research, and how important therefore the foundation that has been laid by the work just completed. It is necessary to remember, too, that unless the research is continued, and continued to very great lengths, its practical value to engineers will be small: the real fruits of the research lie in the results yet to be attained.

For the civil engineer there is one important teaching in the present results. Bridge and structural design has for years past been shaped in an important way by the belief that a member carrying reversed stress is more severely taxed, and hence is in greater danger, than one carrying a one-directional stress, whether steady or variable. This belief has been maintained with persistence in spite of the fact that the maximum stresses occurring in the service of bridges and other steel structures are low, in fact from the fatigue standpoint *very* low. Prof. Moore's work makes it clear that there is no justification for any such belief, since the endurance limit is well above any stresses likely to occur in bridge service, and below this limit no weakening effect of "fatigue" can be detected. It will be in the interests of progress in bridge practice, then, if the reversed stress allowances are speedily discarded, except where they refer solely to riveted joints.

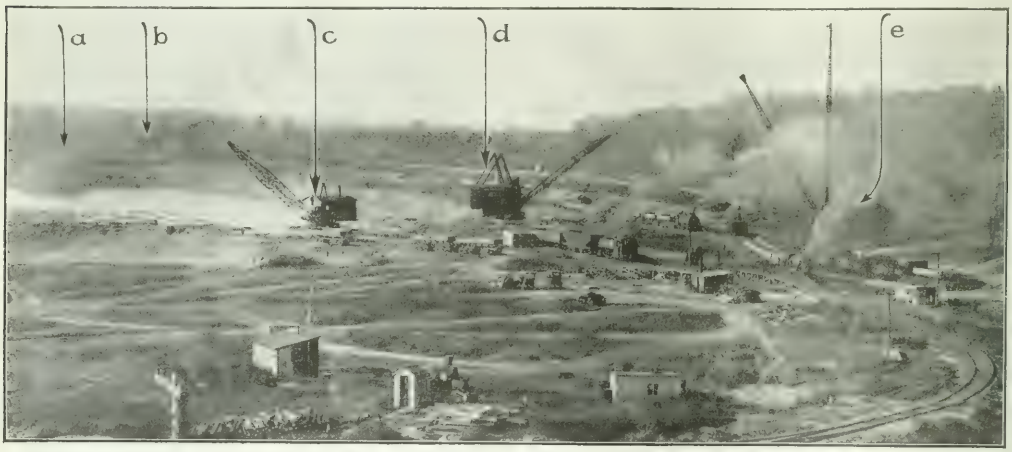
Comparison of Electric and Steam Draglines at Miami

Similarity of Machines and Materials Enables Close Comparison—Accurate Costs and Performance Records Kept—Structural Weaknesses Determined

By G. L. Teeple
Dayton, Ohio

COMPARATIVE performance and cost records of steam and electric dragline excavators on the flood protection works of the Miami Conservancy District decisively favor the electrical machine. It has been found cheaper, less troublesome, cleaner and more comfortable for the operators. It is more constantly reliable, more free from break-downs and delays, and is in general more efficient. These are the opinions of the engineers of the district and of the machine operators.

On the flood protection works, from 19 to 20 draglines have been in service most of the time, and in materials varying from clean sand to tough clay and solid rock. The motive power in nine of these machines has been electricity; in the remainder it has been steam. Under these conditions an unusual opportunity has been afforded for a comparison of the relative merits of the two sources of energy. At the Englewood dam, the opportunity has been exceptional, two machines there having been at work side by side for about three years. They are of the same size and the same make. They are excavating practically identical material under identical conditions, except that one is a steam machine, and the other an electric. A close watch has been kept on these two machines, and in recent months the costs have been kept in part with special reference to a comparison.



DRAGLINE EXCAVATOR OUTFIT AT ENGLEWOOD DAM
a—Steam pump for dragline boiler supply. b—Steam dragline, Bucyrus 24. c—Auxiliary steam dragline, Lidgerwood Class 13. d—Electric dragline, Bucyrus 24. e—Coal pile and clamshell unloader

At Englewood, the borrow pit occupies the broad flat valley of the Stillwater River for about three-fourths of a mile immediately above the dam-site. The draglines are placed in tandem on the east pit edge, which extends roughly at right angles to the dam, and parallel to which the standard gage railway tracks are laid which carry the 12-yard dump-car trains to the dredge pump sump. The steam machine works the north part of the pit and the electric the south half, cutting successive slices from the pit edge, and dumping the excavated material into the cars alongside. These materials have been remarkably uniform, the upper 2 ft., approximately, being a rather light loamy top soil, and the underlying formation being an uncemented, easily-dug sand-and-gravel. The total depth of the pit is about 15 ft. The excavated portions form a pond or lake, 3 to 4 ft. deep, so that the bucket nearly always starts its work in water. The only impediments to free digging have been a few stumps.

Since it is evident that the test at Englewood furnishes no criterion of the performance of an electric machine in tough materials, it ought to be added that elsewhere on the conservancy work electric draglines have excavated tough clay, solid rock and Cincinnation formation, (inter-stratified clay, shale and limestone), with entire satisfaction, and with no indication that they would prove any less relatively efficient on such materials than on the materials at Englewood.

Both machines at Englewood are Bucyrus Class 24 type draglines. Each has an 85-ft. boom and a 4½ yard bucket. In working condition, the electrical machine weighs about 120 tons and the steam about 140 tons. They came onto the work new in the spring of 1918, and have since been in practically continuous use except for a few weeks during each of the last two winters. The work has been heavy and unremitting, through two 10-hour shifts, 20 hours a day, 6 days a week. The heavy strain is indicated by the fact that each machine was compelled, last winter, to go into the shop for a major repair. These facts are stressed to show that the test made, covering the months of May, June, July and August of 1921, and after three years of service like that indicated, is not one of picked machines in the "pink and prime" of condition, but of scarred

veterans that have been "through the war" and are still turning dirt out with little or no slackening in speed.

The steam machine has a main engine with double cylinders 10½ x 12 in. and a swing engine with double cylinders 8 x 8 in. The boiler is 58 in. x 14 ft. and carries steam at 125 to 150 lb. Coal is switched in from the railway main line a considerable distance, and is unloaded by clamshell on the ground near the dam site. A team carts the coal to the vicinity of the dragline, whence it is carried onto the machine by hand. Water for the boiler comes from a steam pump drawing its supply from the borrow pit pool.

TABLE I—COMPARATIVE COSTS OF OPERATION OF STEAM AND ELECTRIC DRAGLINES
Englewood Dam, Miami Conservancy District, May to August, Inclusive, 1921

Item	Electric	Steam	Electric Pr. Yd.	Steam Pr. Yd.	Electric Pr. Ct.	Steam Pr. Ct.
Labor	$6,926 25	$11,184 81	$0.0245	$0.0404	38.1	53.6
Supplies and minor repairs	1,993.24	1,821.27	.00704	.00657	11.0	8.7
Power	4,491.82	4,242.37	.0159	.0153	24.6	20.3
Cable	1,685.35	844.49	.00595	.00305	9.3	4.1
Depreciation	3,092.00	2,774.00	.0109	.0100	17.0	13.3
Total	$18,188.66	$20,866.94	$0.0644	$0.0753	$100.0	$100.0
Total work	283,024 c.y.	276,910 c.y.				
Cost pr. yd.	$0.0643	$.0753				

The electrical machine takes power from a special transmission line connected with the 33,000 volt circuit of the Dayton Power & Light Co. A transformer station at the dam steps this current down to 2,300 volts, whence it is distributed to the camp and work. The work circuit has two branches, one feeding the dredge pumps and the other the electrical dragline. The current is metered for the entire work circuit, and also for the dredge pumps, the difference giving the energy used by the dragline. This measure includes borrow pit line and transformer losses, but this, of course, does not effect the validity of the cost comparison. The machine takes current at 440 volts from three 75 kw. transformers in the borrow pit near it, connection being by three 4-0 flexible cables, the current being three-phase. These cables are 500 ft. long and are insulated with standard mining cable insulation which permits them to

TABLE II—COST OF EXCAVATION PER CUBIC YARD
By Class K, Lidgerwood Dragline, Germantown Dam

Labor, including erection, maintenance, operation and dismantling		$0.463
Power:		
Electric current	0.0114	
Transmission lines and substations	0.0026	
Labor of electricians	0.0020	0.0160
Supplies		0.0030
Repairs, incidentals and drag cables		0.0120
Depreciation		0.0153
Total		$0.0926

be laid along the ground. The current is three-phase, 60-cycle alternating. The dragline motors are of the slip ring, variable speed type. The load and hoist motor is of 200 hp., the swing motor of 75 hp., and a third motor, of 3 hp., works a small air compressor which operates the friction clutches on the cable drums.

While the air compressor on these machines works only the friction clutches, the drum brakes being operated by electrical devices, experience with other conservancy machines has shown that air is superior on the drum brakes also.

For presentation, Tables I and III the costs of operation are distributed under five main heads: Labor, Supplies and Minor Repairs, Power, Cable, and Depreciation. The minor repairs, being practically all materials, are bunched with the supplies for convenience. Cable is separated for exhibition on account of the special interest attaching to this item. Depreciation is an estimate only, based on first cost of the machine, but since the same percentage is applied to both machines, no material error will arise in the figures as used for purposes of comparison.

It should be carefully noted at the outset that the figures given are only for ordinary running expenses plus the rough depreciation measure. They do not include items of track construction and maintenance, nor electric line construction and maintenance, which are properly chargeable, the track items to the steam drag account, and the electric line items to the electric drag account. Neither are any overhead charges included (except 10 per cent on the cost of the coal in the pile.) Likewise the items of erection, major repair, dismantling and salvage are omitted, as being unknown or unnecessary to the purpose in view which is the comparison of the *relative cost* of moving the material by

TABLE III—COMPARISON OF COSTS, ELECTRIC AND STEAM DRAGLINES
Month by Month, at Englewood

Item	Electric	Steam
May, 1921		
Electric, work done 62,158 cu.yd.; cost per. yd. $0.073. Steam, work done 61,433 cu.yd.; cost per yd. $0.087.		
Labor	$1,858.42	$2,581.28
Supplies and minor repairs	636.72	399.85
Power	968.83	967.00
Cable	291.08	718.60
Depreciation	773.00	693.50
Total	$4,528.05	$5,360.23
June, 1921		
Electric, work done 68,950 cu.yd.; cost per yd. $0.060. Steam, work done 80,300 cu.yd.; cost per yd. $0.063.		
Labor	$1,583.87	$2,940.89
Supplies and minor repairs	305 71	248 76
Power	918 25	1,160 41
Cable	577.86	
Depreciation	773.00	693.50
Total	$4,158.69	$5,043.06
July, 1921		
Electric, work done 71,780 cu.yd.; cost per yd. $0.062. Steam, work done 61,625 cu.yd; cost per yd. $0.080.		
Labor	$1,697.15	$2,620.31
Supplies and minor repairs	359.82	432.96
Power	1,259 96	1,038 93
Cable	363 49	125 89
Depreciation	773 00	693 50
Total	$4,453.42	$4,911.59
August, 1921		
Electric, work done 80,144 cu.yd.; cost per yd. $0.063. Steam, work done 73,552 cu.yd.; cost per yd. $0.075.		
Labor	$1,786 81	$3,042.33
Supplies and minor repairs	690 99	739 70
Power	1,344 78	1,076 03
Cable	432 92	
Depreciation	773.00	693.50
Total	$5,048.50	$5,551.56

the two draglines. The omitted items will aproximately balance each other, as they would enter the final complete account. The running accounts presented will indicate the chief differences in the performance of the two machines. They will not, however, give any fair indication of *absolute* costs, a point which must be steadily kept in mind. (Compare the figures in Table II, which gives the final absolute costs for the Germantown machine).

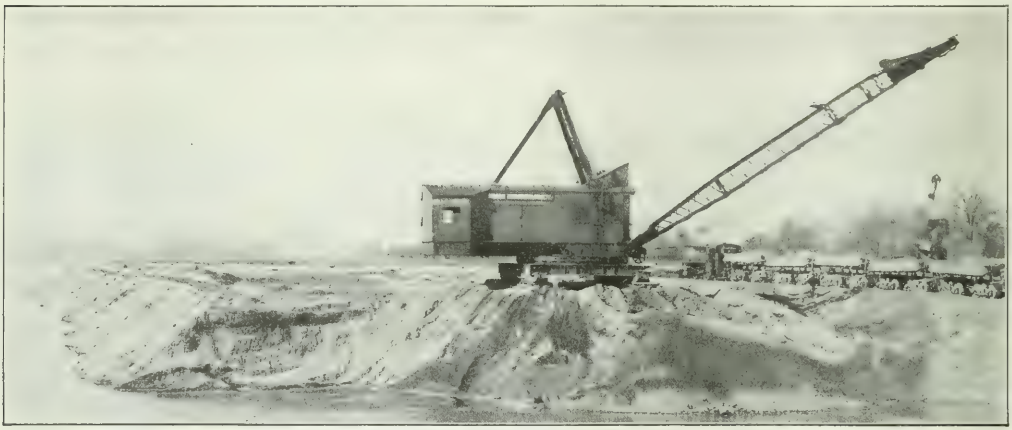
Labor is much the largest item in both accounts, being for the full period about 38 per cent of the total for the electric and about 53 per cent for the steam machine. It is also the item in which the electric machine shows its chief saving, the total labor cost being $6,926.25 against $11,184.81 for steam for the four months. The item includes all ordinary labor around the machines, that of the pumpman who attends the pump and boiler supplying feed water to the steam machine and also that of the team and man who haul coal. A pumpman is

required on both day and night shifts, but the coal team works during the day shift only. It is these two items which run the labor cost of the steam machine so much higher than that of the electric, together with the wages of the fireman and of the extra man required on the steam drag crew to help handle the coal from the pile on the ground to the machine. This will be clear from Table IV, which shows the itemized cost of the two crews. (Really four crews, there being a day and a night crew on each machine.)

The rates given are in case averages, there being slight variations due to length of service and other conditions. The rate for the team and man hauling coal is $8.80 per day.

The time costs of the chief electrician and of the master mechanic are not included in the labor costs as given, nor in any item. Each may be roughly estimated at $50 per month. Approximately divided between the two machines, as they are, their omission is not thought in the charge. The maximum demand meter is placed at the 33,000-2,300-volt transformer sub-station at the dam. The monthly bill from the power company is for the total energy used at the dam, and the amount of this to charge to the electric dragline is computed as a percentage from the readings of the various meters on the several dam circuits as described. The variation in the conditions is shown in Table V, the maximum demand being that for the entire work, the rate being the corresponding charge per kw-hr. the consumption given being that for the dragline machine alone, and the cost given making allowance also for discounts which vary with the gross bill.

A complete account of the electric power would include a pro-rated item covering the cost of the pole lines and transformers bringing the power from the Dayton Power & Light Co.'s circuit. As noted, it is not possible at this time to present such an item, the omission being balanced by a similar omission covering railway



ELECTRIC DRAGLINE AND TYPICAL EXCAVATING CONDITIONS

materially to affect the relative showing. The labor of shifting the borrow pit transformers is also not included. These transformers, attached to the electric dragline by 500 ft. cables as noted, are mounted on a sledge or "stone boat," and are moved down the pit, 850 to 900 ft. at a stretch, as the machines reaches the end of its tether. This is done during the "noon hour," ¾ hour long, two teams and ten men doing the work in that time. Also every four moves the "stubs" have to be cut off the branches of the borrow pit pole line, requiring four men about one day. This totals about $13 for labor per move, each move yielding about 70,000 cu.yd.

Supplies and minor repairs are almost entirely materials, the labor item in all cases but one being included in the pay of the crew, since the crews make these repairs at odd, favorable or necessary times.

Electric Power—This item, as entered in Tables I and III includes electrical energy only. This energy is derived, as stated, from the plant of the Dayton Power & Light Co. in Dayton, and the charge is made to depend not only on the actual energy used, but also on the "maximum demand" for energy on the entire work at the dam during the month, the theory being that this maximum must be reserved at the central station for possible use on the work and hence must be allowed for trackage, etc., necessary to bring the coal to the pile on the dam-site.

Of interest in this connection is the small loss sustained due to stoppages of the electric current in the power company's main circuit. Only four such shutdowns occurred during the four months considered. They were as follows: May 13, 3 hr.; May 27, ½ hr.; in June, none; July 28, 1 hr.; August 22, 4½ hr. Total, 9 hr. No overhead being included in the tables, this item, practically negligible in comparison, does not appear.

Steam Power—As given in Table I and III the cost of this item is that of the coal only, delivered upon the ground near the borrow pit as described. The cost per ton so delivered, including 10 per cent for field warehouse overhead, but not including switching and unloading charges, was $6.519. The high rate is due to the fact that the coal used was part of a large pile accumulated in part during 1920, to insure a certain supply, prices at that time being rather high. Freight charges may be reckoned at about $2.50 per ton, and switching and unloading at about 25c. the latter being by clamshell. The tonnage used was as follows; in May, 130; June, 156; July, 140; August, 145; Total, 571. The total cost of hauling this (an average distance of about half

a mile), was $906.40, this item being included in the labor account as already noted.

Depreciation is an estimate, it being reckoned at 2 per cent per month of the original cost of the machines, this cost being for the electric machine $38,650, and for the steam machine $34,675. In Table II, showing costs at Germantown, the exact figure can be given, the work there being finished and the machine sold.

Tables I and III show the operating costs for May, June, July and August, 1921, severally, and for the four months period as a whole. The material moved during each month is also shown, and the cost per cubic yard for the excavation, including only the items as given in the tables. In Table I the cost per cubic yard is also given for the several items, for comparison with Table III, which exhibits the performance of the electric dragline machine at the Germantown dam. The yardage in each case is measured with the material in place in the dam embankment.

TABLE IV—CREWS FOR STEAM AND ELECTRIC DRAGLINES

Steam Machine	Rate of Pay	Electric Machine	Rate of Pay
Runner	$278 per mo.	Runner	$278 per mo.
Oiler	56 cts. per hr.	Oiler	54 cts. per hr.
Fireman	53½c. per hr.	Pit Boss	52c. per hr.
Pumpman	50 cts. per hr.	2 Laborers	40 cts. per hr
Pit Boss	52½c. per hr.		
3 Laborers	40 cts. per hr.		

Examination of the figures will show that the cost per yard is least with the electric machine in every month of the trial. In only one month, June, did the steam machine approach its rival; in the others the advantage is decisive. For the whole period the cost per yard for the electric machine was 6.43c.; for the steam 7.53c. Except in June the yardage handled by the electric was the greater; and the total yardage it handled was greater in the ratio of 283,000 to 277,000.

It should be stated at once that the difference shown does not come from a difference in ability of the two operators. Both are first-class men, able to handle either an electric or a steam machine, and there is little to choose between them.

As to speed, *while in operation*, the steam machine seems to be somewhat the faster, due to its quicker swing and hoist, the loading being about the same in both. (But there seems to be no doubt that this difference can be corrected in a new gear ratio, or a slightly higher permitted speed, an absolute limit being set to this factor in the electric design.) But the superior speed of the steam machine while in operation is more than offset by the time lost in shutdowns for minor repair. Here the superiority of the electric is unquestionable, by emphatic testimony of electrical engineers and master mechanics alike. It is interesting to note, however, in this connection, that the supplies and minor repairs item in the cost accounts does not reflect this testimony, the total of this item being $1,993.24 for the electric as against $1,821.27 for the steam machine. Remembering that this item on the repair end is practically all spare parts, it would suggest that the manufacturer and not the contractor, is getting the chief benefit from this particular feature. In reduced labor cost for these repairs, the contractor would of course benefit.

As to cost of the energy, note that the "finished product" in electric current, is delivered to the machine on the dam at only slightly higher cost than the raw product, coal, is delivered into a pile at the edge of the borrow pit, the figures being $4,491.32 against $4,242.37 for the total period, the first moving 283,000 cu.yd. and the second 277,000 cu.yd. Note also that the excess cost of steam operation over electric lies largely in the labor of getting the raw energy, coal, handled by men and team across half a mile of borrow pit, onto the dragline, and into the boiler, the steam machine requiring for these purposes (and for water supply), three extra men on its crew besides the man and team that do the hauling. The remaining excess lies mainly no doubt in the crude mechanism of the dragline engine and boiler as a means of transforming the coal energy into mechanical energy at the drag cable, as compared with the high efficiency of the several transformations in the electrical system.

TABLE V—COST OF ELECTRIC ENERGY

Month	Max. Demand	Rate	Consumption	Cost
May	1,404 kw.	$0.0264	51,290 kw.-hr.	$968.83
June	1,440 "	0.0272	47,090 "	918.25
July	1,362 "	0.0253	69,600 "	1,259.96
August	1,404 "	0.0254	74,000 "	1,344.78

Two other points seem worth making. One concerns the apparently greater breakage of dragline cable on the electric machine, leading to a total expense of $1,685.35 for that time as against $844.49 for the steam. Opinions differ as to the reasons. The higher conservancy authorities consider this may represent normal conditions and attribute the result as perhaps due to a greater elasticity in operation of the steam machine, leading to lesser shock and lesser breakage to the cable. The mechanical and electrical authorities, however, believe the figures are due to a chance piling up of cable expense for the particular period, since such breakages occur at irregular intervals.

The other point concerns the relative costs at Germantown and Englewood, as given in Tables I and II. The materials at these two dams was much the same, except that the top soil at Germantown was somewhat thicker, and the underlying sand and gravel perhaps not quite so loose. But it needs emphasis again that the two tables are not directly comparable except as to current consumption. Supplies, minor repairs and drag cables, taken together, may perhaps also be compared, the figure being $0.013 per yard at Germantown, and $0.015 at Englewood. For the other items it must be kept in mind that the figures for Germantown are for the completed job, with equipment sold, while those at Englewood are running costs for the four months only, as heretofore noted. Labor at Germantown includes erection, dismantling, maintenance and operation, while at Englewood it includes only the two latter. Depreciation at Germantown is got by dividing first cost plus major repairs minus actual salvage value, by the total number of cubic yards placed in the dam. At Englewood it is an estimate only. The figures for Germantown give the actual cost per cubic yard for the several items; those for Englewood, necessarily incomplete, have their chief value as a basis of comparison.

Maximum Traffic Through Panama Canal

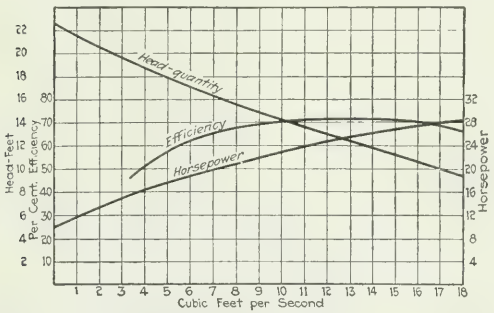
The high record of commercial traffic through the Panama Canal was reached Nov. 23, when 18 merchant vessels, the British cruiser Raleigh and a launch made the transit. The cargo carried was 78,648 tons, yielding nearly $80,000 revenue.

The New Orleans Automatic Sewage Pumping Stations

Trash Passing Pumps Simplify Maintenance and Attendance Saving City More Than $30,000 Annually in Salaries of Operators

By George G. Earl
General Superintendent, Sewerage and Water Board, New Orleans, La.

IN ABILITY to pass trash and still maintain a high efficiency the centrifugal pumps of the New Orleans Sewerage Commission, designed by its own engineers, have no equal. The successes of the early practice in eliminating the difficulties arising from trash have made possible the installation of a large number of automatic relifting stations requiring practically no attention. The saving in salaries over full-crew stations is in excess of $30,000 annually. The first of these pumps went into operation in 1917 and seventeen have been added since that time. So far they have "passed everything which has gotten around the suction elbow" and we see no reason to fear that they will ever fail to do so. Their efficiency is not in the least



EFFICIENCY TEST OF 12-IN. PUMP WHICH WILL PASS A 12-IN. BALL

interfered with by any amount of trash and we would not hesitate to build pumps of this latest type for the largest sizes and do away with all screening at the final discharge pumping stations.

The gradual development of the pumping of sewage at New Orleans leading up to the present types is interesting in many ways. In 1893 the writer, as engineer for the New Orleans Sewerage Co., took up the question of sewage pumping for the central section of the city, and could then find no one who would undertake the construction of a steam-driven centrifugal pump to discharge through 5,000 ft. of 36-in. force main against a varying lift of from 30 to 55 ft., including friction. In consequence a contract for direct-acting steam-driven pumps was let, but never executed because the company, after the construction of a few miles of sewers, was unable to finance itself further.

In 1900, when the city took up the sewerage problem for itself, contractors willingly competed on centrifugal pumps for this station and for two smaller stations discharging into the Mississippi River against similar lifts, and also for six automatically-operated intermediate-lift stations at which the lift ranged from 8 to 15 ft. The efficiency guarantees for these last-named stations were very low, and only 60 per cent pump efficiency was guaranteed at the high-lift stations discharging into the Mississippi River through long force mains. The specifications contained a requirement that all centrifugal pumps must be able to pass 3 x 4 in. spheroids, and while the contractors were able to make the larger steam-driven pumps at the central sewerage pumping station and the pumps at the intermediate-lift stations with low lifts comply with this clause, and to meet their efficiency guarantees, they could not accomplish this with the pumps of smaller capacity working at higher speeds at the other two stations, and discharging through long force mains against varying river heights. The claim was then advanced that the required ability to pass 3 x 4-in. spheroids made the guaranteed efficiency impossible to obtain for these last-named pumps, and pumps which made only 45 per cent efficiency were tendered for acceptance. The Sewerage and Water Board not being willing to concede so much, the contractors were requested to build runners after a plan furnished by the mechanical engineer of the board, which they did. It is said that the contractors' engineers did not believe that these runners would pump water at all, but they did. Further, they passed 3 x 4-in. spheroids, and made 80 per cent efficiency on test. These runners have been in constant service since 1908.

Vibrations Break Shafts

At the three stations discharging sewage into the Mississippi River, where coarse screens protect the pumps against trash, little trouble has been experienced. At the main sewerage station, however, with runners, just passing their efficiency guarantee, there was a certain amount of vibration which resulted eventually in the crystallization and breaking of the lower ends of vertical shafts of both pumps. As increased capacity had to be obtained, and the originally intended plan of adding another steam-driven pump and another 48-in. discharge main 7,000 ft. long to the river involved a cost which the board could not afford, especially since the higher rates of discharge would only be required for relatively short periods, it was decided to add a large electrically-driven two-speed centrifugal pump, working into the existing force main, instead of an additional steam-driven pump with an additional force main. This new pump was designed by A. B. Wood, mechanical engineer of the board, and was built by the Nordberg Manufacturing Co. without a guarantee of any kind. On tests, it showed as follows:

At low speed (218 r.p.m.) it discharged from 55 to 35 sec.-ft. against lifts of from 43 to 35 ft., with pump efficiencies from 69 to 83 per cent.

At high speed (364 r.p.m.) it discharged from 106 to 133 sec.-ft. against lifts of from 87 to 72 ft., with pump efficiencies of from 80 to 84 per cent.

This 36-in. pump has done practically all of the sewage pumping at the main station since 1915. It has had little difficulty in passing such trash as reaches it through the existing very coarse screens. It is a horizontal shaft outfit, driven by a 1,200-hp. induction motor operated by current from either of the board's power stations. With its installation the main sewerage pumping station changed from a steam-driven station

with a full crew to an electrically-operated station with a very small crew. Three-fourths of the boilers and much of the other equipment have been removed to the main power station, or to other points where they can be more usefully employed. The saving as a whole thus effected has been very great.

Rags the Great Obstruction

Six relifting stations, originally built to be operated electrically and automatically without screening and without attendance, started into operation in 1907. At first they gave no trouble and to this time their automatic stopping and starting, their ventilation, their atmospheric condition and dryness have been everything that could be desired. The one great difficulty which gradually became more and more serious was pump obstruction by rags accumulating on the runners. The capacity and efficiency was cut very seriously. More and more frequent visits and opening of pumps for the removal of rags became necessary. Two or three visits a day for their removal, and constantly reduced efficiency due to their presence, together with the nuisance which the accumulation of trash at the stations produced, seemed to indicate that screening and full provision for constant attendance with a screening's-removal service eventually would be necessary. Another factor which pointed in the same direction was that the main intercepting sewer, into which all sewers finally discharge, was built only large enough to take care of a certain portion of the area which they serve. It was the intention in the original plan to provide another interceptor in the future to carry the flow from the upper and rear portion of the city, but funds have never been available. The existing main sewer can take care of its dry-weather flow from the larger area for many years to come, but it is incapable of handling the flow which occurs during great storms, when the big masonry lined and covered drainage canals themselves are rivers of no small magnitude. To have built the necessary sewerage interceptors and main station pumping capacity and force mains to the river to handle this wet-weather sewage flow during great storms would have absorbed enough money to provide dry-weather flow facilities and satisfactory sewerage service for large areas requiring such service. It has been the policy of the board to give a reasonable service to the largest possible number of people all of the time, rather than to provide excessive safeguards and then give service as far as its funds would go to only a limited portion of the city. Under the above conditions, it appeared better to extend a full dry-weather flow sewerage service and let the storm drainage system take care of the excess sewage flow during great storms. To accomplish this result, provisions had to be made at the sewage relifting stations to send their discharge either into the discharge sewer or into the storm drainage system, a requirement which again pointed toward attendants at these stations.

Reasons for Automatic Stations

Six relifting stations existed in 1915, and two more were contemplated for early construction. Eventually, within the area served by the existing city drainage system, there will be at least twenty of them. The thought of adding attendants on three watches 365 days every year with a screenings-removal service for twenty scattered sewage pumping stations was enough to cause us to think again, at least.

The relifting pumps originally installed were only a trial installation, having usually only about one-third of the capacity of the suction sewer. Since the areas served were mostly outlying areas with many unpaved streets and in which local drainage conditions were by no means fully developed, the need for the full equipment of pumps was even greater after rains than it will be after the areas which they serve are fully built up, paved and provided with better local surface drainage facilities. It was therefore decided to provide pumping capacity fully equal to the maximum delivery capacity of the sewers on the suction side of these stations. Units having a capacity of about 15 sec.-ft., with 12-in. suctions and 12-in. discharge pipes, were decided upon. In view of our experience and our firm determination to continue the "automatic operation of these stations without screening and without attendants" we decided that the trash-passing specifications to which we could work should be 12-in. balls, instead of 3 x 4-in. spheroids, and to that we added table cloths, overcoats, assorted rags and trash, or anything else that could enter the pumps through their 12-in. suction elbows. We did not, however, send these specifications out for bids with guarantees attached, but instead had castings made according to our own designs and finished the pumps in the board shops. These pumps are single-suction centrifugal pumps with two-blade inclosed-type runners, which apparently pass anything which can enter the suction pipe. Results of a test are shown.

Mr. Wood has built these pumps up to 22-in. suction and discharge openings, and tested them out against heads up to 180 ft. While he has not obtained quite so high an efficiency with them as with the more usual type of centrifugal pump designed to work with water which is free of trash, he has obtained better than 70 per cent efficiency with a very flat efficiency curve over a wide range and with very desirable characteristics.

Function of Automatic Apparatus

The automatic apparatus at these stations covers a twofold function: First, it stops and starts the pumps. A heavy cast-iron float in a large float tube, which feels the pressure in the low-level sewer, starts the pumps one after another as the level in the sewer continues to rise and stops them one after another as this level continues to fall, each pump starting or stopping at different predetermined pressures in the sewer on the suction side. Second, it opens and closes the by-pass gates. Another apparatus feels the pressure in the discharge sewer and maintains a gate leading to the sewer open until this pressure rises to a predetermined amount, after which this gate is closed. Coincidentally another gate permitting the discharge from the station to enter the storm-water drainage system is opened, and remains open until the pressure in the discharge sewer falls to another and very much lower predetermined pressure, when the first-named condition is restored.

Nothing inside or outside of any of these sewage relifting stations indicates to sight or smell that they are sewage pumping stations. Most of them are entirely beneath the street surface with only a very small structure usually built along the curb line, to carry a circular stairway to permit entrance. The eighth of these stations is now in course of construction, and at least one other will have to be built in the early future.

We regard their success and the practicability and desirability of the automatic operation of electrically-

driven centrifugal pumps for sewage pumping without screening and without attendants, for a wide range of lifts, or conditions, as fully demonstrated. Since 1907 these stations have been operated with never more than two men taking care of six widely scattered stations, and never more than three visits a day to any station. We still continue one visit a day to each station, but one visit every 15 days would do as well as matters now stand.

Extensive Surface Repairs to a Concrete Dry Dock

Gunite on Wire Mesh Forms Continuous Sheet Over Sides and Floor—Six Cement Guns Did the Work in 50 Days

REPAIR of a concrete graving dock at South Chicago, Ill., made necessary by disintegrated concrete, has been effected recently by covering the surface with gunite applied over a layer of wire mesh by means of the cement-gun. Fig. 1 shows the application of the gunite to the floor, with a portion of the completed wall at the right.

This dry dock, at 101st St. and the Calumet River, is owned by the Chicago Shipbuilding Co. and was built in 1915. It is 705 ft. long, 88 ft. wide on the bottom, 106 ft. wide at the top and 29 ft. deep. Owing to disintegration of the surface, it was decided during the summer of 1921 to carry out repairs and prevent further deterioration. As a rule the disintegration does not go very deep, but in some places deep holes could be made easily.

In the repair work, the entire surface of the walls and floor was gone over thoroughly with ordinary picks where the concrete was soft, and in some cases it could be removed in large slabs and flakes. This first cleaning was followed up with pneumatic chipping hammers by means of which the entire surface was thoroughly cleaned where the concrete was soft and scored where the concrete was sound. Holes 1¼ in. in diameter, about 6 in. deep and spaced approximately 30 in. c. to c., were drilled all over the walls and floor with pneumatic drills. Railroad spikes were set in the holes and secured by grouting. To these spikes horizontal steel rods were secured, and to the rods was fastened heavy steel wire mesh reinforcement. This wire mesh extended over the top of the wall and about a foot down on the outside.

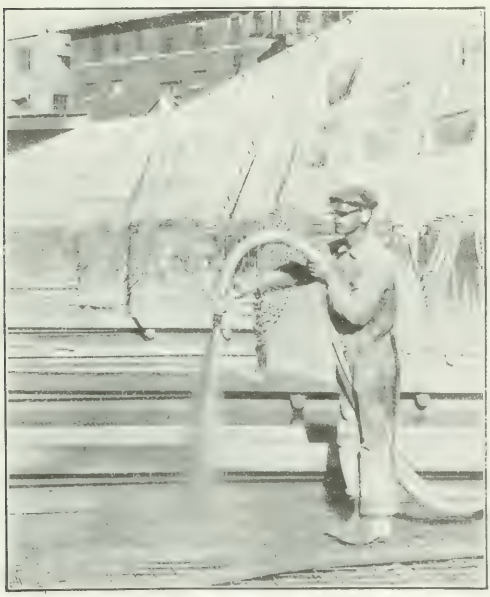


FIG. 1. APPLYING GUNITE SURFACE TO FLOOR OF DRY DOCK

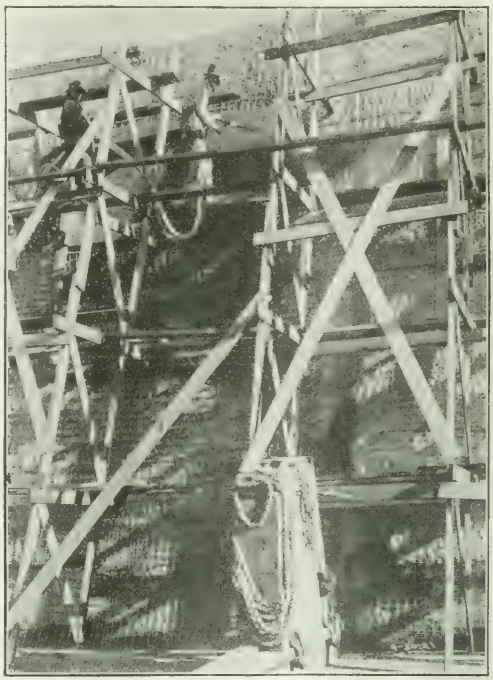


FIG. 2. SCAFFOLDS AND REINFORCEMENT FOR CEMENT-GUN WORK

Gunite was then shot in place, to form a heavily reinforced coating, beginning 1 ft. down on the outside of the wall, extending over the top, down the wall and across the floor in one continuous sheet. Fig. 2 shows the scaffolding, reinforcing rods and wire mesh, and also the gunite being applied by the men at the right.

About 400 lin.ft. of the dry dock was scaffolded at one time, the scaffold being taken down and moved as the work proceeded. A locomotive crane on the surface was used for this work. The scaffold was made in 6-ft. sections which were made up complete on the surface, the locomotive crane carrying them to place and lowering them into position. The 6-ft. sections of scaffold were placed 6 ft. apart, so that the operating plank would span from section to section, and the sections were lightly tied together with horizontal stringers consisting of 1-in. boards.

As it was desired to push the work vigorously and so far as possible prevent the loss of work in case of rain, the scaffold was so built that tarpaulins could be thrown over the top and extend down the sides to protect the new material against the washing action of the rain. Thus work could be carried on until the rain became

so heavy as to drive away the men. In this way very little time was lost.

Two batch mixers were used, both specially adjusted for the semi-dry mix used in cement-gun work. These were placed on the top of the wall. After screening, the mix was delivered by means of chutes to two platforms on the floor of the dock, around each of which three cement guns were grouped. In this way, six cement guns were used continuously. The contract for the repairs was taken by the Cement Gun Construction Co., Chicago. Work was started Aug. 29, 1921, and was pushed vigorously with a large force of men and equipment so that it was completed in about 50 days.

France Builds Compressed Straw Houses

A NEW system of building houses now in vogue in various parts of France utilizes as a principal material straw pressed and molded in blocks of convenient dimensions, says a recent issue of *Le Genie Civil*. Straw has long been used in construction, though principally in roofing, but the Feuillette system (named after its originator) produces houses of one or two stories which are quite as weather-resisting, says *Le Genie Civil*, as those constructed of masonry.

The framing of the houses is of light wood and usually is put up in sections, so that fabrication on a wholesale scale is possible. The blocks of compressed straw are merely used as filling for walls and partitions, all the stresses being carried by the framing. The blocks are made usually 40 cm. in thickness and of a length depending upon the dimensions and spacing of the framing members. The blocks are made by subjecting the straw to intense pressure in a press similar to those used for compressing fodder.

The main characteristic of the straw houses is their lightness of construction—the weight of all materials is put at one-sixth of that of an ordinary masonry house of the same dimensions. Accordingly it is possible to put in foundations much less massive than would otherwise be used. Then straw is a poor conductor of heat, a fact which keeps the house cool in summer and makes it possible to heat it easily in winter.

In order to keep the dampness from mounting from the foundations up through the walls there is placed between the foundations and the first course of straw bricks layers of bitumenized cardboard.

The exterior walls are smeared with some waterproofing mixture which, it is said, render the houses almost as impervious to moisture as any other type of construction. On the interior walls is placed a waterproofing mixture of a lighter grade and to this adheres the wallpaper, tinting or whatever other decorative materials are used.

The roof is of ordinary construction and the windows and doors are placed upon special sills of a cement mixture to guard against the infiltration of rain water or that from the melting of snow or ice. Lightness of the materials of which the houses are constructed allows rapid construction of them. It takes from one to two months to complete a house, and the economy of time and materials over the ordinary type of masonry construction in wide use in France is estimated at 40 per cent, by the originator of the system. This saving would perhaps be greater, it is pointed out, in agricultural or industrial construction, where masonry is always the most expensive construction item.

If let alone the straw would serve as refuge for insects and vermin of various kinds but this has been guarded against by putting around the perimeter of the house, between the foundation and the first course of bricks, a perforated pipe through which, from time to time, may be passed toxic gases—for example sulphuric gases and formic aldehyde—which spread throughout the thickness and the height of the straw brick walls. Thus is supplied a permanent system of disinfection. Houses already built in various parts of France have been as free from vermin as masonry types.

The risk from fire seems not to have been raised above that of the ordinary type of building, for the insurance companies have applied the same rates to the straw houses that exist for the other types.

"The construction of this style of house—light, sound resisting, isothermic—seems destined to have great use in agricultural communities where the usual materials are rare," says *Le Genie Civil*. "They will be able, without doubt, to render service in devastated regions where they should permit rapid reconstruction work.

"Finally, for countries or communities subject to earthquake shocks the straw house is interesting, because of its lightness and its small amount of inertia. Its framing, relatively elastic, should easily permit it to withstand seismic disturbances.

Suggestions for Electrolysis Mitigation

A VOLUMINOUS second report has been issued by the American Committee on Electrolysis, a joint committee of nine electrical, gas, and water associations. The preliminary report of this committee, issued in 1916, is intended to be superseded by the new report, although more work is to be done and further reports may be expected. The great value of the present report is that it represents unanimous agreement of the representatives of all the organizations involved on some fundamental points, including, perhaps as the most important, suggestions for the mitigation of electrolysis trouble.

Stating that the practical electrolysis problem is due to electric-railway stray current, the committee lists suggestion of two kinds, those which reduce stray current by more efficient and economical operation of the railway (better bonding and more complete distribution of current supply), and those tending to prevent or limit electrolysis effects when stray current exists. The latter include the insulation of joints in pipes and cables, the provision of insulated coverings for pipes, and, as measures of opposite kind, the interconnection of affected structures with the railway return circuit and electrical drainage of pipe and cable sheaths. They also include the provision of substations and return feeders in an amount exceeding the requirement of most economical railway operation, and the use of a modified system of power distribution.

Reviewing results attained in this field abroad, the committee reports that electrolysis trouble has been largely eliminated in Europe. Further research, necessary to develop American practice fully, should include the study of current densities across contact surfaces of pipes and earth, and study of the actual efficiency of various methods of electrolysis mitigation. The committee, which is headed by Bion J. Arnold, 33 W. 39th St., New York City, is issuing the report for a nominal price of $1, although the major publication cost has been defrayed by the societies joined in the work.

English Impact Measurements Analyzed

Significance of the Results and Comparison with A. R. E. A. Tests—Deficiency of Observed Live-Load Stresses—Influence of Secondary Stresses—Impact on Short Spans—More Tests Needed

By F. E. Turneaure
Dean, College of Mechanics and Engineering, University of Wisconsin, Madison

THE English impact tests reported in *Engineering News-Record* of Oct. 20, p. 642, are highly interesting, not only because of their results but also because of the use of a form of extensometer which records by mirror and photographic film. This apparatus has undoubtedly considerable advantage over the form of apparatus used in the American Railway Engineering Association tests, by reason of the very small inertia effected and the high frequency of the vibration period of the instrument. This instrument should enable tests to be made on very short spans in a more satisfactory manner than we were able to accomplish with the American Railway Engineering Association instruments, in which the frequency is relatively low, resulting in many cases in disturbing instrumental vibrations.

Outside of the effect of instrumental vibration, the results obtained in the English tests show the same general characteristics as those obtained in the American Railway Engineering Association tests, and the diagram of maximum values (p. 644) corresponds as well as could be expected to the results obtained in the American tests. Anyone who has carried on experiments of this kind appreciates very fully the fact that results are not altogether consistent, and that some erratic values must be expected, due in part to the variety of causes producing impact and in part to the effect of secondary stresses, inaccuracy of instrument, and other causes not easily determined.

Measured Stresses Too Low

In examining the published results on page 643, a very noteworthy feature is the large discrepancy existing in most cases between the calculated live-load stress and the observed live-load stress at slow speeds, or the so-called observed static stress. This discrepancy is so large as to have a considerable bearing on the significance of the impact percentages as calculated in column 15 of the table. Generally speaking, the higher values of impact percentage occur with very low ratios of observed to calculated live-load stress; and on the other hand, where the ratio of observed to calculated live-load stress is relatively high, the impact percentage is generally low.

Considering the 19 reported measurements on plate-girder flanges, the three highest values of impact percentage are 77.5, 80, and 92 (neglecting the plus-or-minus errors); the corresponding ratios of observed to calculated live-load stress are 50, 27, and 43 per cent. The highest ratios of observed to calculated live-load stress are 92 and 94 per cent, and the corresponding impact percentages are 30 and 26. In the 10 measurements on lower-chord members, the maximum impact percentage is 62, with a ratio of observed to calculated live-load stress of 35 per cent. The maximum ratio of observed to calculated live-load stress is 85 per cent, with an impact ratio of 13 per cent. The average ratio of observed to calculated live-load stress for all lower-chord tests is 48 per cent. Three high values of impact percentage on rail bearers are: 159 per cent, with a ratio of observed to calculated live-load stress of 53 per cent; 93 per cent with a live-load ratio of 30 per cent; and 76 per cent with a live-load ratio of 10 per cent. The only high impact coincident with high ratio of observed to calculated stress for rail bearers is 90 per cent impact for a live-load stress ratio of 100 per cent.

Two questions arise in considering the significance of these results: First, the cause of the low ratio of observed to calculated live-load stress; and, second, the effect of this condition upon the impact percentage, and upon the selection of the proper formula to use in designing.

Influence of Secondary Stresses

The very low ratios of observed to calculated live-load stress are due to various causes, some of which, at least, have been mentioned in the article in question, namely, effect of deduction of rivet holes and omission of web in calculating flange stresses, effect of floor system in carrying load, and effect of secondary stress. In the case of the measurements on lower chords the effect of the floor system could not be of much consequence, and the discrepancy must be attributed almost wholly to the effect of rivet holes and to secondary stresses, as the actual total stress in such case must be very closely equal to the calculated stress. The very low average ratio of observed to calculated stress in these members (namely 48 per cent) indicates that secondary stress must be a large factor in reducing the observed stress. Without more detailed knowledge of the exact position of the instrument and make-up of the members themselves, it is impossible to extend a study of this phase of the question much further; but it is, I think, desirable to point out the possible effects of secondary stress on the determination of the impact values.

Abnormally High Impact

The experience of the committee of the American Railway Engineering Association in conducting its tests shows that, where the secondary stresses were opposed in sign to the other stresses, their effect was generally to increase very considerably the impact percentage as calculated by comparing maximum readings with slow-speed readings. In many cases two and sometimes four instruments were used on the same member, so as to determine approximately the actual secondary stresses as well as the impact ratios. In a built-up lower-chord member, for example, there would be very considerable secondary stresses near the joints and the instrument on the upper edge might show a slow-speed or static stress much less than the intrument on the lower edge. The effect of vibrations under high-speed tests would frequently affect the upper instrument as much as the lower, which would result in the calculated impact percentage for the upper edge being greater than the lower. The actual maximum fiber stress, however, would occur on the lower fiber, and the impact percentage for this

side would be more significant than the impact percentage for the upper fiber. Furthermore, on account of this bending effect, the deformations recorded by the instrument do not represent the actual deformations of the extreme fiber, since the instrument measures the deformation not of the extreme fiber of a member but of an imaginary fiber at a considerable distance from the surface of the member. In the instruments used by the American Railway Engineering Association, this distance was 1½ inches.

Similar Effects in A.R.E.A. Tests

As an illustration of this bending effect, taken from the results of the American Railway Engineering Association tests, I give below the impact percentages calculated for the two sides of the bottom flange of a 70-ft. plate-girder span. The static stress on the outside flange was 2,200 lb. per sq.in.., while on the inside flange it was 2,900. The impact percentage on the outside flange was 78 per cent and on the inside 64 per cent. Obviously, the 64 per cent is more significant than the 78 per cent. In another case, two instruments were attached to one of the vertical posts near the center of a 300-ft. span truss. The total stress was not large but there was considerable secondary stress due to lateral and floor-beam action. This resulted in a static tensile stress of 1,100 lb. per sq.in. on one corner of the member and a compressive stress of about the same amount on the other corner. Under high speed, the vibrations of the truss produced an impact of 89 per cent on the tension side. Under the circumstances, this result would seem to be of very little significance.

In another structure, consisting of a 64-ft. riveted truss, four instruments were placed on the four corners of a lower chord member. The separate results were approximately as follows:

	Slow-Speed or Static Stress, Lb. Sq In.	High-Speed Max. Stress, Lb. Sq. In.	Impact, per Cent
Inside top edge	840	2,150	156
Inside bottom edge	3,800	5,400	42
Outside top edge	3,600	5,400	50
Outside bottom edge	6,700	8,600	28

There was evidently considerable lateral as well as vertical bending due to large secondary stresses. The axial stress found by averaging diagonally opposite edges is practically the same from both sets of diagonals, thus indicating consistent results and roughly checking the behavior of the instruments. It will be noted that the absolute effect of the vibration due to high speed is not much greater on the highest stressed corner than on the lowest stressed corner, but the impact percentage is widely different. In this case the value of 156 per cent is obviously of little significance in selecting a proper impact ratio for design purposes. The committee used a value for this truss of about 50 per cent. This was an extreme case of bending stresses, but it illustrates the difficulty of arriving at a proper impact percentage from measurement on one edge of a member only, and also the general principle that where there are secondary stresses the measurements taken on the edge of the member having the lesser stress will almost certainly show the higher impact values.

This effect of secondary stress was so noticeable in the tests conducted by the American Railway Engineering Association Committee that a considerable effort was made, especially in the case of eyebars, to place the instruments at approximately the quarter-points of the members, as the effect of secondary stresses due to member vibration is approximately a minimum at this point. This is quite evident when we consider that vibrating members, even eyebars, will act as beams fixed at the ends. The A.R.E.A. committee had at its disposal 12 instruments, and in the case of riveted members and plate girders usually placed instruments on at least two edges of the member, sometimes on four corners. In this way some check was had on the effect of secondary stresses, and where impact values were calculated for two sides of the same member the practice of the committee in general was to adopt an average value of maximum impact percentage obtained from the separate readings, as the most significant value for the member in question. It would seem to be on the safe side.

Impact on Short Spans

Considering further the actual values obtained in these English tests, there would appear to be some good evidence indicating an impact greater than 100 per cent for very short spans, although the tests are not very conclusive on this point, especially when viewed in the light of the above discussion. The A.R.E.A. committee obtained a few values greater than 100 per cent, and expressed its belief that probably accurate tests of very short spans would show an impact ratio of somewhat more than 100 per cent. The proposed curves in the diagram of the English tests give impact values exceeding 100 per cent for spans below 25 ft., apparently based on these particular tests.

This question was carefully considered by the A.R.E.A. committee, both by the subcommittee and by the full Committee on Iron and Steel Structures; and while it was recognized that probably the impact for very short spans might occasionally be more than 100 per cent, a value of 100 per cent at zero span length, with a curve of the form adopted, was considered satisfactory. The only structures appreciably affected by a higher curve would be spans less than 20 ft., that is to say plate girders and I-beams. For this type of structure, used generally for spans up to 75 ft. or more, it appeared to the committee that past experience should be given very considerable weight. Considering the use of the vast number of structures of this type designed on the basis of approximately 100 per cent impact and overloaded in many cases to the extent permitted by the A.R.E.A. rules for rating existing structures, it was concluded by the committee that 100 per cent was sufficiently high. The plate-girder type of structure is less affected by secondary stresses and local vibrations than are trusses, and for this and other reasons might reasonably be designed on a basis of a somewhat higher working stress than trusses. This possibility has been suggested several times, but it was considered by the committee preferable to maintain the same working stress as for trusses and substantially the same impact for short spans as has been used for many years, namely, 100 per cent at zero span length. This is perhaps not a strictly logical method of procedure, but it has the advantage of simplicity, and was adopted for the reasons given.

Precision and Range of Tests

Referring again to the tabulated results, it would seem that the precision of the readings is not quite as great as would be indicated by the tabulated figures. As stated in the article, the readings were made by dividers and an ivory scale, checking to 0.005 in. They

are, however, recorded in the table to the nearest one-thousandth inch, this being obtained probably by averaging. It is hardly to be expected that readings of the kind can be determined to an accuracy of 0.001 in. The American Railway Engineering Association committee did not go beyond 0.01 in., but photographic records could probably be measured somewhat more accurately than the pencil records of the American Railway Engineering Association tests. However, the shifting of the zero line in many cases, indicated by the plus-or-minus errors, seems to indicate that in spite of the sensitiveness of the apparatus its precision is hardly enough to warrant reading the records much closer than 0.01 in.

This is of some significance in connection with some of the smaller values, such as the one where the low-speed stress is given at 0.17 and the high-speed stress at 0.30 tons per square inch. The actual ordinate measured in the first case was 0.017 in. and in the second case was 0.03 in., and from these figures the impact percentage was calculated as 76 per cent. If I am correct in my understanding of the scale used in these readings, it would seem difficult to establish an impact percentage more accurately than 50 to 150 per cent. In other words, this particular reading is not of much value.

In these comments, I do not wish to be considered as criticising the work of the English committee. Its results are of much value, and I feel very confident that the instrument used is more sentitive and accurate than that used by the American Railway Engineering Association committee for short span tests. It is to be hoped that many further tests will be made. The tests reported do not go beyond a span length of 146 ft. 8 in. They therefore do not give any additional information concerning impact on long spans. For the range tested it would appear that these tests when viewed in the light of the above discussions give results somewhat lower than those obtained by the A.R.E.A. committee.

Major Mount's definition of impact as "the effect produced upon any member of a structure by a moving load which results in stress exceeding the static stress" is substantially the same as that given in the first report of the A.R.E.A. committee, namely, "The term impact is here used to include any effect of the moving load which results in stresses exceeding the static stresses." This is the sense in which the matter has been considered in all the work of the committee.

New National Forest in Pennsylvania

The Allegheny National Forest is to be created on the headwaters of the Allegheny River in Pennsylvania, according to an announcement of the United States Forest Service. The land which it is proposed to acquire consists of some 400,000 acres in Warren, McKean, Forest and Elk Counties, this area having been selected by the National Forest Reservation Commission and approved by the State of Pennsylvania. It is expected that at least 50,000 acres will be acquired during the current year, but additional purchases will depend on an appropriation for next year, for which no provision has been made by Congress. There have previously been acquired some 2,000,000 acres in 17 sections of the White Mountains and Southern Appalachians. The federal legislation under which these purchases are made is designed to aid in the regulation of navigable streams.

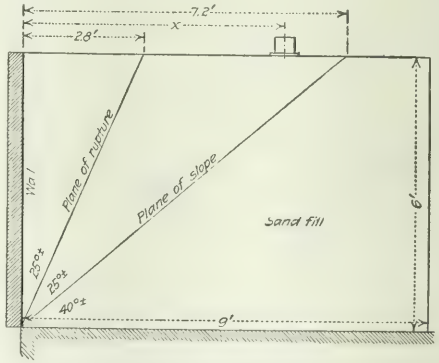
Measured Retaining-Wall Pressure From Sand and Surcharge

Cincinnati Experiments on Effect of Settling, Static and Dynamic Surcharge—Full Wall Friction Active

By Jacob Feld
Research Fellow, University of Cincinnati

EXPERIMENTS conducted at the University of Cincinnati during the past two years have shown the adaptability of the earth-pressure test bin described in *Engineering News-Record* of Aug. 25, p. 314, for investigations of the action of granular materials subjected to various external influences. Recent measurements of the variations in the lateral pressure exerted by fills of sand can now be reported. The maximum height of fill was 6 ft. Static and dynamic surcharges were tried, and the results therefore are directly applicable to railroad fills retained by walls, as well as to ordinary retained fills.

The apparatus measures the horizontal and vertical components of pressure due to granular material in a



SECTION OF TEST-BIN

large concrete bin (12 x 5 x 12 ft.) against one side, which is a "free" wooden wall 5 ft. wide by 6 ft. high. The material used was a river sand, containing 8% gravel, 3% clay, 6% water and practically no loam. It weighed 100 lb. per cu.ft, and when shovelled assumed a natural slope of 40 deg. The coefficient of internal friction as determined by experiment was 0.67 when using the force required to keep the sand in motion, and 0.75 when using the force required to start motion, corresponding to angles of friction of 34 and 37 deg. respectively. These coefficients were determined by filling with sand a bottomless box which rested on a surface of the same sand, and measuring the force required to start motion and to keep up the motion uniformly. If we assume that the difference between the two values found is due to cohesion (which does not act during motion) then 0.67 and 0.75 are the coefficients of internal resistance to motion, the first due to friction alone, the second due to the combined effect of friction and cohesion.

Level Fill.—Tests with sand containing different percentages of water and therefore giving different coefficients of internal friction and densities, using test-walls backed with wood, glass and sheet metal, yielded the

following formulas for the pressures of horizontal fill against a vertical wall:

Horizontal component, $H = \frac{1}{2} wh^2 \tan \frac{1}{2} (90° - \phi)$

Vertical component, $V = H \tan \phi'$

Total pressure $P = \sqrt{H^2 + V^2}$

The horizontal component is very closely given by the formula deduced by Coulomb (1773), which formula also represents a special case of the Rankine theory. But while both theories assume ϕ to be the angle of natural slope, the present formula requires ϕ to be the angle of internal friction corresponding to the force required to *start* motion. For sand its value is approximately equal to 0.9 of the angle of natural slope. The vertical component in all cases is found to be equal to the product of horizontal component and coefficient of friction between wall and filling material. In other words, the lateral earth pressure acts at an angle ϕ' to the horizontal (for vertical wall). The value of ϕ' was found in the same manner as the coefficient of internal friction. The height of application of the resultant is about $\frac{1}{3}h$ for fills up to 2 ft. deep. For deeper fills the resultant rises to from $0.34h$ to $0.37h$ under ordinary conditions.

TABLE I. PRESSURE OF 6-FT. LEVEL SAND FILL

(Pressures in Lb. per Ft. Width of Wall)

Day	Time	Time of Settling, Hr.	Temp., Deg. C	Horiz Comp.	Vert. Comp.	Total Press.	Ratio V/H	Ratio Height Above Base
1st	5 p.m.	0	13	456	z299	545	0.66	0.335
2nd	12 m.	19	14	x419	286	x508	0.68	0.34
2nd	5 p.m.	24	13	422	286	509	0.68	0.34
3rd	9 a.m.	40	19	426	280	510	0.66	0.34
3rd	12 m.	43	20	432	284	517	0.66	0.34
3rd	5 p.m.	48	20	432	286	518	0.66	0.34
4th	12 m.	67	17	451	279	530	0.62	0.34
5th	9 a.m.	88	14	463	x278	540	0.60	0.345
5th	10 a.m.	89	16	466	278	542	0.60	0.345
5th	12 m.	91	17	469	280	545	0.60	0.35
5th	5 p.m.	96	17	467	283	546	0.61	0.35
6th	9 a.m.	112	15	461	281	540	0.61	0.35
6th	11 a.m.	114	19	z473	286	x 553	0.605	0.35
6th	12 m.	115	19	472	286	552	0.605	0.35
6th	5 p.m.	120	18	465	292	549	0.63	0.35
7th	9 a.m.	136	17	449	287	534	0.64	0.345
7th	12 m.	139	21	453	290	537	0.645	0.35
7th	5 p.m.	144	20	454	293	541	0.645	0.345
8th	9 a.m.	160	19	444	292	531	0.66	0.34
8th	12 m.	163	23	448	291	534	0.65	0.34
8th	3 p.m.	166	26	469	290	552	0.62	0.34
Per cent variation from initial reading				+3.7 −8.0	+0.0 −7.0	−1.5 −6.8	+3.3 −9.7	+5.0 −0.0

NOTE: x, denotes minimum reading. z denotes maximum reading.

To determine the effect of settling and variation in temperature upon these three factors in the determination of the earth pressure, readings were taken for a period of 8 days of the pressure of a 6-ft. fill. Various other tests on smaller heights check the results obtained. Table I gives a few of the readings obtained. A "blank test," where readings were caused by a mechanically applied pressure against the wall, showed very little variation, thereby proving that the variations in the values of Table I are due to changes in the fill and not to changes in the apparatus.

Conclusions for Level Fill.—The initial pressure is practically the maximum. The minimum pressure occurs within one day after filling. Both components vary directly with the temperature, i.e., a rising temperature is accompanied by an increase in pressure, and a falling temperature by a decrease; the variation being about 0.15% per degree Centigrade. Settling of the fill causes a slow decrease in both components, with intermittent sudden increases, especially of the horizontal component, due to small ruptures in the fill. But the total pressure does not appreciably surpass the original value. The point of application of the resultant rises very slowly with time, and the ordinarily used value $h/3$ is always on the safe side. The ratio of vertical to horizontal component, or the tangent of the angle of inclination of the resultant earth pressure, remains fairly constant and equals the coefficient of friction between the fill and the wall.

TABLE II. PRESSURE OF 6-FT. FILL WITH 100-LB. SURCHARGE AT VARIOUS DISTANCES FROM WALL

(Pressures in Lb. per Ft. Width of Wall)

Distance Load from Wall X, Ft.	In.	Horiz Comp.	Vert. Comp.	Total Press.	Ratio V/H	Ratio Height Above Base	Increase in P
(No Load)		[469.2]	[286.8]	[551.6]	[0.610]	[0.367]	
8	6	472.5	288.6	553.6	0.610	0.367	0.4%
7	6	473.4	288.9	554.6	0.611	0.367	0.5%
6	6	474.4	289.4	555.8	0.611	0.367	0.8%
5	6	475.3	290.0	556.8	0.611	0.368	0.9%
4	6	476.3	290.5	557.9	0.611	0.367	1.1%
3	6	478.1	291.7	560.1	0.611	0.368	1.5%
2	6	479.7	293.8	562.7	0.612	0.368	2.0%
1	6	483.1	297.5	567.6	0.617	0.380	2.9%
[After Test, no Load]		[483.5]	[299.3]	[568.6]	[0.620]	[0.380]	[3.1%]

Static Surcharge.—The horizontal section of the bin is 5 x 9 ft.; 45 pieces of 1-in. board, $11\frac{3}{4}$ x $11\frac{3}{4}$ in., were used to cover the surface of a 6-ft. level fill of sand. A single load of 100 lb. was successively placed on each square, starting with the one farthest from the wall, and readings taken while the load rested on the fill and after it had been removed; the effect was that of a localized surcharge of 100 lb. The averages of the five positions of the load at each distance back of the wall gave the values in Table II.

Conclusions for Static Surcharge.—An approaching load produces an appreciable increase in pressure when the load is still about 2 ft. away from the intersection of the plane of natural *slope* with the surface. The rate of increase is about constant until the load reaches a point midway between the planes of rupture and natural slope; much faster increase follows, as the load moves closer to the wall. The ratio of vertical to horizontal component is constant till the load is on the wedge of rupture, when it increases slightly. The changes in magnitude, direction and position of the point of application remain undiminished after the load is removed, showing that such changes are due to changes in the physical properties of the fill. Both the density and the angle of repose are increased.

TABLE III. PRESSURE OF 6-FT. FILL AFTER ROLLING 100-LB. LOAD AT VARIOUS DISTANCES FROM WALL

(Pressures in Lb. per Ft. Width of Wall)

Distance Load from Wall X, Ft.	In.	Horiz. Comp.	Vert. Comp.	Total Press.	Ratio V/H	Ratio Height Above Base	Increase in P
[Initial]		483.6	299.4	568.6	0.620	0.369	0.0
8	6	484.4	299.8	569.6	0.620	0.368	0.2
7	6	484.6	300.0	570.0	0.619	0.368	0.2
6	6	484.6	300.1	570.0	0.620	0.368	0.2
5	6	485.0	300.4	570.4	0.619	0.369	0.3
4	6	485.4	300.4	570.8	0.619	0.369	0.4
3	6	485.5	300.6	571.2	0.619	0.369	0.5
2	6	485.9	300.9	571.4	0.619	0.369	0.5
1	6	486.6	301.6	572.4	0.619	0.370	0.7
All load [illegible]							
Mean [illegible]							
		409.0	267.6	575.6	0.575	0.384	1.2
Mean [illegible]		414.4	269.6	537.0	0.627	0.367	4.2

Dynamic Surcharge.—The same fill was then subjected to moving load by rolling a 100-lb. keg of nails across the bin, at a speed of about 3 ft. per sec. Readings were taken after rolling the weight three times across the width of the bin and removing the weight.

The variations obtained, Table III, are due to a passing load at various distances from the wall and *not including the load itself*. Eight distances, spaced 1 ft. apart, were included in this test.

Conclusions for Dynamic Surcharge.—Rolling a fill after tamping has no immediate effect on the pressure. Settling after rolling and tamping resulted in a slight increase in pressure and a rise of the point of application, due to some rupture in the fill, later followed by a gradual return to the original pressure, the point of application remaining at its highest point. The decrease in vertical component is due to a drying out of the fill along the wall surface.

General Deductions.—These tests show that although the pressure of sand against a retaining wall is closely approximated by the theoretical formulas, the idea of a wedge of rupture is not exactly correct, for loads outside the plane of rupture have an appreciable effect. The fill does not transmit pressures immediately but undergoes a temporary set upon the application of loads, and retains this set after the removal of the loads. It therefore does not act as an elastic solid.

The apparatus used was designed and constructed by the writer under the advisorship of G. M. Braune, late Professor of Civil Engineering at the University of Cincinnati. Some of the tests were performed last year, the rest, under the advisorship of E. D. Gilman, Assistant Professor of Civil Engineering, during the past few months. Investigations are now being made into the influence of non-horizontal surfaces and non-vertical walls.

English Experiments on Sand Pressure

(*London Correspondence*)

P. M. CROSTHWAITE has recently given particulars to the Institution of Civil Engineers of some experiments on the pressure of sand. To ascertain the angle of internal friction in sand, clay and other materials, he loaded a plunger of known diameter and measured the penetration (d, in feet) caused by known weights P. The value of ϕ, the internal angle of friction, was calculated from Rankine's formula

$$d = \frac{P}{w}\left(\frac{1 - \sin\phi}{1 + \sin\phi}\right)^2$$

where w is the unit weight of the material. The angle of friction from these experiments was much less than the angle of repose, and depended on whether the material was put loosely together, shaken or consolidated.

To test his conclusion that walls calculated by Rankine's theory, which assumes the angle of internal friction and the angle of repose to be the same, would have a factor of safety of from 2½ to 4, he then measured the pressure of dried sand against a model wall. The first experiments were made with a vertical door backed with sand and hinged at its lower edge, the tension in a string necessary to keep it in position being measured. Experiments were made with level fill and surcharge, and with loose and stirred sand. They proved that the pressures calculated by Rankine and Coulomb are much too high.

To test the wedge theory, a false bottom coated with glued-on sand was provided that could be set at any angle with the back of the wall, so that the pressure produced by any wedge could be measured. These experiments proved that the wedge theories of Darwin, Boussinesq, Brightmore and others that take into account the friction between the back of the wall and its backing give correct results for the wedge of maximum thrust so long as the wall is not surcharged, but that they break down altogether when applied to a surcharged wall, the calculated pressures being 30 per cent too great; also, that wedges making a small angle with the back of the wall produce a greater pressure than calculation by the theory gives. However, when the formula was modified by neglecting the friction against the back of the wall and using the angle of internal friction instead of the angle of repose, the results agreed with the test values. The angle of internal friction was in this case arrived at by calculating what angle would satisfy the maximum pressures observed for the unsurcharged wall for the sand lightly put together and well stirred. These angles, instead of being 35°, the angle of repose, were 42° 20′ and 49°.

Mr. Crosthwaite then experimented to test definitely if wall friction did actually affect the horizontal pressure or not. A long box was cut into two compartments by a vertical transverse saw cut. One half was fixed to solid supports, the other being carried on live rollers. When the box is full of sand the two compartments are urged asunder by the pressure of the sand on the plane passing through the saw cuts, which pressure was determined by measuring the tension on a string that prevented the rolling half of the box from being pushed forward. The rolling box was then turned end for end, so that the sand in the fixed compartment was held in position by the solid end of the box, the face of which was coated with glued-on sand. This is the same as if it had been retained by a rough wall, and if friction between the wall and backing affects the amount of the horizontal thrust the amount of the tension required to keep the rolling box in position should have been less than before. There was practically no difference, which showed that it is not correct to assume that friction between wall and backing affects the horizontal thrust.

The conclusions are that the plane of rupture has no existence, at least no trace was found of it in these experiments; that the angle of repose relates only to the surface; that the angle of internal friction varies with the state of aggregation of the material; that friction at the back of wall does not affect the amount of the resultant thrust; that the wedge theory when modified by leaving out wall friction and introducing, instead of the angle of repose, the angle of internal friction, gives correct results in all cases.

Status of Federal-Aid Road Projects

The status of federal-aid highway projects as of June 30, 1921 (the end of the governmental fiscal year), is given as follows in a tabulation issued recently by the U. S. Bureau of Public Roads: Number of projects, 746; mileage, 3,802.9; federal aid paid, $22,502,609.78; total cost, $51,860,009.18. The average cost per mile of all federal-aid highways built has been $13,635, distributed among the following three items: Surface, $9,040; grading, $2,938; structures, $1,657. Of the total money expended the amount which has gone into surfacing is: For Class 1 (gravel, sand-clay, top soil, shell, etc.) roads, $7,103,390.37, or 13.8 per cent; for Class 2 (macadam) roads, $3,587,258.51, or 7.0 per cent; for Class 3 (brick, block, portland cement concrete, and bituminous concrete) roads, $23,691,252.25, or 45.5 per cent; for grading, $11,175,276.28, or 21.5 per cent; for structures, $6,302,831.70, or 12.2 per cent.

Training Officers in the Corps of Engineers, U. S. Army

Extract from the Annual Report, for 1920-21, of the Chief of Engineers, U. S. A., Maj.-Gen. Lansing H. Beach.

ENGINEER officers of the Regular Army enter the service from two principal sources, military organizations and civil life. Officers from the first source include those commissioned from United States Military Academy, from the Regular Army, and from units of the Reserve Officers' Training Corps. Those from the second source have had little or no military training and usually enter the service within a short time after being graduated from civil technical institutions.

The difference in preparation prior to appointment in the army involves some variations in the training of these officers during their early years. Those entering the army with previous military experience usually require special stress on technical subjects in the formative period of their commissioned service, and those entering without previous military experience require special stress on subjects peculiar to the military profession, such as military art, military administration, military law, etc.

Some Sent to Technical Schools

On his initial entry into the Corps of Engineers the officer in the normal case is sent to the Engineer School at Camp A. A. Humphreys, Va., to pursue the basic course. This course, during the last year of five months' duration, comprises only elementary subjects such as administration, guard duty, law, military courtesy, military hygiene, hippology, field-service regulations, infantry and calvary drill, minor tactics, and troop leading, to include the company nomenclature, care and use of engineer equipment, map reproduction and photography, elementary bridges, railroads, etc. . . . The course was followed by actual service with troops.

While the basic course is adjusted as fully as possible to the varying needs of the student officers drawn from the several sources, it is evident that on its completion the fundamental differencies in the early training of these officers will not have been compensated. Those from the Military Academy and those from the best private military schools will usually be stronger on military subjects and weaker on technical subjects than those drawn from civil technical schools. These differences are taken into account in making the assignments for the six or seven years following the completion of the basic course.

The next step in school training is covered by the company commanders' course at the Engineer School and the civil engineering course conducted under the supervision of the Engineer School at high-grade civil technical institutions. All officers take the first of these two courses, but those who hold degrees from civil technical institutions of recognized excellence are not required to pursue the civil engineering course. They may, however, attend special courses in lieu thereof, such courses being designed to supplement their previous training.

Either before or after pursuing the company commander's course, officers commissioned from military sources are sent to civil institutions for one year of instruction in those technical subjects which either are not taught at West Point or which are given there in a very elementary form, but which are needed by the engineer officer in the discharge of his professional duties.

It is proposed that the policy adopted for this year's civil engineering course be continued, that is, that of sending the students to civil institutions of recognized high merit. This policy is not new. Since 1910 officers of the Corps of Engineers in small numbers have been sent to civil technical schools for instruction. Other government departments and arms of the service, notably the Navy, have committed themselves to it as a fixed policy. There are many good reasons for this policy, and the result of this year's work fully demonstrates its highly beneficial effects.

Among these reasons may be cited the psychological effect on the officer student and on the general public. In the past the military and the civil have been most distinct, both in training and method of life. This has led to mutual distrust, a pretended fear of militarism, which is not only bad for the service but ruinous to the country at large. Entirely due to ignorance of our former method of instructing our officers in technical subjects, civilian engineers have somewhat the same misgiving as to the professional attainments of army engineers. Such criticism is at this time quite prevalent in connection with the campaign for the creation of a department of public works. It is without foundation in fact and overlooks the achievements of army engineers which exist in public buildings and monuments, such as the Congressional Library and the Washington Monument; river and harbor improvements such as the Panama Canal, and the vast and complicated engineer undertakings in France, all of which were under the supervision of army engineers. Such doubts will disappear and no grounds whatever will exist for mistrust when the engineer in civil life realizes that his colleague in the army is a product of the same, an equal, or a better civil institution than himself. The reciprocal knowledge of the technical capacity of civil and military engineers will be established for all time by contact formed at these civilian institutions.

Another reason for the use of civilian institution for the civil engineering course is that by eliminating this course from the Engineer School proper the use as instructors of many high ranking officers may be avoided and much overhead expense may be thus eliminated. This point is particularly important at this time when the demand for economy is so great. It is to be noted if officers are to be developed as instructors of efficiency equal to those in civil institutions some of them must devote their entire life to pedagogical work and even then they may not reach so high a plane of teaching as those instructors in the best civilian schools. Still another reason for using civilian institutions for the civil engineering course is that better equipment can be obtained at less expense in the better civil institutions.

A consideration of the foregoing appears to show conclusively that the policy for instruction in technical subjects is sound. Officers of the Corps of Engineers should attend civil schools which possess ample equipment, a corps of selected instructors, with efficient courses and methods of instruction. Further, through the intimacy of college life mutual relations of respect and good will can be established and maintained between the professional military engineer and his colleague who remains in civil life. Such relations undoubtedly benefit the administration of government affairs, not only in time of war but in time of peace.

On completion of those two courses the officer spends two years in practical work in connection with river and harbor improvements or fortification projects and is then again detailed with troops for a period of two years. In addition to the practical work which can be furnished by the corps itself, officers are detailed to various industrial concerns, such as railroads, large construction companies, etc.

Later Training

The program above indicated covers the first six or seven years of the officer's commissioned service and during this period of service as a lieutenant, and, perhaps captain, aside from instruction received by school courses, he receives training in administrative and executive work as an assistant in the office of the Chief of Engineers or as an assistant to army, corps, or department engineers, or he may receive training in supply work as an assistant or a principal in charge of an engineer depot. He acquires experiences in construction as a district engineer or as an assistant to a district engineer on river and harbor and fortification work.

On or shortly prior to promotion to the grade of field officer he may take the field officers' course of approximately six months at the Engineer School, Camp A. A. Humphreys. This course endeavors to acquaint him with the duties of a field officer of engineers and of a staff officer for the Engineer Service. It stresses the relations of engineers with the staff and other troops. On completion of this course the officer is either sent to the school of the line or is returned to engineer duty.

Progress in Air Surveying

IN HIS report for the year ending June 30, 1921, just published, Col. E. Lester Jones, director of the U. S. Coast and Geodetic Survey, gives the following summary of the bureau's activities in connection with the work of aerial surveying:

The Mississippi River delta was photographed by the Air Service of the Navy during March, April, and May, 1921, for the use of this bureau in revising the chart of this area. Office work on these photographs is now in progress.

Atlantic City, N. J., and the vicinity was photographed in July, 1919, by the Air Services of the Army and Navy, and almost the whole of the outer coast line of New Jersey was photographed in March, 1920, by the Army Air Service. Revised charts of the New Jersey coast are now being compiled, and will soon be issued, showing corrections as obtained from these photographs. An officer of this bureau established the ground control and verified the results of the office compilation, making an examination of the photographic mosaics in the field.

The results of this work have produced some interesting and important conclusions in regard to chart revision: (1) The cost of the revision of the topography of the New Jersey coast by means of aerial photography is about one-third of the estimated cost by plane-table methods; (2) the inaccuracies to which aerial photographs are subject become negligible when reduced to a scale of 1:80,000, the scale of our coast charts; (3) no better historical record could be kept of shore-line changes than that furnished by aerial photographs, as every detail is shown.

Owing to lack of trained personnel, the Air Services of the Army and Navy have not been able so far to carry out a program of photographing portions of the Atlantic coast as requested by this bureau for the purpose of chart revision. The situation is improving and these services are planning to co-operate more fully in the near future.

An officer of this bureau has devoted practically all of his time during the year to the study of this subject and in keeping in touch with developments. Instruments for use in compiling data are being acquired. In June of this year a mathematician was assigned to devote a part of his time to the study of the mathematical problems connected with aerial surveying. A draftsman was also detailed for a portion of his time in order to become familiar with the process of compilation of data from photographs. In this way preparations are being made to handle photographs as they are received from the Air Services. The nucleus of an office and field force is being formed, so that when the time comes that the Air Services will be able to make extensive photographic surveys the Coast and Geodetic Survey will be ready to do its part with a small increase in personnel and the charts of the United States will be closer to perfection, as far as topographic features are concerned, than they ever have been before.

Too much stress can not be laid on this successful method of revising our shore topography, emphasizing *accuracy*, *economy*, and *speed*. But the Coast and Geodetic Survey does not maintain airships and seaplanes, and unless there is greater co-operation from the Army and Navy Air Services valuable time will be lost in supplying for charts and maps important information for commercial purposes on sea and land.

Paint Research To Be Undertaken

Research into the problems of the protecting power and durability of paint on wood is being planned by the Engineering Foundation. It is likely that the organization of the proposed investigation will be directed jointly by the Foundation, the Division of Engineering, and the Division of Chemistry and Chemical Technology of the National Research Council. The Foundation says that in view of the great annual expenditure for paint, about $300,000,000, it is important to have dependable information on the durability both of paint and of the wood which it protects.

First Unit for Queenston-Chippawa Water Power Plant Opened

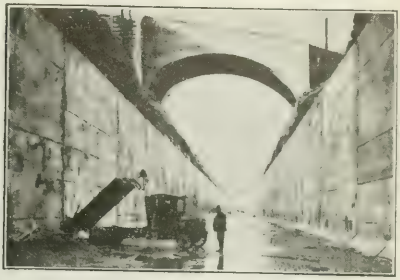
ON DEC. 28, 1921, the first unit of the new Queenston-Chippawa hydro-electric power plant around Niagara Falls was turned over with appropriate dedicatory exercises. This marks the beginning of the service of the 550,000-hp. development started before the war by the government of Ontario under the direction of the Hydro-Electric Power Commission of Ontario. On the opposite page are shown some views of the completed project, which has been described frequently in *Engineering News-Record*. As a matter of record here, however, there are set down below the main features in the development.

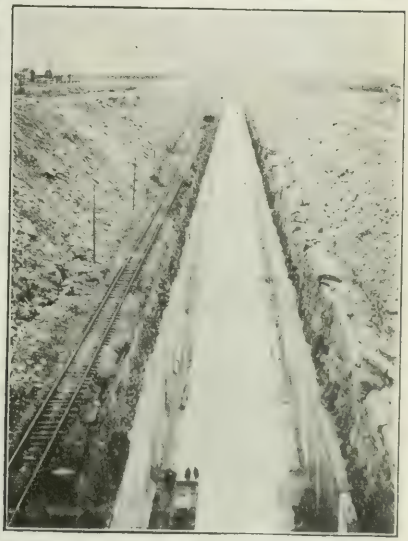
The project takes water from the Niagara River on the Canadian side, about 1½ miles above the Falls, and delivers it through a canalized river and dug canal a total distance of 13½ miles to a power house under the bluff on the lower river 5 miles below the Falls. The upper 4½ miles of this channel is in the Welland River, whose flow is reversed for that distance, and the canal section partly through rock and partly in earth cut is 8½ miles long. Approximately 15,000 sec.-ft. will be delivered through the canal to the forebay, at a level 305 ft. above the tail water. The total fall between Lake Erie and Lake Ontario is 327 ft., so that only 22 ft. is lost in the fall of the Niagara River and in the canal. The estimated total output of the canal is 550,000 hp., but at present only 275,000 hp. is to be developed, with five 55,000-hp. reaction turbines of the vertical single-runner type. These are connected to generators generating at 12,000 volts and 25 cycles. The voltage is increased to 110,000 for distribution.

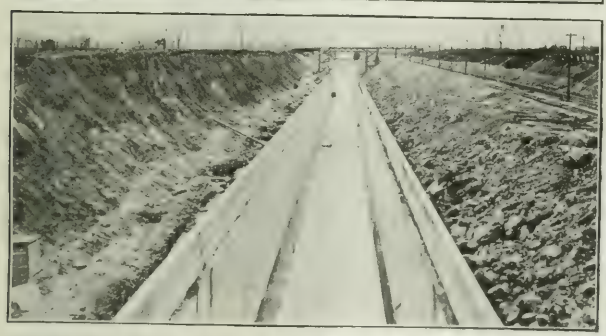
The intake at the mouth of the Welland River was designed as a fingering tube arrangement drawing in water on the bottom element of the cylinder, but construction of this instake has not been carried beyond laying dry the site inside a cofferdam. The Welland River section was dredged by cableway excavators and by hydraulic machine, and the dredge worked its way for a mile up the canal section. From this point the canal is all in rock with the exception of a built up rock-filled section 2,500 ft. long across the gorge just above the Whirlpool, a relic of a former course of the Niagara River. Where the canal is in rock the sides and bottom are lined with concrete for the purpose of increasing its carrying capacity, and in the Whirlpool section the side slopes are heavily paved with concrete. The section of the river is 150-ft. bottom width with slopes of 2 on 1, through the main rock cut 48 ft. wide at the concrete lining. There is a 1 on 2 rock-paved earth slope above the rock cut where conditions require it. In the Whirlpool the bottom width is 10 ft. with a slope of 1½ on 1. At one point the bottom of the canal is 145 ft. below the original ground level. The maximum depth of cut in earth is 80 ft. and in rock 85 ft. The depth of the water in the canal is from 35 to 40 ft. The amount of material excavated from the canal proper is over 17,000,000 cu.yd. of earth and rock. The earth excavation amounts to 13,200,000 and the rock excavation to 4,182,000. Concrete in the amount of 450,000,000 cu.yd. has been used.

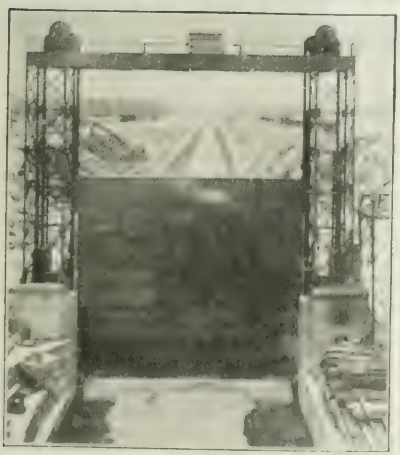
Early estimates of the cost of the canal, made before the increased costs due to war, have been greatly exceeded. While the figures are not now given out, it is reported that the total cost will be between $55,000,000 and $60,000,000 for the completed installation.

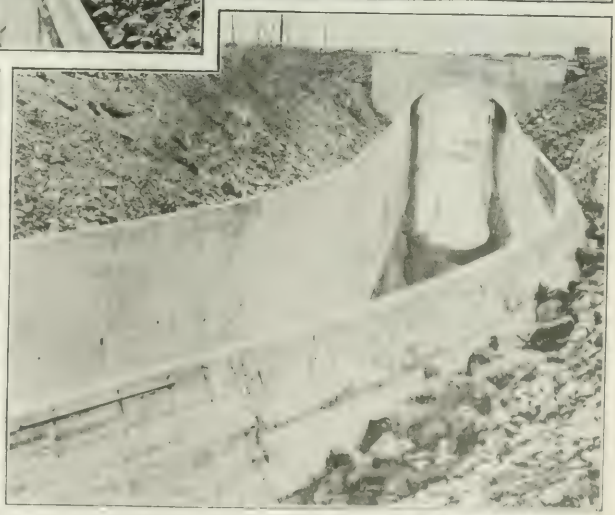












Views of the Completed Queenston-Chippawa Hydro-Electric Development Around Niagara Falls in Ontario

Upper left—Aerial View Looking Across the Niagara River at the Power Completed Power House and Forebay Showing Approach Canal to Forebay. Lower Left—Section of Concrete Lined Penstock. Upper Right—Control Gate in Canal Above the Head of Power Section. Upper Center—Bottom of [illegible] Below the [illegible] Lower Right—[illegible]

Lake Coal Dock with Unloading and Handling Plant

Crib and Concrete Dock—571 ft. Bridge with 10-ton Grab Unloads 625 Tons Hourly from Ship Screen and Conveyor Plants—500,000 Tons Storage

FOR handling coal brought by water from the lower lake ports, there are at Duluth, Superior and other points at the head of the Great Lakes, large coal docks equipped with machinery for unloading vessels, stocking and screening coal and shipping it by rail for distribution through the Northwest. These large storage facilities enable the fuel companies to supply their territory during long winter periods. One of the largest of these coal handling and storage docks is the new Dock No. 4 of the North Western Fuel Co. at Rice's Point, on Superior Bay, Duluth, Minn.

This dock and its coal handling bridge are shown in Fig. 1, with a general layout plan in Fig. 2. The filled area is 500 x 1,765 ft. and has on one side a vessel slip 150 ft. wide and 1,565 ft. long, with about 26 ft. of water. On the dock there is storage capacity for about



FIG. 1. COAL HANDLING BRIDGE ON DOCK NO. 4, NORTHWESTERN FUEL CO., DULUTH, MINN.

400,000 tons of bituminous coal and 90,000 tons of anthracite, with provision for future increase in the latter. As the two kinds of coal have to be handled separately and graded into various commercial sizes, there is elaborate equipment for screening, conveying and storing, and also for loading the different sizes into box cars and gondola cars for shipment, and into wagons and motor trucks for local distribution. Bunker coal can be supplied to harbor boats by a small fueling plant at the head of the dock.

Dock Construction—Timber cribs 24 and 26-ft. wide, with sand filling and concrete caps, form the sides of the dock as shown in Fig. 3, the inclosed space being filled with sand pumped in by dredges. The cribs were built in a neighboring slip, floated to site, completed to the full height of 28 ft. and then loaded and sunk in a dredged trench. They are secured by anchor and brace piles inside of the rear wall. The heavy concrete cap on the dock wall has buttresses spaced 18 ft. c. to c., extending below and behind the wall and resting on interior piling. Expansion joints are placed every 160 ft.

For the front track of the coal handling bridge, white oak ties are embedded in the concrete, the rails resting on steel tie plates and being fastened with screw spikes. For the rear track, there is a reinforced-concrete girder on 3-pile bents spaced 3 ft. c. to c. with ½-in. steel plates or ties 3½ ft. long embedded in the concrete. These plates are 4-in. wide, except for 9-in. plates at the rail joints, and the rails are secured by clips on U-shaped anchor bolts. The rails weigh 100 lb. per yard and have special splice bars to allow the passage of the rail clamps of the coal handling bridge. Concrete bumping blocks at the ends of the tracks are fitted with timber bumpers and rope mats as shock absorbers.

A traveling bridge with trolley and grab bucket, Fig. 1, is installed for unloading vessels and for stocking and reclaiming the coal. Its unloading capacity is about 625 tons per hour when working in free coal. With a span of 342 ft. between supports the total length of the bridge is increased to 571½ ft. by a hinged apron at the water end and a cantilever extension at the rear end. The operating speeds are 200 ft. per minute for hoisting, 1,000 ft. for trolley travel and 50 to 70 ft. for traversing along the dock. Ordinary unloading is done with a 10-ton clamshell bucket 6½ ft. wide, with a spread of 22 ft. For cleaning up cargo in the hold a 6-ton bucket is used, having a width of 12 ft. and a spread of 24 ft. The buckets have a clearance of 50½ ft. above the dock floor.

Eight 30-in. single-flanged wheels travel on the front track and seventeen 24-in. wheels on the rear track. All wheels are driven from a 200-hp motor, but a clutch provides for traversing the front or shear end while the rear end remains stationary, thus permitting the bridge to be skewed about 6 deg. on either side of its normal center line. This arrangement avoids undue stress when the bridge gets out of square with its tracks, due to high wind or slipping of the wheels, and

it also enables the bridge to be squared up when necessary. Incidentally, it assists in adjusting the head of the bridge to vessel hatches.

For control of bridge movements there is an automatic cutout which operates at the speed limit, a solenoid brake and automatic rail clamps. The brake and clamps are normally applied, being released only when the bridge is to be moved. The three devices are interlocked so as to operate in proper order. Collectors on the rear leg of the bridge take current from conductors of 4 x 4-in. steel angles along the track.

An elaborate plant for screening and sizing bituminous coal is mounted on the rear tower or pier of the coal-handling bridge, as shown in Fig. 4. This plant provides for loading coal into cars and it can also transfer the smaller sizes to stock piles or to six stationary bins on the dock by bucket elevators and belt conveyors. On the bridge tower are four 50-ton bins, one of which is for run-of-pile coal and is loaded directly from the clamshell bucket. The others are placed under the screens which prepare stove, nut and screening sizes. The flow diagram of the bituminous coal handling plant is shown in Fig. 5.

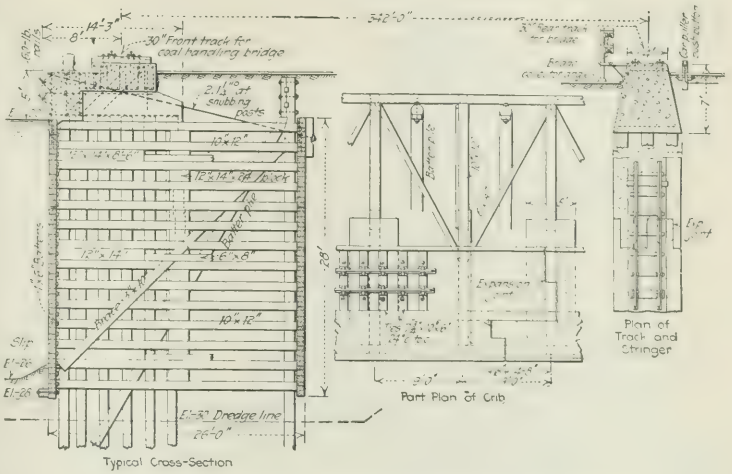


FIG. 3. CRIB DOCK WALL WITH CONCRETE CAP AND GIRDER

All sizes of coal can be delivered into box cars by means of two box-car loaders and two loading booms with belt conveyors, the latter being used also for loading open cars. It is possibe to load two cars simultaneously on either one or two tracks. The loading capacity of this bituminous plant varies from 2,000 to 6,000 tons in a 10-hour day, depending upon whether gondolas or box cars are being loaded, and also whether the loading is done at one or two points.

For local distribution of bituminous coal there are six 300-ton bins along the rear of the dock (see Figs. 1 and 2), each equipped with screens for sizing the coal and with chutes for loading wagons or motor trucks at the rate of about 1,000 tons in ten hours. For supplying fuel to harbor vessels there is at the end of the dock a plant with a timber runway, clamshell bucket and scraper bucket, operated by an electric hoist. These buckets serve a weighing hopper mounted on a 50-ton scale and feeding a belt conveyor operating on an adjustable boom.

Anthracite coal is stored under cover in a frame building 480 x 288 ft., inclosed by timber bulkheads and having a flat roof with hatchways 9 x 22 ft. for the clamshell buckets. The flow diagram for this section of the plant is shown in Fig. 6.

For removal of anthracite from the storage building there is a 36-in. belt conveyor, No. 1 (see Fig. 6), 517 ft. long, located in a reinforced-concrete tunnel on pile foundations. This tunnel, Fig. 7, extending the full width of the building, has a semicircular roof with openings fitted with chutes and undercut gates spaced 8 ft. c. to c., staggered on opposite sides of the tunnel. An electrically propelled feeder travels above the conveyor and delivers the coal from the chutes to the belt. Coal that does not flow by gravity to the tunnel is trimmed to it by means of flying steel scrapers operated

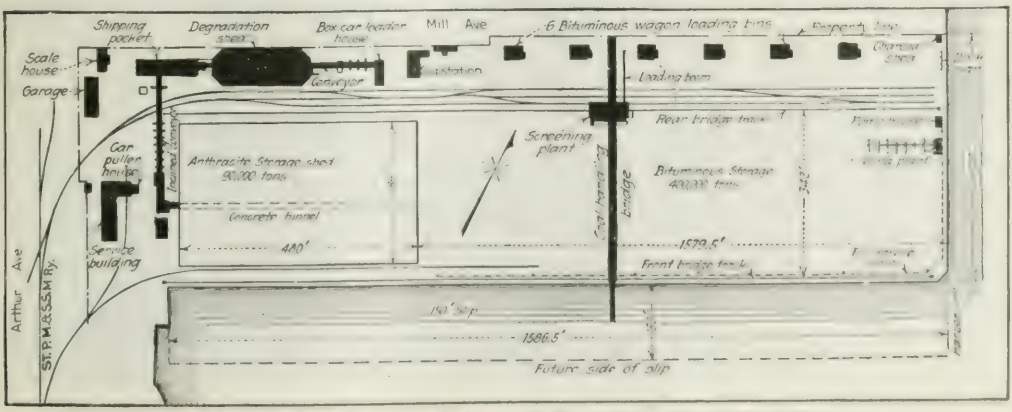


FIG. 2. DOCK FOR UNLOADING, STORING, SCREENING AND HANDLING COAL

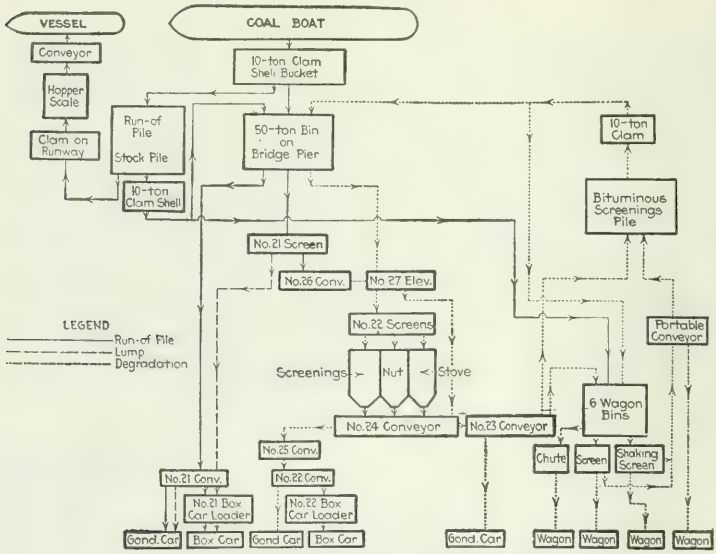


FIG. 5. FLOW DIAGRAM OF BITUMINOUS COAL

in pairs on single cables, handled by an electric hoist.

An inclined 36-in. belt conveyor, No. 2, at right angles to No. 1 and 284 ft. long, receives the coal from the latter and transfers it to the shipping pocket. Each of these conveyors has a capacity of 300 tons per hour at a belt speed of 250 ft. per minute. A bifurcated chute with a flop gate at the head of No. 2 conveyor passes the stove and egg coal to cargo screen No. 1 or the nut coal screen No. 2. These screens are of the balanced horizontal shaking type, 6 ft. wide and 33 ft. and 43 ft. long.

When cargo egg or stove coal is to be screened, the coal is delivered to screen No. 1, from the lower deck of which the nut and smaller coal passes to No. 2 screen, where it is re-sized into nut, pea, buckwheat and dust. Screen No. 1 also has a perforated section for separating stove from egg, the latter passing to a 225-ton pocket, while the stove is conveyed to a 450-ton pocket. The dust is diverted to a 225-ft. flight conveyor which carries it either to the dust bin or the degradation shed, where the small sizes produced in handling are again screened.

The 1,600-ton shipping pocket is divided into compartments for egg, stove, nut, pea, buckwheat and dust sizes, each compartment loading trucks and wagons by two chutes with undercut gates, screen plates and hinged loading aprons. The degradation or undersize material is carried by 16-in. belt conveyors to a bucket elevator, No. 9, which either delivers it to No. 2 screen for re-sizing or diverts it to the flight conveyor for stocking in the degradation shed. For rail shipments, the pocket has 13 undercut gates which deliver coal to a 42-in. steel apron conveyor, No. 3, 120 ft. long and running at 80 ft. per minute. This conveyor in turn delivers the coal to No. 3 screen, the upper deck of which takes out any dust, buckwheat, pea and nut sizes which may have been made in the pockets. The small or degradation coal passing through this screen is delivered to 16-in. degradation belt conveyor No. 7, which in turn delivers it to No. 9 bucket elevator for rehandling.

Handling "Degradation" Coal—In preparing coal for shipment, degradation material is removed and finally separated into the smaller commercial sizes. In the 6,000-ton degradation shed is a crib tunnel with gate openings 10 ft. apart, through which, in reclaiming, mixed degradation material is delivered to belt conveyor No. 7, which carries it to No. 9 elevator for delivering it to No. 2 screen, where it is re-sized.

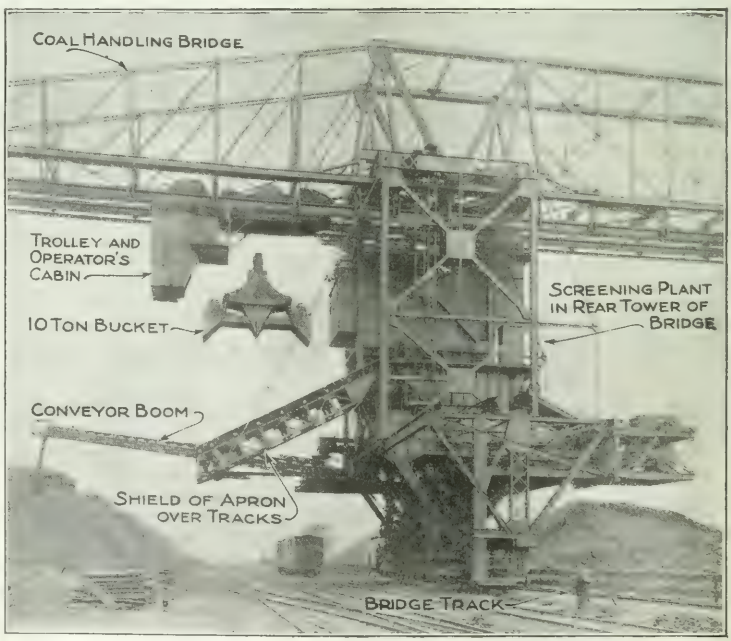


FIG. 4. SCREENING AND LOADING PLANT ON COAL HANDLING BRIDGE

Flying scrapers of the type described previously are used for trimming coal to this tunnel.

The coal passing over No. 3 screen is carried by a 42-in. inclined belt conveyor, No. 3½, to the loading shed for loading to cars, where it is delivered to a 42-in. hinged shuttle belt conveyor on loading boom No. 10.

Power and Miscellaneous Equipment

Alternating current at 13,200 volts, purchased from the Great Northern Power Co., is delivered by underground feeders at a substation, where it is converted to 600-volt direct current by transformers and rotary converters. For weighing shipments from the dock, there is a 150-ton track scale for cars, and one 20-ton and two 15-ton scales for trucks and wagons. The track scale is set 1.5 ft. above yard level to give a starting grade of about 1 per cent from the scale.

Railway tracks are laid with 85-lb. rails and No. 7 and No. 11 frogs; tamarac ties are used on straight track, curves having white oak ties, steel tie plates and bridle bars. A 50-hp. electric reversing car-puller mechanism, with endless rope system, serves all loading tracks, there being seventeen push button stations to start, stop and reverse the car puller rope. The entire dock is floored with 2-in. maple plank laid on 2 x 6-in. mudsills about 4 ft. c. to c., except that driveways have 3-in. maple plank. A steam fire pump serves 1,300 ft. of pipe having 2½-in. hose valves about 200 ft. c. to c., and a 6-in. fire main along the north side of the dock is connected to a city main and accessible to the fire department. There are also hose carts and closets and a number of fire extinguishers in the buildings. A brick service building contains the dock offices, storeroom, machine and electric repair shops, and quarters for the men. These quarters have hot and cold water and toilet facilities, including shower baths and lockers.

Engineers and Contractors

For the principal parts of the work the contractors were as follows: Dredging and filling, Great Lakes Dredge & Dock Co., Duluth; timber cribs, bridge tracks, concrete crib caps and a large portion of the structures, Morris & Dougherty and Peppard & Fulton, St. Paul and Minneapolis; coal handling bridge, Brown Hoisting Machinery Co., Cleveland, Ohio; anthracite handling equipment, Jacobsen & Schraeder, Chicago; substation equipment, Westinghouse Electric & Manufacturing Co. Scales, scrapers, fire service system, compressed air system, garage, electrical equipment and

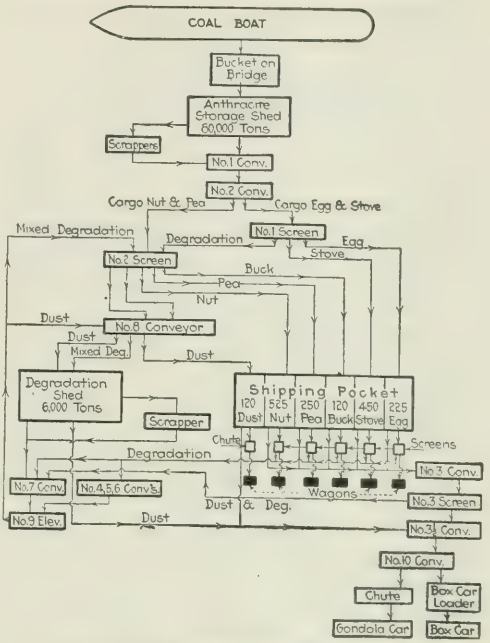


FIG. 6. FLOW DIAGRAM OF ANTHRACITE COAL

feeders and the boat fueling plant, were installed by the North Western Fuel Co. with its own forces. The concrete girder and pier type of construction for the front bridge track (Fig. 3) was suggested and designed by the firm of Toltz, King & Day, consulting engineers, St. Paul.

The general layout and detail design of this dock are the result of a study of requirements and local conditions, in which there was close co-operation between the management, the operating and engineering departments and the equipment manufacturers. Nathaniel Hanson was assistant engineer in charge of office work; L. Morris Mitchell, engineer in charge of construction from early in 1919 to the completion of the work; and Norman W. Rose, electrical engineer. All design, construction and installation were under the direction of G. H. Hutchinson, chief engineer of the North Western Fuel Co., St. Paul, Minn.

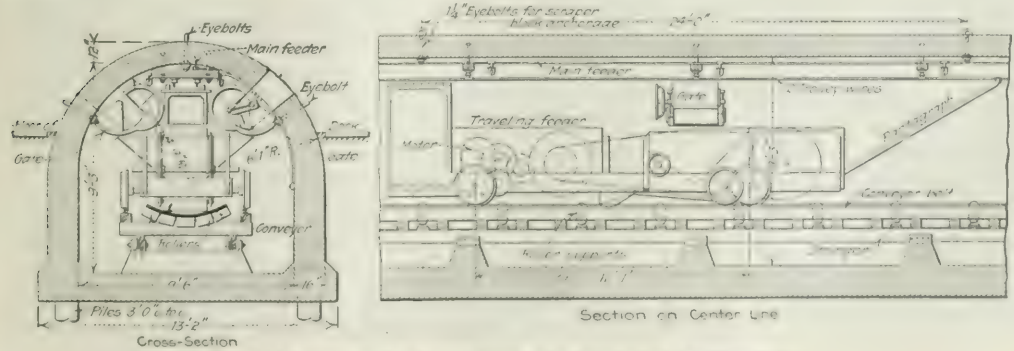


FIG. 7. TUNNEL AND CONVEYOR FOR REMOVING ANTHRACITE

Relocation on the South African Government Railways

Easier Grades and Curves on Detour Lines—Better Operating Conditions—Tunnels, Heavy Earthwork, Slides in Cuts

A SEVENTY-MILE relocation in rough country, reducing curvature 50 per cent and maximum grades from 3.3 per cent to 1.5 per cent, to permit handling traffic in fewer and heavier trains without pushers, is an example of improvement and relocation work being carried out on the South African Government Railways to meet the requirements of increasing traffic. This relocation is in Natal, on the line from the port of Durban to the inland city of Pietermaritzburg, a railway center, at an elevation of 2,218 ft., beyond which lines extend to the interior. It is this line which has been selected as the first section of an electrification program, as noted in *Engineering News-Record* of Jan. 29, 1920, p. 227, and Sept. 16, 1920, p. 558. A map of the old and new locations is shown in one drawing, with profiles of the principal part of the work in another. All lines are of 3 ft. 6 in. gage.

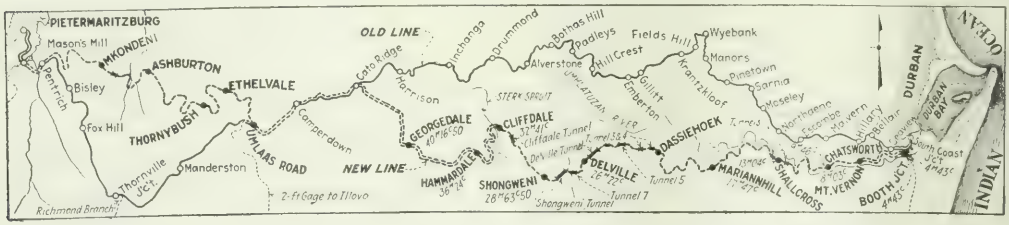
Heavy grades and excessive curvature characterized the original line, which was built more than forty years ago. It is considered that the 3.3 per cent limiting grades and 300-ft. radius curves were reasonable, but that an unnecessary amount of curvature was introduced owing to the fact that then train resistance due to curvature was not realized as it is today. In many cases sharp curves were introduced on maximum grades without compensation, so that the actual grade was equivalent to about 4 per cent. As early as 1895, reduction of curvature had been considered, with local relocation. At that time the inward or westbound traffic was by far the more important, but in 1905 the coal traffic from the interior to the coast had increased to such an extent that it was 54 per cent of the total, so that attention had to be given to improving conditions for eastbound movements.

A policy of improvement was adopted by the government in 1903, but progress has been slow, as the program was to extend the work over a term of twenty years. In the meantime, however, the traffic capacity has been increased by the introduction of more powerful locomotives. On the eastern section, from Durban to Cato Ridge, the new line is entirely independent of the old location. From Cato Ridge to Pietermaritzburg there are short stretches of improved line and double tracking on the old line, with a long single track relocation. The present policy on all improvements is to build long stretches of new line to take the bulk of the traffic, leaving important sections of the old line in operation for local service and as a relief track. Originally it was the policy to follow the old location as much as possible, which prevented any comprehensive improvement.



THIRTY-FOOT CONCRETE CULVERT IN HIGH FILL ON SOUTH AFRICAN RAILWAY

The heaviest work of the entire line is that between Durban and Cato Ridge. On the original location from Booth Junction (just outside Durban) there are grades of 3.3 per cent in both directions, as shown by the profile. Between Drummond and Alverstone is a grade of 3.3 per cent against the heavy eastbound traffic, so that two pusher engines and two crews are required. Freight train loads on this old line are limited to 245 tons westbound and 540 tons eastbound.



LINE REVISION BETWEEN DURBAN AND PIETERMARITZBURG, SOUTH AFRICAN GOVERNMENT RAILWAYS

Surveys for relocation have been made at different times since 1902, but the route was not selected definitely until 1914. This route results in a much more regular profile or grade line. On the new location the maximum grades are 1.5 per cent westbound and 0.56 per cent eastbound, the total rise and fall is 600 ft. less, the distance is only 600 ft. longer. The sharpest curves are of 495 ft. instead of 300 ft. radius and the total curvature is reduced 50 per cent, the original curvature averaging 360 deg. per mile. Train loads will be increased to 700 tons westbound and 1,000 tons eastbound, without the aid of pushers. Further, the improved conditions will permit the number of freight trains between Durban and Cato Ridge to be reduced from 32 to 18 daily, by heavier loading, with a reduction in time of two hours for each round trip.

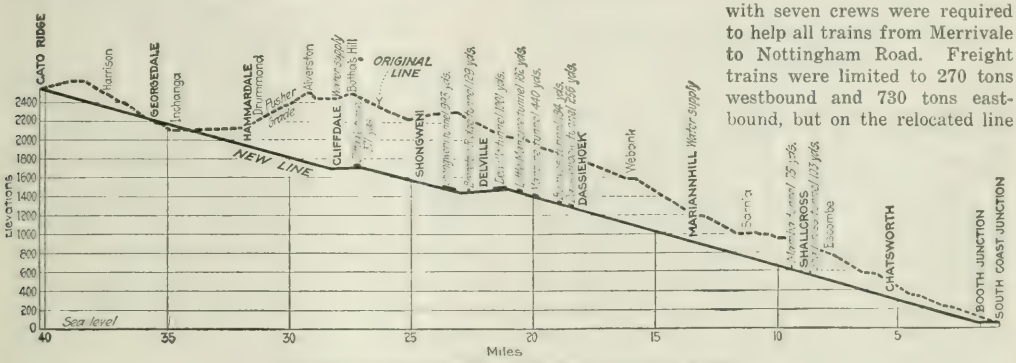
Ten tunnels are required, aggregating 11,040 ft All are lined with concrete. The largest are the Deville and Shongweni tunnels, 3,003 and 2,980 ft. long, in granite and sandstone. Heavy earthwork is encountered, the total excavation being about 4,500,000 cu.yd. A concrete bridge across the Umhlatuzan River, with seven arch spans of 30 ft., having the rail level 85 ft. above the water, is the most important structure on the

main line. Near Clairwood the same river is crossed by a double track bridge having ten plate girder spans on concrete piers with concrete pile foundations. A 30-ft. concrete arch culvert carrying Sterk Spruit (or creek) through a high double track embankment near Cliffdale is shown in one of the views.

Ten stations are provided, at each of which is a passing siding 1,900 ft. long. The track is laid with 80-lb. rails on native hardwood ties. Work has been delayed by bad weather and the shortage of railway and building materials, especially cement, but it was expected to have the grading and tunnels completed during 1921. The cost of the new line between Durban and Cato Ridge will be about $5,000,000.

of considerable trouble. At one point the sliding hillside was checked in 1917 by building a toe, on the up-hill side of the roadbed, consisting of 5,000 tons of stone anchored by old rails on steel ties. The ties were placed vertically, with the horizontal rails forming an anchorage. Three or four rows of ties were used, with rock filling between them. In addition, forty-eight concrete struts were built under the track, transmitting the pressure to solid ground on the down-hill side of the cut. This proved successful until the severe storms and floods of 1917 occurred, when the saturated hillside slid down and blocked a number of cuts. Extensive works were needed to give permanent relief from such occurrences.

In this section of the old line five pusher engines with seven crews were required to help all trains from Merrivale to Nottingham Road. Freight trains were limited to 270 tons westbound and 730 tons eastbound, but on the relocated line these loads will be increased to 415 and 1,000 tons respectively. The length of this improved section is 21½ miles, an increase of 1¾ miles, with maximum grade of 2 per cent westbound and 1.5 build per cent eastbound, 162 ft. reduction in rise and fall, curves of 495 ft. instead of 300 ft. radius, and a reduction of 3,114 deg. in total curvature.



OLD AND NEW PROFILES—DURBAN TO CATO RIDGE

The importance of this Cato Ridge-Clairwood relocation is evidenced by the following statement in the report for 1920-21 by R. C. Wallace, the present chief civil engineer of the government railways: "This deviation embraces the heaviest piece of railway con-

On the western section, from Cato Ridge to Pietermaritzburg, there is a long ruling grade of 3.3 per cent from Pentrich to Fox Hill, opposed to the heavy eastbound traffic. A long single track relocation eliminates this operating obstacle. With an increase of ¾-mile in distance the new line reduces the maximum grade eastbound to 1 per cent and westbound to 1.43 instead of 2.1 per cent; the sharpest curves are of 720 ft. instead of 300 ft. radius, the total curvature is reduced by 2,317 deg., total rise and fall is reduced by 235 ft., and five pusher engines have been released.

Very heavy earthwork has been required. The total cost of the improvement of the western section, including the relocation and two stretches of double tracking on the old line will be about $2,100,000. An existing branch from Thornville to Richmond makes it necessary to retain the old line in service, an arrangement which fits in with the present policy of keeping the old lines for local and auxiliary service, as noted above.

West of Pietermaritzburg, on the main line to Ladysmith and Johannesburg, improvements have been made for about fifty miles, including relocation, grade reduction and double tracking. On the first twelve miles there is a tunnel 2,727 ft. long. Extensive slides in the long cuts were a cause



CONCRETE ARCH BRIDGE OVER UMHLATUZANA RIVER

struction in the Union of South Africa, and must certainly rank high in the records of railway construction in any part of the world. But although the construction work has been of such magnitude, the real engineering problem was the survey, which is the most brilliant piece of location ever done in South Africa. It will always remain an eloquent testimony to the railway engineering skill of this country."

The improvement works are being carried out under the direction of Sir W. W. Hoy, general manager, Railways and Harbors, Union of South Africa. A. M. Tippett is engineer in chief, and A. J. Beaton has been acting engineer in chief during Mr. Tippett's absence in Europe.

Low Friction Loss in Twenty-Five-Year Old Cast-Iron Pipe

By Thomas F. Wolfe
Secretary, The Cast Iron Pipe Publicity Bureau, Chicago, Ill.

In the design of water-works systems the common practice is to assume that the loss of head due to friction increases with the age of the pipe. The standard formulas for friction loss take this fact into account. In many cases it is time that the friction increases with the age of the pipe but, with certain waters, the loss does not increase appreciably even over a great number of years. Although the use of formulas that pre-suppose an increased friction loss with age is on the safe side, it will pay in many instances to investigate the quality of the water that is to flow through the lines and to base the size of the pipe on the probable condition of that particular pipe after a number of years' service. Along these lines some information was unearthed in a recent water survey for leakage made at Hammond, Ind. The data cited below were not collected for the purpose of determining friction loss but as ordinary care was taken in making readings, and the length of pipe tested was more than 15,000 ft. a slight error in pressure readings would make little difference in resulting coefficients.

FRICTION FACTORS IN AN OLD 24-IN. CAST-IRON PIPE

Velocity	Loss Between Observation Points, Lb.*	Loss in Feet, per 1,000 Ft.	Coefficient — Hazen-Williams Formula	Coefficient — "n" in Kutter's Formula	Loss per 1000 Ft. New Pipe by Weston
4.86	20	3.00	131.4	0.0109	3.80
4.75	17	2.53	140.8	0.0103	3.64
4.24	16	2.38	130.0	0.0112	2.89
4.30	15	2.23	136.5	0.0106	2.97
Average			134.7	0.0107	

* No difference in elevation of gauges.

The line tested was a 24-in. main running from the pumping station at the shore of Lake Michigan to the town of Hammond about five miles inland. A few connections tap into this main near the pumping station and then for a distance of 16,000 ft. there are no connections. To determine the leakage, two pitometer taps were installed, the distance between taps being 15,500 ft. The pipe, coefficients determined by traverse across one diameter at each tap were 0.82 for the "inflow" tap and 0.83 at the "outflow" tap. A 20-min. flow test was made, taking manometer readings every 15 sec. and pressure readings every minute. In order to eliminate possible instrument errors, the position of the pitometer rods was reversed after half the readings were made. The average of 80 simultaneous readings on the two taps indicated no readable difference in velocity. While this showing does not necessarily mean an absolute absence of leaks, the leakage is negligible.

It will be seen from the above results that in spite of the fact that this pipe has been in service more than 25 years, the loss in head is less than that shown in Weston's Tables for new pipe, and the coefficients in both the Hazen-Williams and Kutter's formulas approach very nearly the values for new pipe. The piece taken out when a 16-in. cut was made on this main, showed that the coating on the inside as well as the outside was in perfect condition.

This survey was made by W. R. Brown, of Chicago. John Ericson of Chicago is consulting engineer.

Why New York City Opposes The Joint Port Plan

At a recent meeting of the municipal engineers of the city of New York, Arthur M. Tuttle, chief engineer of the Board of Estimate and Apportionment of the city of New York read a paper entitled "The Narrows Tunnel and Its Relation to the Port of New York Problem." After a prefatory statement of the freight handling difficulties in the port, Mr. Tuttle described the formation of the Port of New York Authority and made the following reference to the conflict between that body and the city, particularly in reference to the port development scheme of the former (*Engineering News-Record*, Jan. 5, 1922, p. 26) and the Narrows Tunnel scheme of the latter (*Engineering News-Record*, Oct. 27, 1921, p. 704):

From the date of the creation of the New York-New Jersey Port and Harbor Development Commission to the present, there seems to have been a growing hostility to this body and to its successor on the part of the municipal authorities in New York City, who are given no voice in the formulation or management of the proposed undertaking, the naturalness and occasion for which it is not difficult to see. The intrusion of the state into the management of the city has been the occasion for growing resentment which has recently been emphatically expressed. It is furthermore evident that there can be no guarantee that the jealousy of local community interests, which it is sought to avoid, will not crop out with equal force in the bi-state commission, and as the terms of the proposed union of port interests are so binding that it would be very difficult to withdraw from them even if the consolidation of interests should later prove ineffective or unsatisfactory, the resulting confusion in case of a deadlock might prove disastrous. Again, the pooling, on equal terms, of the economic interests of a single community of nearly 6,000,000 inhabitants with those of 104 scattered municipalities having a total population of about 2,500,000 and very much smaller assets, does not represent what would seem to be a sound policy, and particularly when the issues involved are of only a general character and do not bear with equal force upon the respective parties, the one having the lesser interest taking a far less risk than the other as to the outcome of the combination.

If the principle be accepted as a correct one, it would seem to follow that similar bi-state commissions should take general charge of the water-supply, drainage and sewerage, and rapid transit problems of the metropolitan district regardless of state lines. While such an arrangement might be considered as advantageous in many respects, the conflict of laws and interests by reason of dual jurisdiction which could not be fully avoided, with the possibility of resulting endless confusion and clash would seem to warrant very serious hesitation over any such commitment, but would rather point either to a joining of state interests only in the carrying out of particular and clearly defined projects or the setting up of an independent state as a better means of securing the desired end. If the former alternative is selected, it would also seem that the interests of the City of New York, financial and otherwise, should always be recognized by at least giving it strong direct representation on any such bi-state commission in which its affairs are so deeply concerned.

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Colonel Prout's George Westinghouse

A LIFE OF GEORGE WESTINGHOUSE. By Henry G. Prout, C.E., A.M., LL.D. New York: Charles Scribner's Sons. Cloth, 6 x 9 in.; pp. 375; 9 illustrations. $2.50.

The writing of this illuminating biography of George Westinghouse is due to the initiative of the American Society of Mechanical Engineers, and is a continuation of the effort begun twelve years ago when the John Fritz's autobiography was published under the auspices of the same body. The committee in charge of the present work was composed of Charles A. Terry, as chairman, Paul D. Cravath, Alexander C. Humphreys, James H. McGraw, Charles F. Scott, Lewis B. Stillwell and Ambrose Swasey. The writer of the biography, Col. Henry G. Prout, was well qualified for the work by his long connection with Westinghouse, as president of the Union Switch & Signal Co., and by his experience as editor of the *Railroad Gazette*, in which position he was conceded to be one of the leaders in American technical journalism. He brought to the work, then, a thorough understanding of Westinghouse, and the ability to put his thoughts in writing.

The book is divided into two general parts: (1) The first and the last two chapters sketch the life of Westinghouse, picture his character, and interpret the influence of his efforts on human progress; (2) the other chapters go into details regarding his inventions and enterprises.

Taken as a whole, the biography will appeal chiefly to engineers, though the general chapters are sure to interest and be of value to any reader. The other chapters are necessarily technical, and will be followed closely by those who want a clear record of the various devices and enterprises with which Westinghouse was concerned.

These chapters, however, though dealing with technical development, shed illuminating light upon Westinghouse's character and methods. In fact, only by reading them does one get the full story—a true appreciation of his imagination, his engineering resourcefulness, his courage, his marvelous persistence, his ability as an organizer, his leadership of men.

Between the technical chapters there is not much to choose. Some of them tell of Westinghouse's personal inventive ability; some, of his direction of developments whose details were worked out by his subordinates. Each class of activity, however, carries its own special inspiration. In one chapter we get the fascinating story of the air brake; in another, Westinghouse's influence in making practicable, largely through the development of the transformer, the commercial use of alternating current; in another, the inventions in the art of railway signalling; in still another, his work on steam turbines, on reduction gears, on the friction draft gear. The list is a long one. Not the least interesting and illuminating of the specific chapters is the one on his financing methods.

The last chapter is the most important. It is an attempt—and a happy one—to appraise the influence of Westinghouse upon human progress. The author rightly gives him a high place—for the influence of the air-brake and automatic signalling on transportation, and for the commercial introduction of alternating current. Railroad transportation today, with all of its socializing influence, would be impossible without the air-brake and automatic signalling. Col. Prout rightly calls these devices essential contributions to the greatest of material civilizing agencies. Hardly of less importance is the introduction of the alternating current, a veritable obsession with Westinghouse, in which he met obstacles and opposition which would have overwhelmed a less stout-hearted and determined character. It need not be told any engineer that the basis of our marvelous distribution of electric power today is the alternating current. Westinghouse championed it when it had no other friend.

All in all the book gives an excellent picture of one of the country's great engineers and industrial leaders. It furnishes much inspiration and holds many valuable lessons for all who would aspire to high place whether in business or in engineering.

A Handy Book on Railway Signaling

BY J. A. PEABODY

Signal Engineer, Chicago & Northwestern Ry.

RAILWAY SIGNALING. By Evelyn Edgar Kirk, Member of the American Railway Association, Signal Section, Member of the American Railway Engineering Association, Associate Member of the American Society of Civil Engineers; Professor of Railway Civil Engineering in the University of Illinois. New York and London: McGraw-Hill Book Co. Cloth; 6 x 9 in.; pp. 371; illustrated. $4.

There is such a dearth of concise information on railway signaling that this book is timely and interesting. After a preliminary chapter, the author describes types of position and light signals. Then in two chapters he describes mechanical interlocking very clearly, dividing this into the portions inside and outside of the tower. Good illustrations of the various parts, particularly of the machine and descriptions of the uses of the parts, assist in the description. This applies particularly to the machine locking, which so many find hard to understand. Other chapters are devoted to electro-pneumatic interlocking and electrical interlocking.

The chapter on direct-current circuits starts out with a diagram of the track circuit and a very brief description of its purpose. It would seem that this essential part of signaling could, with benefit, have been given more nearly equal attention to that given the very complete chapter on automatic block signaling on track with alternating current circuits. An instructive chapter on automatic block signaling on single track analyzes clearly the various systems used. The various types of power signal mechanisms are illustrated and described in a manner similar to that in which the subject of interlocking is handled. But a paragraph on automatic stops is so brief as to be misleading, since it gives the impression that it describes the only type of automatic stop devised. A chapter on highway crossing signals shows the methods of control of automatic flagmen and bells. Appendices include information of general use.

In all cases the treatment is brief, but particularly

so in regard to batteries and current consumption. Nothing is said as to such recent developments as trickle charging of batteries. Difficulties that may be experienced in maintenance of signal work are not touched upon, but criticism as to difficulties would apply to most books of this class.

Both test and illustrations are well put together and clearly printed. The work is in text book form, with a good table of contents and well indexed, and is therefore handy as a reference book for experts, and also for division engineers and other railroad officials who want general information rather than details. It will be of interest also to signalmen and students of railway engineering.

Kidder and Nolan's Architects' Handbook

THE ARCHITECTS' AND BUILDERS' HANDBOOK. Data for Architects, Structural Engineers, Contractors, and Draftsmen—By the Late Frank E. Kidder, C.E., Ph.D., Author of "Building Construction and Superintendence." Compiled by a Staff of Specialists and Thomas Nolan, M.S., A.M., Editor-in-Chief, Fellow A. I. A., Professor of Architectural Construction, University of Pennsylvania. Seventeenth Edition, Enlarged. Total Issue, 85,000. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Limited. Flexible; 5 x 9 in.; pp. 1,907. $7; 42s. net.

One of the oldest and best of the handbooks, Kidder's, was extensively revised a few years ago under the editorship of Thomas Nolan and with a staff of specialists as associate editors. (See this section in *Engineering News*, May 18, 1916, p. 941, for details.) In the present edition 29 chapters of the sixteenth edition "have been revised where necessary to make the data agree with the latest research and practice," and two new chapters have been added. Of the new chapters, one on Specifications for the Steelwork of Buildings is by Robins Fleming and one on Domical and Vaulted Structures is by Edward P. Ries. The chapters in the sixteenth edition dealing with fireproofing of buildings and reinforced-concrete construction have been rewritten by Rudolph P. Miller. Other portions that have been rewritten are the sections on heating and ventilation and on chimney construction, by Louis A. Harding. Less extensive new material deals with building laws governing masonry loads and presents data on girderless reinforced concrete floors and on tanks, and the registration of architects. Standard documents of the American Institute of Architects and architectural education are also considered. Cuts have been added and some of the old ones made anew. The new edition with its many revisions and additions is a credit to all concerned.

Masonry and Concrete Construction

ENGINEERING CONSTRUCTION IN MASONRY AND CONCRETE: Part II—William Henry Warren, LL.D., Whitworth Scholar; M. Am. Soc. C. E., Challis Professor of Engineering and Dean of the Faculty of Engineering, University of Sidney, New York and London: Longmans, Green and Co. Cloth; 6 x 9 in.; pp. 498; illustrated. $12.

This is one of the few British civil engineer's books which show any recognition whatever of American engineering practice; obviously the author has read some American books and periodicals on engineering design and construction. Previous investigation of British text books would lead one to believe that he is a unique example among his fellows. The explanation probably lies in the fact that he is a professor of engineering in the University of Sydney, Australia. It is a difficult matter to write anything very new on the subject which Professor Warren has undertaken. The best that can be said of the new books on this subject is that they adequately take care of the details which are available, but which may be in other books treated in a less well balanced manner. There is some additional interest in the book before us in that the practice in foundations in some Australian bridges is rather carefully gone into.

British Studies of Concrete Aggregates

GEOLOGICAL AND PHYSICAL CHARACTERS OF CONCRETE AGGREGATES: With Special reference to British Resources as illustrated by the Aggregates, Used in a Series of Five Tests Conducted by the British Fire Prevention Committee (1917 to 1919)—A Memoir by Arthur Holmes, D.Sc., F.G.S., Technical Assistant to the Committee; with an Introduction by Prof. W. W. Watts, F.R.S. Red Book 256, British Fire Prevention Committee. London: His Majesties' Stationery Office. Paper; 6 x 9 in.; pp. 171; illustrated. 10s. net.

While this "Red Book" of the British Fire Prevention Committee is a distinctly British production in that it relates to the economic geology of aggregates in Great Britain, it should have some value to American investigators of similar lines. It is concerned primarily with the fire resistance properties of concrete, but it contains also a survey of all the British concrete aggregates. It is stated that the "general outcome of the investigation seems to show that, valuable as they are under normal conditions, concretes with siliceous ingredients in the coarse aggregate are generally untrustworthy both in themselves and in relation to other materials used in association with them when submitted to high temperatures. At the same time it appears that rocks with a coarse texture, whether crystalline or clastic, are inferior to fine-grained rocks. Rocks devoid of flint and quartz and particularly fine grained varieties seem to stand up much better, while limestone has proved to possess many qualities of high value for fire resistance slabs. Of the artificial materials those which have already been submitted to high temperatures before use, like brick and slags, have often good fire resistance qualities. It is perhaps unlikely that some of these materials will find favor when so used if they are subject to a moist climate and the influence of the weather."

Building and General Sanitation

DRAINAGE AND SANITATION: A Practical Exposition of the Conditions Vital to Healthy Buildings, their Surroundings and Construction, their Ventilation, Heating, Lighting, Water and Waste Services; for the use of Architects, Surveyors, Engineers, Health Officers, Sanitary Inspectors, and for Candidates preparing for the Examination of the various Professional Institutions—By E. H. Blake, Member of the Royal Sanitary Institute, Vice-President of the Institution of Sanitary Engineers. Second Edition. London: B. T. Batsford, Ltd.; New York: D. Van Nostrand Co. Cloth; 6 x 9 in.; pp. 519; 379 Illustrations specially drawn by the Author. $4.50.

From the viewpoint of British theory and practice this is a comprehensive and satisfactory treatise on the subjects indicated by the title and subtitle. The scope of the volume extends beyond the building, so as to include water supply, sewerage and the final disposal of sewage and refuse. There is a chapter on sanitary surveys and reports and another one consisting of legal notes. Judging from the chapters on sewage and refuse disposal the revision of the first or 1913 edition has not been thorough, as there is nothing on the activated-sludge process or on garbage utilization by feeding to hogs and other changes from refuse disposal by incineration.

New German Journal on Railway Shops

Beginning in January a new monthly journal called *Das Eisenbahnwerk* (*The Railway Shop*) is being issued in Germany. The editor is Dr. Hans A. Martens. The publisher is H. Apitz, Berlin W 57, Mansteinstre 12.

Standard German Work on Steel Making

Reviewed by RICHARD MOLDENKE
Consulting Metallurgist, Watchung, N. J.

LEHRBUCH DES EISENHUTTENKUNDE: Verfasst Für Den Unterricht, Den Betrieb und Das Entwerfen von Eisenhuttenlagen. Von Bernard Osann, Professor An Der Bergakademie In Clausthal Geheimer Bergrat. Zweiter Band: Erzeugung Und Eigenschaften Des Schmiedbaren Eisens. Mit 651 Abbildungen Im Text Und 10 Tafeln. Leipzig: Wilhelm Engelmann. Cloth; 6 x 9 in.; pp. 794. Paper, 145 marks; cloth, 175 marks

Five years have passed since the publication of Prof. Osann's first volume on the Metallurgy of Iron and Steel. The blast furnace was the subject matter of that book. [Reviewed by Mr. Moldenke in *Engineering News*, Dec. 16, 1915, p. 1175.—EDITOR.] Now we have the iron and steel-making processes based upon the blast furnace product. Together with the well known book of the same author on the iron and steel foundry, now in its fourth edition, there is available an up-to-date, comprehensive treatment of the metallurgy of iron which should be in possession of every engineer and metallurgist able to follow the German text. The books are naturally written with the requirements of German economic conditions in view, and hence much attention is given to the basic converter process, not used at all in the United States, but peculiarly adapted to the high phosphorous ore conditions of Germany, with the commercial value of the slags made into fertilizers. Similarly, the mechanical puddling processes for wrought iron are not taken up, this portion of the iron industry being practically obsolete in Germany. None the less, after going into a discussion of fuels and refractories, the making of wrought iron is briefly described for its historical interest.

Every detail of converter construction and operation is gone into thoroughly and well illustrated. Many examples of heat calculations are worked out, so that the student as well as plant metallurgist can follow out the economy of operation intelligently. Attention is also given to small converters. The converter processes for steel-making take up about 200 pp. of the book.

The open hearth processes come next. After the general history of this development, producer and other gases are discussed in some 60 pp. American engineers will be interested in the descriptions of gas made from peat and lignite, as also in the discussion of the rôle of hydrogen in producer gas. The utilization of the by-products from bituminous coal is so thorough in Germany that producer gas is usually made with coke as the basis. Hence the special attention given this phase of gas-making. Water-gas, Mond-gas and other fuel gases are also described.

The open hearth processes and their duplexing variations occupy about 100 pp. One readily sees how it has been possible, by means of the refinements in the processes developed, for Germany to have produced so much high class steel from what we would call inferior raw materials.

A chapter on crucible steel follows, the melting process itself and that of alloy steels being described briefly. More attention is devoted to electric steel-making, but even here the subject matter could have been further extended in view of its increasing importance. Doubtless the author will do this in a subsequent edition, when information of what has transpired outside Germany during the war will be better available to him. Copious titles of published articles are, however, given, so that those interested may delve into details the author may not yet consider ready for full acceptance.

A very complete chapter—so far as the requirements of the book are concerned—on cementation and case-hardening, the malleable castings' annealing process, heat treatment of armor plate, tools, and a variety of special steel products, follows. Then comes 60 pp. on furnace construction for these purposes, such as soaking pits, annealing and heating furnaces. A final section deals with the metallographic side of steel and the methods of testing used to ascertain its value.

Prof. Osann's work on the metallurgy of iron and steel is unquestionably the standard text and reference book on the subject in Germany today, and as such is well worth study on this side of the ocean.

South African Irrigation Magazine

A commendable new venture in the field of government periodicals is the *South African Irrigation Department Magazine* (A. D. Lewis, Director of Irrigation, Union Building, Pretoria). The first issue contains departmental staff contributions on a variety of irrigation and related subjects. There is an article of some length on the Hertebeestpoort dam, a structure of the constant-angle arch type which will have a total height of 198 ft. above the lowest foundations, a thickness of 72 ft. at the bottom and 15 ft. at the top, a crest length of 450 ft. and a crest radius of 225 ft. for the downstream face. Construction is now well under way. There are also notes on a number of other dams and some interesting meteorological and stream flow statistics.

Fire Tests of Protected Columns

An abstract has been made of the Underwriters Laboratories' exhaustive report on fire tests of columns, the abstract covering only the behavior of gypsum, clay tile, and related coverings. In this abstract the favorable showing made by gypsum is brought to the front. It was prepared by George H. Graves, consulting engineer, for the Gypsum Industries Association (111 W. Washington St., Chicago). Unfortunately, the title page does not make it clear that the digest covers only part of the total investigation made at the Underwriters Laboratories. However, in the text itself this is sufficiently clear.

McGraw-Hill Company Papers

Beginning Jan. 15, the McGraw-Hill Company, Inc., began the publication of two new papers, *Bus Transportation* in New York and *Electrical Review and Industrial Engineer* in Chicago.

Bus Transportation is an outgrowth of the demand in the urban and suburban transportation field for data upon the operation of motor buses. It is thus an outgrowth of the *Electric Railway Journal*, one of the oldest properties of the McGraw-Hill Co. The new magazine will be published monthly under the editorship of Harold V. Bozell, who is co-editor of the *Electric Railway Journal*.

Electrical Review and Industrial Engineer is the converted form of the *Electrical Review*, long published at Chicago and recently purchased by the McGraw-Hill Co. It has been changed from a weekly to a monthly publication and will be devoted to the interests of those who operate and maintain electrical and mechanical equipment in mills and factories. D. H. Braymer, who is co-editor of *Electrical World*, is editorial director of the new papers.

PUBLICATIONS RECEIVED

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known by the editor the price is stated in each entry. Where no price is given it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be obtained without cost, at least by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or, in case of books or papers privately printed, then to the author or other persons indicated.]

AMERICAN RAILWAY ASSOCIATION: Historical Statement and Present Activities—New York: The Association. Paper; 6 x 9 in.; pp. 134; organization diagram.
The historical statement (10 pp.) covers the period 1872 to 1921. The matter on present activities summarizes the organization of the several divisions and their action as to rules and standards.

AMERICAN SOCIETY FOR TESTING MATERIALS: Proceedings for 1921—Cloth; pp. 1197; illustrated. $11.

ANNALI DEL CONSIGLIO SUPERIORE DELLE ACQUE, 1921—Fascicolo 2—Rome, Italy: Ministero dei Lavori Publici. Paper; 7 x 10 in.; pp. 154; illustrated; 10 lire.
Among other valuable mat rial, contains a 32 pp. paper by Claudio Segre on delta foundation and sedimentation in artificial reservoirs, data on heavy rains in 1920; review of water legislation in Italy and elsewhere.

SURFACE WATER SUPPLY OF CANADA: Atlantic Drainage South of St. Lawrence River—For Climatic Years 1918-19 and 1919-20.—By K. H. Smith, M. E. I. C., District Chief Engineer, Ottawa, Ont.; Dominion Water Power Branch. Paper; 6½ x 9¾ in., pp. 141; map.

BUREAU OF MINES: Report for 1921—Washington, D. C.: The Bureau. Paper; 6 x 9 in.; pp. 133.

CANADIAN RECLAMATION SERVICE: Annual Report for 1920-21. Paper; 6 x 9 in.; folding map. Ottawa, Ont.

THE CITY PLAN OF HAMILTON, OHIO—By Harland Bartholomew, City Plan Engineer, St. Louis. Published by the Hamilton Chamber of Commerce. Paper; 8 x 11 in., pp. 66; illustrated.

CURRENCY INFLATION AND PUBLIC DEBTS: An Historical Sketch—By Edwin R. A. Seligman, Ph.D., LL.D., McVicar Professor of Political Economy, Columbia University. Prefatory note by Alvin W. Krech, President of the Equitable Trust Co. New York: Equitable Trust Co. Cloth; 6 x 9 in.; pp. 86.
Text, tabular data and bibliography by countries.

DESCRIPTIVE GEOMETRY—By George Young, Jr., Professor of Architecture, Cornell University, and Hubert Eugene Baxter, Assistant Professor of Architecture, Cornell University. New York: Macmillan Co. Cloth; 5 x 7½ in.; pp. 310; illustrated.

THE DESIGN OF STEEL MILL BUILDINGS: The Calculation of Stresses in Framed Structures—By Milo S. Ketchum, Consulting Engineer; M. Am. Soc. C. E. Fourth Edition, Rewritten. New York and London: McGraw-Hill Book Co., Inc. Flexible; 6 x 9 in.; pp. 632; illustrated. $6 net postpaid.

ESSENTIALS OF INDUSTRIAL COSTING—By George Armstrong, C. E., M. E. New York and London: D. Appleton & Co. Cloth; 6 x 9 in.; pp. 297; illustrated. $5.00.
Deals clearly and concisely with principles and methods, chiefly by the case system. Has chapters on economics development and necessity, purpose and function, and mechanism of costing; elements and sources of costing data; material; labor; expense and its distribution; depreciation, interest and power; final costing; and connection of costing with the general books and monthly statements therefrom. The "illustrations" are in the nature of blank forms.

FIRE PREVENTION AND FIRE PROTECTION: As Applied to Building Construction—Second Edition, Revised. By John Kendall Freitag, B. S., C. E. New York: John Wiley & Sons. London: Chapman & Hall. Flexible; 4½ x 7. Pp. 1038; illustrated. $5.00.

FUNDAMENTALS OF ECONOMIC PLUMBING—By William Paul Gerhard, Consulting Sanitary Engineer, New York. From The American Architect—The Architectural Review, Dec. 21, 1921. Paper; 9 x 12 in.; pp. 4.

HYDRO-ELECTRIC DEPARTMENT OF TASMANIA. Report for 1920-21. Hobart, Tasmania. Paper; 8 x 13 in.; pp. 47; illustrated.

INDUSTRIAL OPPORTUNITIES IN NEW JERSEY—Trenton, N. J.: Department of Conservation and Development. Paper; 7¾ x 10 in.; pp. 32; illustrated.

AN INVESTIGATION OF THE FATIGUE OF METALS—By H. F. Moore and J. B. Kommers, Urbana, Ill.: Engineering Experiment Station, University of Illinois. London: Chapman & Hall. Paper; 6 x 9 in. 95c
An abstract of this bulletin appeared in *Engineering News-Record*, Jan. 12, 1922, p. 76.

IOWA ENGINEERING SOCIETY: Proceedings, Des Moines, Iowa: Lloyd A. Canfield, Secretary-Treasurer. Paper; 6 x 9 in.; pp. 207.

MAINE ASSOCIATION OF ENGINEERS: Proceedings, 1917-20—Bangor, Me.: The Association. Paper; 6 x 9 in.; pp. 128.

NATIONAL BRICK MANUFACTURERS ASSOCIATION—Proceedings, 1921. Indianapolis: T. A. Randall, Secretary, 211 Hudson St. Paper; 6 x 9 in.; pp. 216.

NEW JERSEY BOARD OF PUBLIC UTILITY COMMISSIONERS: Reports, March 16, 1920, to Dec. 21, 1920—Trenton, N. J. Cloth; 6 x 9 in.; pp. 630.

PLUMBING FIXTURE TRAPS: An Historical, Statistical and Experimental Engineering Research on Vented and Unvented Traps—By A. E. Hanson, Hydraulic and Sanitary Engineer. New York City: The Author, 2 Rector St. Cloth; 7 x 9 in.; illustrated. $2

THE PORT OF PORTLAND, MAINE—Port Series, No. 1. Prepared by The Statistical Division Board of Engineers for Rivers and Harbors, A. H. Ritter, Chief Statistician, Washington, D. C.: War Department, Corps of Engineers, U. S. Army. Paper; 6 x 9 in.; pp. 64; folding maps and tables.

The reports in the series here begun will describe port and harbor facilities for shipping, port charges, railroads, the local conditions of transfer between rail and water and also that of transportation between port and interior, other conditions governing the movement of traffic through the port and such additional information as may be of value to operators of vessels and to producers and manufacturers seeking the most economical outlet for their product. They will also show the facilities available for the handling and distribution of imports. Manifestly this is a most desirable line of work and it is to be hoped that the board will be able to continue its investigation in as worthy a way as it has already done in the case of Portland.

PRACTICAL ELECTRICITY FOR BEGINNERS—By George Willoughby, Shop Supervisor, Arthur Hill Trade School, Saginaw, Mich. Peoria, Ill.: Manual Arts Press. Cloth; 5¼ x 8 in.; pp. 101; illustrated. $1.

PRACTICAL LEAST SQUARES—By Ora Miner Leland, B. S., C. E. New York and London: McGraw Hill Book Co. Cloth; 6 x 9 in.; illustrated.

PRACTICAL STRUCTURAL DESIGN—Second Edition, Enlarged and Revised. By Ernest McCullough, C. E., Ph.D., New York: U. P. C. Book Co. Cloth; 6 x 9 in.; pp. 317; illustrated. $3.
The first edition of this elementary "practical" text and reference book was favorably reviewed by Walter S. Edge in *Engineering News-Record*, Jan. 17, 1918, p. 128. Besides correcting errors, this edition contains a new chapter on Semi-Rigid Frames.

PRINCIPLES OF RAILROAD TRANSPORTATION—By Emory R. Johnson, Ph.D., Sc. D. Dean of the Wharton School of Finance and Commerce and Professor of Transportation and Commerce in the University of Pennsylvania, Author of "Ocean and Inland Water Transportation," "Elements of Transportation," etc., and Thurman W. Van Metre, A. M., Ph. D., Associate Professor of Transportation in the School of Business of Columbia University, Author of "Economic History of the United States." New York and London: D. Appleton & Co. 6 x 9 in.; pp. 617; illustrated with half-tones, maps and diagrams.
The 1916 edition of this book was favorably noted in some detail in *Engineering News-Record*, Oct. 19, 1916, p. 748, and characterized as "devoted chiefly to the social, political and economic relations of the railway rather than to the physical features of its construction and operation." The book itself contains no intimation of the extent of the revision of 1921. The paper jacket speaks of an entire rewriting with the assistance of Prof. Van Metre, and of a new title, but this was true of the 1916 as compared with earlier editions. However, some fresher figures are apparent and there is a chapter on the 1920 Transportation Act.

PRODUCTION OF COAL AND COKE IN CANADA, 1920—Compiled by John Casey. Ottawa, Ont.: Department of Mines. Paper; 6¾ x 9¾ in.; pp. 36.

REPORT OF THE CHIEF ENGINEERS, U. S. ARMY, 1920-21—Washington, D. C. Paper; 6 x 9 in.; pp. 2115.

SEWERAGE AND SEWAGE DISPOSAL: A Textbook—By Leonard Metcalf and Harrison P. Eddy. New York and London: McGraw-Hill Book Co. Cloth; 6 x 9 in.; pp. 598; illustrated. $5.

SOME FACTORS IN THERMAL SANITATION IN THE TROPICS— By George Walter Grabham, M. A., F. G. S. From The Journal of Hygiene, Jan. 12, 1921. Cambridge, England: University Press. Chicago, Ill.: University of Chicago. Paper; 10 x 7 in.; pp. 30; illustrated. Single copies: 12½s. net; $2.50.
Deals with the heat absorbing properties of various materials and fabrics, and summarizes experiments on the translucency and porosity of materials used for clothing.

SOUTH AFRICAN RAILWAYS AND HARBORS: Report for 1920-21. Pretoria: Ministry of Railways and Harbors. Paper; 8¼ x 13 in.; pp. 147; illustrated
Besides traffic and financial statistics this report discusses various phases of railway development: electrification, road motor service, grade and curve revision, preservative treatment of native woods, etc.; also harbor improvements. Several pages contain extracts from the reports of the chief civil and mechanical engineers.

STANDARD GENERAL SPECIFICATION FOR WIRE ROPE: Canadian Engineering Standards Association, Ottawa, Ont. Paper; 6 x 9 in.; pp. 16. 25c.

TASCHENBUCH FÜR DAS EISENBAHN-TICHERUNGSWESEN—Von Behrens, Regierungs-und Baurat, Mitglied des Eisenbahn-Zentralamts, und Schubert, Eisenbahninspector, technischer Betriebs Kontrolleur beim Eisenbahn-Zentralamt. Berlin: H. Apitz. Boards; 4¾ x 7 in.; pp. 362; 50 marks.

TESTS OF ROAD MATERIALS OF INDIANA—Bulletin 7, Engineering Experiment Station. Prepared by the Staff of Laboratory for Testing Materials, Purdue University, Lafayette, Ind. Paper; 6 x 9 in.; pp. 54.

INTERSTATE COMMERCE COMMISSION: Report for 1920-21. Washington, D. C. Cloth; 6 x 9 in.; pp. 226.

UNITED STATES COAST AND GEODETIC SURVEY: Report for 1920-21. Washington, D. C. Cloth; 6 x 9 in.; pp. 141; illustrated.

UNITED STATES GEOLOGICAL SURVEY: Report for 1920-21. Washington, D. C. Paper; 6 x 9 in.; pp. 108.

VERMONT SOCIETY OF ENGINEERS: Proceedings, Sept. 27, 1921—Montpelier, Vt. Paper; 6 x 9 in.; pp. 16.

WATER POWER OF THE WORLD: Part II, World Atlas of Commercial Geology—Text by Herman Stabler, B. E. Jones, O. C. Merrill and N. C. Grover. Washington, D. C.: U. S. Geological Survey. Stiff Paper, Linen Back; 14 x 10½ in.; 36 pp. text, 10 full-page maps. $1.
Text and tables describe and summarize the world's water power by grand totals, by continents and by countries. One map shows altitudes and one mean annual precipitation for the two hemispheres. The other maps show by symbols the relative water power, (1) developed and (2) both developed and undeveloped for the two hemispheres, by continents and countries.

WHARF MANAGEMENT—Stevedoring and Storage—By Roy Stone MacElwee, Director of the Bureau of Foreign and Domestic Commerce, U. S. Department of Commerce and Thomas R. Taylor, Chief of the Latin-American Division, Bureau of Foreign and Domestic Commerce. [Shipping Series]. New York and London: D. Appleton & Co. Cloth; 6 x 9 in.; pp 350; 94 line cut and half tone illustrations. $5

WORLD ALMANAC AND ENCYCLOPEDIA—1922. New York: Press Publishing Co. Paper; 5 x 7 in.; pp. 858. 35c.

HINTS FOR THE CONTRACTOR

Timber Lining in Canal Placed Rapidly With Aid of Jack Frames

IN RENEWING the timber lining of a 26 x 8-ft. canal on the White River development of the Puget Sound Power & Light Co., it was desirable to have the canal out of service as short a time as possible. The work was therefore planned to be carried out by four crews, one working each way from the center and one starting at either end. By creating a rivalry between the crews and developing interest in their relative daily progress, the work was completed in record time. Jack frames on wheels with which the walls could be held in position for the caps were important factors in the rapid progress.

As originally built, the lining was supported on pile bents driven 8 ft. apart with each floor sill gained into piles on opposite sides and resting at the mid point on top of a pile driven on the center line of the canal. The floor and side lining consisted of 3-in. fir planks spiked to sills and wall piling and with 1 x 4-in. battens over cracks.

On account of the alternate wetting and drying of the sides as the flow of water in the canal varied, the walls became badly rotted. In this condition there was danger during wet weather of water pressure building up on the outside and caving in the rotted walls. The sills, flooring and piling up to a point about 2 ft. above the floor, which is always wet, did not require renewal, being practically as sound as ever.

The new lining placed on the sides is 3-in. tongue-and-groove cedar placed upright inside the old walls. It is held at the top by a 6 x 8-in. cedar waling strip and at the bottom by a 3 x 10-in. cleat spiked to the floor sills with 12-in. boat spikes. The side lining was nailed at the top to the waling strips and after these were jacked out tight against the lining they were held in that position by 6 x 8-in. fir caps placed across the canal at 8-ft. intervals. The caps were gained to take the strips and were bolted to them.

For distributing material along the canal a small caterpillar tractor was used, hauling a train of three 28-ft. trucks along the canal bottom. The tractor could couple on either end of the train, thus eliminating the necessity for turning the train around. All materials were distributed before the work commenced.

For forcing the new lining out tight against the old, 15-ton ratchet jacks were used, mounted on frames carried on four wheels, as shown in the accompanying picture. These frames were easily moved and two men could move the 8 ft. from one cap to the next, jack the walls out, mark the cap, cut and creosote the gain, set the cap in place and be ready to move again, all in a period of five minutes.

Each crew consisted of about 19 men, all of whom were employed just for this job. The crew which excelled in placing caps put 108 of them in place in a day. Another crew lined 3,304 ft. of canal in one day.

The relining of 9,900 ft. of canal was completed in 5½ days at a total cost of about $36,000. The work was under the direction of A. P. Newberry and Fred Haase of the Puget Sound Power & Light Co.



RELINED CANAL WITH JACK FRAME IN FOREGROUND; CLOSE VIEW OF JACKING DEVICE
(Note spring for drawing back timbers when jack is released)

Bearings Have Critical Friction Load

AN INVESTIGATION of ball and roller bearings of rather large size recently made at the Bureau of Standards for the Navy Department shows that these bearings have critical loads beyond which their friction coefficients increase rather rapidly. For balls of 1, 1¼ and 1½ in. diameter, running in grooved races, the friction coefficient was about 0.00055 up to a critical load ranging from 1,300 lb. per ball for 1-in. to 2,200 lb. for 1½-in. balls. Helical ("flexible") rollers 1¼ in. in diameter by 5¼ in. long showed a similar critical load of 25,000 lb. total; below this load their friction coefficient was 0.00075. In every case the critical load determined on the basis of friction coefficient was considerably lower than the safe load as determined by permanent deformation. The deformability of balls, rollers and races was measured, and proved to be closely in accord with Hertz's theory. The investigation is summarized in the Bureau's Technologic Paper No. 201.

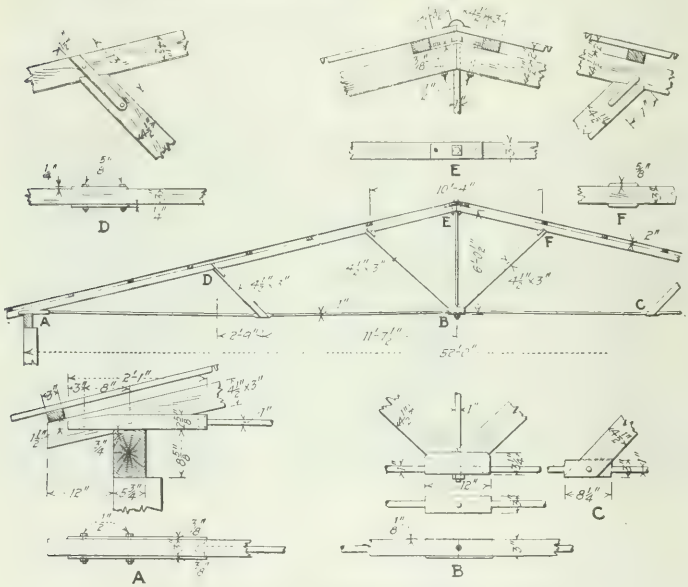
LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Amateur's Roof Truss Defies Fate

Sir—An unusual type of roof truss is shown in the accompanying drawing. The roof covering is of galvanized corrugated-iron sheets, and the trusses are more or less 8½ ft. on centers. The purlins, 2 in. deep, are unsupported between trusses.

"This building was not designed according to theory,"



THIS ROOF TRUSS HAS STOOD FOR EIGHT YEARS

the constructor informed the writer. I agreed with him. However, the building has stood now for more than eight years, and is but another of those examples which are so interesting as showing peculiar construction which serves its purpose.

NEWMAN TATE,
Chief Constructional Designer, Rio Tinto Mines.
Minas de Rio Tinto, Huelva, Spain, Dec. 1.

The Owner a Contributor to Building Corruption

Sir—In your issue of Jan. 5, 1922, p. 4, under the caption "Scandals in the Building Industry," you deplore the fact that contractors generally have not taken action to correct conditions. The Building Construction Employers Association of Chicago early last year through its legal action committee did employ a staff of investigators to run down and expose cases of graft and extortion and it was only because of the fact that the Dailey Commission started to function and it was thought that this committee with the power and authority of the State of Illinois behind it could do the work more effectively, that the employers association abandoned its program.

It is believed most of the scandals will be traced not to contractors, who generally have been given all of the discredit, but to owners who, working through their architects, have used the contractor as a means of corruption. The owner who considers his construction a special case which must be finished regardless of the effect on the industry, is undoubtedly the main cause for the deplorable conditions that have existed.

EDWARD HAUPT,
Chicago, Jan. 9. President, Building Construction Employers Association.

Concerning the Value of Reclaimed Cement

Sir—I note a very ingenious cement sack shaker described in *Engineering News-Record*, Dec. 29, p. 1075. Prominence is given to the fact that the cement saved is twice the value of the labor of shaking. A similar comparison has been noticed in the accounts of other cement sack shakers.

I am very curious to know if this salvaged cement is really fit to use. A few months ago I shook out a batch of bags by the old-fashioned method of beating them in the top of an empty barrel, and collected two large barrels of cement. I did not use this cement in the main body of the structure, as I doubted its value somewhat, but made up a batch of precast hand rail spindles with it, using a 1:2:3 mix, with a little extra cement to make up for what I imagined the loss in strength would be.

I was very much surprised to find out two days later that the concrete had set very little, and after four days, when the spindles should have been quite strong and ready for rubbing, I found that I could remove them from the forms only with very great care, and in fact most of them were broken in the removal. I discarded the whole batch before the engineer on the job saw them, but saved several spindles for several weeks. They hardened some in time, but never got hard enough really to be called concrete.

The point I am curious about is: How much value has this reclaimed cement? If it is considered good, and put back into new work, are we not taking chances? I would like to know the experience of other engineers. I have always used this reclaimed cement in small patchwork, but if my experience has been duplicated by others, it has very doubtful value even for this, and should be discarded altogether. There is a lot of this cement being used, if many men are saving as much as the man in the article quoted, and I would like to hear what the other engineers have to say on the subject.

Jacksonville, Fla., Dec. 31, 1921. C. T. DAWKINS,
General Contractor.

Recommend Nationalization of Water Resources

The British Water Power Resources Committee, which has been investigating available water power throughout Britain, has recommended that the entire water resources be nationalized and placed under the control of a water commission with certain specified powers. The Committee also finds that the total potential water power amounts to 250,000 kw. divided as follows: Scotland, 194,965 kw.; Wales, 35,900 kw.; and England, 20,440 kw. Of this amount 210,000 kw. could be developed economically. The generation of this power over one year would represent slightly under 40 per cent of the total units generated in the 410 steam power plants for electricity supplied railways and tramways.

NEWS OF THE WEEK

New York, January 19, 1922

John R. Freeman Elected Am. Soc. C. E. President

Internationally Known For Hydraulic Investigations — Has Been Vice-President and Director

Professional activities of John R. Freeman, new president of the American Society of Civil Engineers, have been international in character for many years. There are few members of the American Society of Civil Engineers, or the American Society of Mechanical Engineers (which organization he has also served in executive capacities) who are not familiar at least with Mr. Freeman's general professional career, particularly in the field of water supply and fire protection. He has been a prominent figure in the society for years, and served as

Elected President of Am. Soc. C. E.



John R. Freeman

a director in 1896-1898, and as vice president in 1902-1903. He has twice been awarded the Norman medal, once for a paper relating to the hydraulics of fire streams, and the other time for a paper on the nozzle as an accurate water meter. He has been a member of the society since 1889, though seven years prior to that date he was connected with it as a junior.

Mr. Freeman was born in West Bridgeton, Me., July 27, 1855. His early days were spent on the farm and his education was begun in the district school of that place. This education was supplemented by terms in the public schools of Portland, Me., and Lawrence, Mass. Later he entered the Massachusetts Institute of Technology, from which institution he was graduated in 1876. During his summers both in high school and college he was employed in various engineering capac-

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Am. Soc. C. E. Amendments Rejected By Meeting

Major Constitutional Changes Not Recommended, but Minor Changes Approved—Formal Presentation of Honorary Memberships

Recommendations adverse to the major constitutional amendments were voted by the annual meeting of the American Society of Civil Engineers, in New York on Jan. 18, though the minor amendments correcting certain obvious conflicts were favorably received. This action was the most important business transacted at the meeting, which was marked also by the formal presentation of certificates to the new honorary members. Canvass of ballots for 1922 officers showed that the ticket sent to letter ballot, headed by John R. Freeman, was elected almost unanimously. Announcements were made of the awards of the various medals and prizes bestowed annually by the society. A half dozen committees presented technical reports of progress.

An innovation which was well received as a substitute for the mere reading of names of new honorary members was the formal presentation of the five new honorary members just chosen. Each of these members was introduced separately by a member of the society chosen for the purpose and each of those present responded to the presentation of his membership certificate. In the case of the two foreign members elected responses were made by representatives of the French and Italian governments and for Mr. Carson the response was made by L. H. Davis. Biographical skektches of the five new honorary members are presented elsewhere in this section.

The annual report of the Board of Direction showed a total membership of the society on Jan. 1 of 10,342 and a net gain in membership for the year of 435. The financial reports of the society showed a balance on hand as of Dec. 31 of nearly $41,000.

New Work To Be Undertaken—According to action of the Board of Direction, as announced by President George S. Webster, several important new pieces of work are to be undertaken. A committee of seven is to cooperate in a study of regulations for fire protection of docks, wharves and piers. The society will be represented in a joint conference with the Red Cross Society on Flood Prevention. Victor H. Cochrane has been appointed on the bridge specification committee. President Webster will represent the society in a conference of societies on an International Engineering Congress to be held in Philadelphia in 1926.

Committee Reports

A brief summary of the committee reports presented follows. There was practically no discussion on any of the reports. In each case the report was accepted and the committee continued.

Bearing Value of Soils—R. A. Cummings, chairman, reported that the special committee appointed on To Codify Present Practice in Regard to Bearing Values of Soils for Foundations had been more active during the past year than previously, through the effect of an appropriation by the Board of Direction. Funds have been given to researches at Iowa State College, which promises to be the stepping stone to results of practical value. The strength of clays in their undisturbed natural condition has been measured, and a report of this work will be published as part of the committee's report. The recent literature of soil studies has been reviewed and the principal mathematical formulas brought together. A summary of these data together with reports on soil tests made at San Francisco and Seattle by local engineers will be appended to the published committee report.

Bridge Specifications — Reporting on the first year's work of this committee, H. B. Seaman described the distribution of the field to be covered among subcommittees of one each, dealing separately with highway loading and impact, railway loading and impact,

Highway Research Board Meets

Four New Committees Authorized to Round Out Board's Scope—More Money Needed

Approval of the appointment of four new committees, the adoption of a budget providing for expansion of its work, and a resolution to invite six new organizations to take membership were the important steps taken at the meeting of the Advisory Board on Highway Research in New York, January 16. The new committees are: On Highway Traffic Analysis, On Highway Bridges, On Highway Finance, On Maintenance. It was also proposed that the board invite the Committee on Sub-Grade, which formerly functioned under the Federal Highway Council, to identify itself with the board.

Reports on work done during the year indicated that the only vigorous activity has been that of the Committee on Economic Theory of Highway Improvements, under the chairmanship of Prof. T. R. Agg. The researches which it is following and trying to co-ordinate—though not all of them—were started as a result of the committee's activity. They are as follows: (1) economical highway grades at the Iowa Engineering Experiment Station; (2) active resistance of certain types of vehicles and [illegible] at the Iowa station, (3) active resistance of vehicles on concrete road surfaces, including a study of methods of observation and of internal

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substructure and foundations, allowable unit stresses, shop and erection methods, reinforced-concrete structures, and materials. Railway bridge specifications were taken up as the first work, and a tentative specification was presented to the meeting, as a basis for general discussion by the members of the society. There are differences of opinion within the committee on many points of the specification, Mr. Seaman stated, and certain divergences in point of view have developed, especially with regard to the attitude to be taken toward the prior work of the American Railway Engineering Association in this field.

Track Stress Committee—No report of results was presented by the committee on Stresses in Railway Track, member of a joint committee of three societies on this subject. Prof. A. N. Talbot, chairman, reported that tests have been made on curved track, but the unexpectedly large amount of labor in reduction of the results made it impossible to report upon them at present. Tests have also been made in rail joints, to determine their manner of action and the stresses in joint bars and rails. Various further questions are under consideration. The committee was continued.

Standard Contract Clauses—In behalf of H. E. Breed, a progress report was presented by J. S. Langthorn, consisting chiefly of a summary of the proceedings of the conference on standardization held at Washington last December under the auspices of Secretary Hoover.

Highway Research

Highway Engineering — Similarly, Mr. Langthorn reported for Mr. Breed that this committee is devoting itself chiefly to the functioning and co-operation of the Federal Bureau of Roads and the state highway departments. The committee recommended that federal road appropriations be made $20,000 per mile, with an additional allowance of $10,000 per mile where there are special drainage or other difficulties to be met; that for interstate and national roads permanent types of pavements be adopted; and that Congress should be asked by the society to pass H. R. 8978 providing for a road appropriation of $100,000,000 a year for five years in the interest of comprehensive planning and construction. No action was taken on these recommendations.

Among the non-technical committees, the one on the proposed Alfred Noble Memorial reported conferences with Paul Bartlett, the sculptor, and Glenn Brown, the architect, on matters of design. On account of present high costs the committee is not pressing forward with plans for construction. Samuel Rea is chairman of this committee.

Awards of Society Medals and Prizes —The award of medals as recommended by the committee on awards and approved by the Board of Direction was as follows: Norman Medal, no award. J. James R. Croes Medal, to Fred A. Noetzli, Associate Member, for his paper on "Gravity and Arch Action in Curved Dams." The Thomas Fitch Rowland Price to Ernest E. Howard, Member, for his paper "Vertical Lift Bridges." The James Laurie Prize to W. C. Curd, Member, for his paper on "Bank Protection and Restoration; a Problem in Sedimentation." The Collingwood Prize for Juniors to L. Standish Hall for his paper on "The Probable Variations in the Yearly Run-Off as Determined from a Study of California Streams." Wellington Medal, no award.

Constitutional Amendments — Two groups of constitutional amendments were submitted, one proposed by the Executive Committee and legal counsel of the Society to clarify minor inconsistencies in the constitution, which was referred to letter ballot with favorable recommendation; and a second group designed to carry out various changes in the constitution as to the election of directors and as to sections of the Society that have been advocated from time to time in the past. The second group of amendments was also referred to letter ballot but with the recommendation of the meeting against the adoption of the amendments. This group of amendments gave rise to considerable spirited discussion, it being claimed by representatives outside of District No. 1 that something was very much needed to enlist the interest of the members in the other districts. Each of these amendments was voted on separately. When the final one of the group was acted upon a call for a division was made and the count of hands showed 207 votes in favor of the recommendation against the adoption and 36 votes the other way. A request was then made for a show of hands to indicate how many of these present from District No. 1 and how many from other districts. This vote was 223 to 150 but apparently many of those present did not vote.

New Officers—The official canvas for votes for officers showed a total of 2,116 legal votes. Nearly all of these in each case were in favor of the various officers on the ticket. The following were declared elected: President, John R. Freeman. Vice-Presidents, C. E. Grunsky and Robert Ridgway. Directors from District No. 1, C. M. Holland, and J. J. Yates; No. 2, F. E. Winsor; No. 6, J. N. Chester; No. 8, A. J. Dyer; No. 13, W. L. Huber.

President's Remarks

At the conclusion of the business session Mr. Freeman was escorted to the chair. On acknowledging his elevation to office he remarked that he had been a member of the society for about 40 years and that he thought he has gotten most benefit from the society while in the junior grade through the inspiration of the older members. He also said that he wished all could have heard the remarks made the previous evening at the meeting of past presidents of the society. These showed no discord and that all were looking ahead. The three main topics discussed were how more service could be rendered to distant members; how the interest of sections could be advanced and what could best be done for junior members.

62,000,000 Sq. Yd. Concrete Highway Laid in 1921

According to estimates made by the Portland Cement Association, there were laid during 1921, 62,000,000 sq.yd. of concrete highway pavement. This is equivalent to 6,000 miles of 18-ft. road of the average depth. This figure is also almost double that laid in the previous year.

Highway Research Board Meets

(Continued from P. 125)

power losses, at Massachusetts Institute of Technology, in co-operation with the Bureau of Public Roads, the Connecticut Highway Department, The Portland Cement Association, and Yale University; (4) active resistance in economical grades at the University of Michigan; (5) effect of relative air-speed at Kansas Agricultural College; (6) the establishing of the relation between traffic and maintenance cost by the Bureau of Public Roads.

Arrangements are complete or are pending for three additional researches: (1) On relation between roughness and rapidity of road surface and rolling resistance, at Iowa Engineering Experiment Station in co-operation with the Bureau of Public Roads; (2) Elements in cost of highway transport, by the Society of Automotive Engineers; (3) Operating costs of motor transport in and near Los Angeles.

The committees on Character and Use of Road Materials, under the chairmanship of H. S. Mattimore, and on Structural Design of Roads, under the chairmanship of A. T. Goldbeck, have not, because of various hampering conditions, been able to make much progress. The work of organizing the committees, however, is in hand, and in the case of the first one practically finished.

The budget for next year calls for an expenditure of $25,000, compared with $13,000 last year. The additional money is to be spent for an assistant to the director, for clerical services, for a census of highway research, and the preparation of a bibliography. However, these additional expenditures are contingent upon securing the additional funds. A ways and means committee will be appointed to secure the additional money needed. Money in sight this year is as follows: Bureau of Public Roads, $12,000; Connecticut Highway Department, $1,000; Engineering Foundation, $1,000; National Research Council, $500.

A resolution was passed pressing the board to urge upon Congress the increase of the administrator's allowance in the Federal Aid Road Act from 2½ to 3 per cent, with the understanding that the additional one-half of one per cent should be expended upon co-operative research between the Bureau of Public Works and the State Highway Department. Under this plan an additional million dollars would be available for research, provided future annual appropriations by the Government are $100,000,000, since the Bureau of Public Roads engages in these co-operative researches on a dollar for dollar expenditure basis.

It was resolved to invite the following organizations to take membership in the board: Associated General Contractors, Rubber Association, Western Society of Engineers, Eno Foundation, Chamber of Commerce of the U. S. A. and Bureau of Standards.

Officers for the ensuing year were elected as follows: Chairman, Anson Marston, of Iowa; vice-chairman, A. D. Flinn, of New York; Executive Committee, Prof. Comfort, A. Adams, of Boston, H. M. Crane, of New York, T. H. MacDonald, of Washington. Except in the case of Prof. Adams, these are re-elections. Dr. W. K. Hatt, continues as Director of Highway Research, though no action on that matter was required.

New Honorary Members, American Society of Civil Engineers

Samuel Rea



Almost continuously for more than half a century Samuel Rea, elected an honorary member of the American Society of Civil Engineers on June 6, 1921, has served the engineering division of the Pennsylvania R.R. Co. Mr. Rea entered the engineering department of the Pennsylvania July 17, 1871, as a chainman and rodman on the Morrison Cove Branch, and with the exception of being employed by the Hollidaysburg Iron & Nail Co. three years later, with the Maryland Central Ry. Co. in 1889 and an absence of three years' duration later, he has been in the employ of the Pennsylvania since his first connection with it. Mr. Rea has served in an executive and consulting capacity for the Pennsylvania in some of its largest construction enterprises, he was given direct charge of the construction of the double-track tunnels under the North River and the construction of the terminal in the heart of New York City, completed more than a decade ago.

Mr. Rea was born in Hollidaysburg, Pa., in 1855 and he began his engineering work at the age of sixteen years. After rejoining the company in 1875 he served as assistant engineer on various Pennsylvania projects and from 1879 to 1883 served as engineer in charge of surveys in Westmoreland County and of the rebuilding of the Western Pennsylvania R.R. In the latter year he was transferred to Philadelphia as assistant to one of the vice-presidents, with the title of principal assistant engineer, which he held until 1888 when he was made assistant to the second vice-president. This office he retained until 1889, when he resigned to go to Baltimore as vice-president of the Maryland Central Ry. Co. and chief engineer of the Baltimore Belt R.R.

In 1891 he resigned because of ill health and after an absence of three years from the Pennsylvania R.R. Co. rejoined it as assistant to the president in 1892. Successively he then served as first assistant to the president, fourth vice-president, third vice-president, second vice-president in charge of the engineering and accounting departments, and first vice-president. In 1912 Mr. Rea was elected president of the Pennsylvania R.R. Co.

Mr. Rea is a member of various New York and Philadelphia clubs, besides being a member of the Institution of Civil Engineers and various patriotic organizations.

Charles Prosper Eugene Schneider

Charles Prosper Eugene Schneider, elected to honorary membership in the American Society of Civil Engineers on Oct. 10, 1921, is known throughout Europe as well as in this country for his connection with the development of various ordnance including the 75-mm rapid fire guns used in the World War. The war material delivered by his factory (the Creusot Works, France) in large quantities during the war to the French and Allied government were of the most varied types.

Mr. Schneider was born at Le Creusot, France, Oct. 29, 1868, and is a grandson of the founder of the machine shops at that place where the development of the war materials for which he has become noted took place.

Mr. Schneider visited the United States during 1919, coming as chairman of the French Economic Commission in the interest of a closer co-operation between France and the United States. In recognition of his World War work, the Mining and Metallugical Society of America presented Mr. Schneider in 1919 with its gold medal.

Mr. Schneider is past president of the Iron & Steel Institute of Great Britain and honorary president of the Comité Des Forges of France.

Howard Adams Carson



The professional career of Howard Adams Carson, elected an honorary member of the American Society of Civil Engineers on October 10, 1921, has been mainly identified with the engineering development of Boston and its vicinity. Outstanding projects with which he has been connected as chief engineer are the Metropolitan Sewerage Commission for Boston, where he designed and had complete charge of the construction of that system; and the Boston Transit Commission, where he superintended the design and construction of the original Boston subway opened to traffic in 1897. He has been consulted frequently concerning engineering projects, particularly pertaining to tunnel construction, and was one of a board of three who designed and built the double-track tunnel under the Detroit River for the New York Central Lines. He was also consulted concerning the New York and the Philadelphia subways.

Mr. Carson was born in 1842 and when in high school joined a battalion of United States engineers of the regular army and served throughout the Civil War.

He was graduated in 1869 from the Massachusetts Institute of Technology and has kept up a live association with that institution practically since. His professional career began in 1870, when he was appointed assistant engineer for a coal mining and iron manufacturing company in Western Pennsylvania. The next year he was appointed assistant engineer on the construction of the Providence water-works and in 1873 was placed in charge of the construction of the Providence sewers. In 1877-78 he spent his time in Europe studying various sewerage systems and in 1878 was appointed principal assistant engineer of the construction of the Boston main drainage. Ten years later he made the design for the North Metropolitan and Charles River Valley Sewerage System for the State Board of Health of Massachusetts.

He is a member of the Institution of Civil Engineers of Great Britain.

Ambrose Swasey



Ambrose Swasey, elected to honorary membership in the American Society of Civil Engineers on June 6, 1921, has achieved an international reputation through his research work in connection with the production of astronomical instruments of precision. Besides his various technical contributions to the engineering world, Mr. Swasey made the initial gift which established The Engineering Foundation.

Mr. Swasey was born in 1846 in Exeter, N. H., where he gained his early schooling. He learned the machinists' trade in his native town and in 1870 entered the employ of the Pratt & Whitney Co., machinery manufacturers, at Hartford, Conn. In 1880 he went to Cleveland, Ohio, and entered into partnership with W. R. Warner, under the firm name of Warner & Swasey.

Mr. Swasey is an organizing member, past president, and honorary member of the American Society of Mechanical Engineers; past president and honorary member of the Cleveland Engineering Society; past president of the Cleveland Chamber of Commerce; a member of the American Philosophical Society, the Union Club of Cleveland and the Engineers Club of New York.

In 1900 the French Republic made him a Chevalier of the Legion of Honor.

Luigi Luiggi

For more than a third of a century, Luigi Luiggi, elected an honorary member of the American Society of Civil Engineers Oct. 10, 1921, has been prominently identified with the construction of maritime works of Italy. His reputation in the field of maritime engineering has led to his being engaged by both Argentine and Uruguay in a consulting capacity.

Mr. Luiggi was born in Genoa, Italy, in 1856. In 1875 he was graduated from the University of Genoa with a degree of doctor of physics and mathematics. In 1878 he was graduated from the Royal College for Civil engineers with a degree of civil engineer. The following year he became a cadet in the Italian Royal Artillery, Coast Defenses, and in 1880 was appointed member of the Royal Corps of Civil Engineers of Italy.

After there had been successfully completed under his direction several important works at Genoa, he was given the position of engineer-in-chief, Royal Corps of Civil Engineers, and appointed private technical adviser to the Minister of Public Works at Rome. In 1894 he acted as engineer-in-chief at Leghorn, Italy, for all maritime work in the Tuscan and Roman provinces.

He is professor of hydraulic engineering in the University of Rome and a member of the International Technical Committee for the Suez Canal. He served during the world war as colonel in the artillery corps of the Italian army and was decorated by the Ministry of Munitions for distinguished service.

Joint Commission Approves St. Lawrence Scheme

Recommends Early Construction of Following General Plan of Wooten-Bowden Report

The report of the International Joint Commission recommended the navigation and power development of the St. Lawrence was transmitted without comment by President Harding to Congress on Jan. 17. In brief the specific recommendations are as follows:

"1. That the Governments of the United States and Canada enter into an arrangement by way of treaty for a scheme of improvement of the St. Lawrence River between Montreal and Lake Ontario.

"2. That the new Welland Ship Canal be embodied in said scheme and treated as a part thereof.

"3. That the proposed works between Montreal and Lake Ontario be based upon the report of the engineering board accompanying this report, but that before any final decision is reached, the report of the board, together with such comments, criticisms and alternative plans as have been filed with the commission, be referred back to the board, enlarged by other leading members of the engineering profession, to the end that the whole question be given that further and complete study that its magnitude and importance demand, and that after completion the administrative features of this improvement be carried out as set forth in recommendations 7 and 8 hereof.

"4. That there shall be an exhaustive investigation of the extent and character of the damage through flowage involved in the plan of development finally adopted.

BOUNDARY CHANGES PLANNED

"5. That, assuming the adoption of the plan of the Engineering Board, or of other plans also, involving a readjustment of the international boundary, in order to bring each of the power houses on its own side of the boundary, appropriate steps be taken to transfer to one country or the other, as the case may be, the slight acreage of submerged land involved.

"6. That Canada proceed with the works necessary for the completion of said new Welland Ship Canal in accordance with the plans already decided upon by that country.

"7. That such 'navigation works' as do not lie wholly within one country or are not capable of economic and efficient construction, maintenance and operation within one country, as complete and independent units, be maintained and operated by a board hereinafter called the 'International Board,' on which each country shall have equal representation.

"8. That such navigation works as lie wholly within one country, and are capable of economic and efficient construction, maintenance and operation as complete and independent units, be maintained and operated by the country in which they are located, with the right of inspection by the said International Board, to insure economy and efficiency.

"9. That power works be built, installed and operated by and at the expense of the country in which they are located.

"10. That, except as set forth in recommendation 11, the cost of all navigation works be apportioned between the two countries on the basis of the benefits each will receive from the new waterway. Provided that during the period ending five years after completion of the works—and to be known as the construction period—the ratio fixing the amount chargeable to each country shall be determined upon by certain known factors, such as the developed resources and foreign and coastwise trade of each country within the territory economically tributary to the proposed waterway, and that that ratio shall be adjusted every five years thereafter and based upon the freight tonnage of each country actually using the waterway during the previous five-year period.

"11. That the cost of navigation works for the combined use of navigation and power over and above the cost of works necessary for navigation alone should be apportioned equally between the two.

John R. Freeman

(*Continued from p. 125*)

ities with the Lawrence Water Power Co. After graduation he joined the staff of the company regularly and soon rose to the position of principal assistant to Hiram F. Mills, chief engineer.

Increased responsibilities were placed upon him by his employer and after a few years he undertook engineering design on his own responsibility. The fact that he had charge of daily measurements of the water power used by the Lawrence factories and of water-power measurements for the factories in Manchester, N. H., gave him the intimate knowledge of stream flow and of gaging which has proved of much value to him. After ten years' experience, he opened a consulting office in Boston.

ENTERS INSURANCE FIELD

While this step was being considered he accepted the offer of the Factory Mutual Fire Insurance Co. to be its inspector and hydraulic engineer. Thus was his entry into the insurance field in which he has remained since, although not to the exclusion of other business and engineering enterprise. In such work his experiments on the discharge of fire nozzles and the hydraulics of fire streams came to be accepted as standards in that field of engineering investigation. Mr. Freeman sought particularly to perfect standard methods and appliances for fire protection and to unite manufacturers of fire appliances on certain standards of quality while preserving to each his individuality of detail. The specifications almost universally adopted for underwriter fire pumps underwriter nozzels, fire hose and the like, were drawn up by him after much experimental work.

Such investigations and activities led to his being made president and treasurer of the Manufacturers', Rhode Island and Mechanics Mutual Fire Insurance Co. in 1896, and several years later he was put in charge of fire protection and insurance interests of propty valued at more than $300,000,000, making his office the largest of its kind.

In his consulting capacities, he served well the New York Board of Water Supply, being appointed not only its first consulting engineer, but its first employee. One of his outstanding achievements was his report upon the water-supply resources of New York City in 1899, being selected by comptroller Coler of New York as an engineer familiar with large water supplies and unbiased by local prejudice. The request to submit such a report was received by Mr. Freeman in August, 1899, and the report was handed to Mr. Coler seven months later. In its printed form it was a book containing about 600 pages largely illustrated and was generally acknowledged to be the most elaborate water-works report ever prepared by one engineer.

Hardly less interesting as a piece of engineering literature is his report submitted as chief engineer of the committee appointed in 1901 to consider the advisability of constructing a dam across the tidal estuary of the Charles River between Boston and Cambridge for forming a large water park. The report of these studies was a book also of about 600 pages, invaluable to engineers who desire to investigate the subject of such work for improving the condition of tidal inlets. A further water-works achievement was his connection with the joint investigation made for the additional water supply for the City of New York.

Mr. Freeman has also served in a consulting capacity for various cities scattered all over the United States. His foreign activities have carried him to China and elsewhere. His most recent foreign work was consultant in the modernization of the grand canal in China. For a number of years he served as consulting engineer with the Board of Water Supply of the City of New York, (having been appointed to that position in 1905) and also has been engaged as consultant on water-power investigations for the New York State Water Supply Commission, on the Isthmian Canal lock and dam and on the San Francisco water supply, etc.

Besides being a member of the American Society of Civil Engineers, and the American Society of Mechanical Engineers, he is a member of the Boston Society of Civil Engineers and numerous other engineering organizations. He maintains a consulting office in Providence, R. I., and is president of the Manufacturers' Mutual Fire Insurance Co., of that city.

Consulting Engineers Hold Annual Meeting

Following a dinner at which were present 36 out of the 111 members, the Institute of Consulting Engineers held its annual meeting in New York on Jan. 16. Edwin Ludlow, Nicholas S. Hill and W. W. Colpitts were elected to the council, which elects the officers.

It was announced that the United Engineering Societies had accepted the Institute's offer to place in the Engineering Societies' Building in New York a bas-relief of Alfred Noble. Some discussion was offered on the situation regarding income taxes on consulting engineers' fees from states and municipalities, which is confused at present and a movement started toward a concerted action by those interested. Two cases of ethics were considered. The meeting approved a new clause declaring it unethical for an engineer "to submit proposals for or enter into contract for constructing works, plans and specifications for which have been prepared by him as professional engineer." The second case involved the right of an engineer to data developed in preparing a report or design for a client. Both cases will be stated more in detail in a later issue. It was also voted to add to the code of ethics a clause stating it to be unethical for an engineer "to publicly advertise his professional business in conspicuous places or with self-laudatory display."

Civil Engineers Discuss Traffic Handling

Many Remedies Proposed for Extreme Vehicular Congestion in Metropolitan Centers

Continuous movement of vehicular traffic by "platoons" was offered by Ernest P. Goodrich, consulting engineer, New York City, at the meeting of the New York Section, American Society of Civil Engineers, Jan. 11, as a means of relieving congestion on New York City's principal thoroughfares. The plan, which Mr. Goodrich maintains would simplify the problem of handling traffic on Fifth Ave. and crosstown streets, involves the passage of vehicles in groups, with considerable intervals between each pair, thus leaving open spaces for the passage of similar "platoons" of traffic moving in a direction at right angles to the first group. Under the platoon system of traffic regulation the arrangement would be similar to that of a regiment of soldiers formed into companies with spaces between each two companies. The advantages of such a scheme, Mr. Goodrich pointed out, lie principally in the fact that it would not stop traffic at regular intervals, as is the practice now on Fifth Ave. with the block and signal system. The platoons of traffic would keep continuously in motion and their speed would be regulated by a semaphore system of some sort.

Other Traffic Suggestions

Amos Schaeffer, consulting engineer to the borough president of Manhattan, read a paper dealing with an analysis of New York traffic conditions and desirable measures of relief for the present congestion. Among other things he suggested the elimination of the grade crossing at 42nd St. and Fifth Ave. by depressing the 42nd St. street car tracks and vehicular roadway, provision being made also for underground sidewalks at this point. A plan also was advanced for the removal of certain street car tracks at the intersection of 34th St., Sixth Ave. and Broadway.

In street improvements, Mr. Schaeffer stated, the movement of motor vehicles is being facilitated by the adoption at corners of curb radii of 12 ft., instead of the 6-ft. radius formerly used. Elevated railway columns on streets offer great obstructions to traffic movement, according to Mr. Schaeffer. A roadway with a width of 60 ft. would formerly accommodate four lines of vehicular traffic outside of the car tracks if it had no elevated columns, but with such columns, Mr. Schaeffer said, space for only two lines of vehicles is available. Referring to the influence of pavement types on vehicular traffic, Mr. Schaeffer announced that sheet asphalt and granite block were the prevailing types in the Borough of Manhattan. He predicted that the use of modern smooth, granite block pavements would increase and would be acceptable to all kinds of traffic.

Robert Grier Cooke, president of the Fifth Ave. Association, presented the traffic problem from the point of view of the merchant and endorsed the block signal system now in use on Fifth Ave. He believes that some time in the future it may be necessary to limit the number of buses using the avenue.

In New York's traffic squad of the Police Department, according to Inspector John F. O'Brien, there are now 1,547 men. The Police Department has under consideration plans for synchronizing the movement of traffic throughout the entire city by means of the block system and colored lights displayed from towers. Inspector O'Brien pointed out that the left-hand turn is one of the greatest obstacles in facilitating rapid movement of traffic. He explained in detail the Police Department's experiments in traffic handling on Fifth Ave. and in the theatrical district between Times Square and Columbus Circle.

Clifford M. Holland, chief engineer, New York-New Jersey Vehicular Tunnel Commissions, defended the use of a 20-ft. roadway in the tubes, explaining that a provision for greater widths would have increased the cost of the vehicular tunnel beyond all reasonable proportions.

The meeting closed with a discussion of street-car traffic in Newark, N. J., by A. T. Warner of the Public Service Railway Co., Newark, N. J.

Prof. Jacoby to Retire in June

Prof. Henry S. Jacoby, who for thirty-one years has been a member of the faculty of the College of Civil Engineering, more recently the College of Engineering, at Cornell University, will retire at the close of the college year from active duty, having reached the age specified for retirement. Prof. Jacoby for the past twenty-one years has been full professor and head of the Department of Bridge Engineering in the university. He has been unusually active in text-book writing, particularly in collaboration with Prof. Merriman of Lehigh University in their well-known text on bridges, and with Prof. Davis on foundations. It is announced that he will spend a year in travel and then will make his home at Bethlehem, Pa., which is in the vicinity of his early home and of his Alma Mater, Lehigh University.

Couzens Opposes Rapid Transit for Detroit

In a statement issued recently Mayor Couzens of Detroit said that subway or elevated rapid-transit lines are not needed in Detroit. A properly developed rapid-transit system for the city, he says, would cost $100,000,000, and a good part of this sum would have to be put on the tax roll, as fares would not pay the current charges. He suggests that the demand for rapid-transit subways springs from a desire for luxury rather than from the pressure of necessity, and remarks, "Communities are like people; every once in a while they get the idea that they must have certain things to satisfy their ego. A man makes $100,000 one year and thinks he must have a yacht, three limousines, and a palace in Florida, or a workman makes more money than ever before and must have a player piano and an automomobile. Detroit is that way about a rapid-transit system."

Federal Map Board Meets

The Board of Surveys and Maps of the federal government met on Jan. 10 to discuss technical standards regarding a change in scale of topographic maps and technical standards on the subject of "Map Projections."

Engineers Club of Baltimore Opposes Licensing

The Engineers Club of Baltimore went on record at a largely attended business meeting held January 5, as strongly opposed to any form of state legislation requiring the registration or licensing of professional engineers in the state of Maryland.

A bill prepared by a committee composed of a few practicing engineers of the city, for enactment by the state legislature now in session, was not only repudiated by a vote of the club after spirited debate, but the club voted opposition to any bill requiring state registration of professional engineers. The meeting was of a very representative character including local members of the American Society of Mechanical Engineers, American Institute of Electrical Engineers, American Society of Civil Engineers, American Chemical Society, American Association of Engineers, and other engineering bodies.

The bill was strongly supported by some of the practicing engineers of Baltimore who claimed that they had been embarrassed in getting business in some of the fourteen states which have license laws for engineers, and they urged that Maryland have such a license law that they might secure reciprocal benefits. Opponents of state licensing of engineers urged that, because the public and the engineers of fourteen states were so unfortunate as to have license laws deemed detrimental to the best interest of both the engineer and the public of such states, was no reason for Maryland following in the wake; but that the Maryland engineer might better lend encouragement and assistance towards the repeal, if it were possible, of such laws in some of those fourteen states.

The supporters of the bill claimed that the enactment of the bill would elevate the standing of the engineer, would tend to get for the engineer greater compensation for his services, and would better protect the public. The opponents of the bill, while conceding it would be an excellent thing if it were practically possible for any board to sort and grade and record each engineer according to true qualifications and ability, asserted that engineering work and endeavor was as broad as the universe, not a limited field of endeavor as in law or medicine or dentistry; but more varied and diversified by far than any other profession; and thus it was not to be expected that any state appointed board could possibly handle the proper grading and restricting of the individual engineers.

Take Traffic Census to Decide on Grade Crossing Elimination

A traffic census is being taken at Ebensburg, Pa., at an existing railroad grade crossing to determine the method of elimination to be adopted. The Maple St. grade crossing is to be eliminated, and the local residents want a bridge constructed at a cost of $300,000, while the county thinks it sufficient to construct a subway for pedestrians and to divert vehicle traffic to another crossing. H. F. Dorr, county engineer, is therefore having a traffic census carried on to determine how much use is made of the crossing, on the basis of which it can be decided whether vehicle traffic should be diverted or provided for at this crossing.

Florida Road Bonds Bring Premium

With reference to the statement in this journal, Dec. 22, p. 1037, regarding the difficulty of disposing of $5,000,000 worth of road bonds in Florida, the following statement has been received from W. B. Powell, secretary of the Lake County (Fla.) Chamber of Commerce.

"This article does an injustice to Lake County and also the State of Florida. I have not the figures at hand for other counties, but bonds have been fetching premiums right along—Orange County adjoining Lake just sold part of $2,500,000 issue at par and accrued interest, and $15,000 premium on $750,000."

Included in Mr. Powell's letter was a clipping indicating that the $600,000 Lake County issue had been sold on Dec. 28, 1921, for a total of $601,500.

This journal has also received from the county engineer of Escambia County, Florida, the following information:

"The voters of Escambia County authorized the issue of $2,000,000 at 6 per cent. 30-year serial bonds on Sept. 29, 1920. Bids on $1,000,000 of these bonds were first received Nov. 15, 1921, but not being satisfied with the offers received, the county commissioners readvertised for Dec. 17, 1921. Lively bidding resulted and the $1,000,000 bonds sold for par plus a premium of $21,651."

Florida's Road Program for 1922

The Florida State Road Department's 1922 program four major projects enumerated by Judge H. B. Phillips, chairman, at a meeting Jan. 5. These projects are state road No. 2 from Lake City north to the Georgia line and south to Fort Myers; state road No. 4 from Jacksonville to Miami; the Kissimmee-Melbourne short cut between Tampa and Miami; and the Jacksonville-Lake City road. Bids were opened recently for the last four sections of the latter road, the total of the four projects, 42 miles in all, to cost $942,000, according to the lowest bid for a 6-in. concrete road, 16 ft. wide.

Louisiana Gasoline Tax Effective

The gasoline tax of 1 cent per gallon, which is expected to yield in the neighborhood of $1,000,000 yearly for road building purposes, became effective in Louisiana, Jan. 1, 1922. The tax will be collected from manufacturers and wholesalers on the basis of the previous month's sales. The exception to this general method of collection will be small filling stations along the borders of the state where gasoline is brought in wholesale quantities from Mississippi, Arkansas and Texas.

Indianapolis Sanitary Board Now Headed by Engineers

The Board of Sanitary Commissioners of Indianapolis, which has charge of building sewage-works and of the collection and disposal of garbage and refuse, has been reorganized. Jay A. Craven, an engineer member who has been secretary of the commission, is now president. John L. Elliott, recently appointed city engineer of Indianapolis and also to membership on the board, is now vice-president of the board.

"Engineering News" Is Gen. Kuhn's Xmas Gift to 3rd Engineers

The Third Engineer Regiment, U. S. Army, stationad at Schofield Barracks, Honolulu, received from Brig.-Gen. Joseph E. Kuhn, commander of the Hawaiian Division of the Army and formerly an officer of the Corps of Engineers, a Christmas gift in the form of a set of bound volumes of *Engineering News* covering the period from 1888 to 1911 inclusive. For the Third Engineers the gift was received by Col. Thomas Rees, the regimental commander.

Road Expenditures for 1922 Placed at $800,000,000

With the passage recently of the Federal Aid Highway Act it has been estimated by M. O. Eldridge, of the Good Roads Board of the American Automobile Association that during the calendar year 1922 there will be expended on public roads in the United States approximately $800,000,000. On the basis of $3 per day and 200 working days for each individual this would mean the employment of about 1,000,000 men in the building of roads and bridges and in the manufacture of road-building machinery.

It is also estimated by Mr. Eldridge that during 1922 at least $600,000,000 will be expended on city street paving, involving the employment of 750,000 laborers.

Heavy Rains Damage Structures in Southern California

As the result of unprecedented December rains highways were subjected to considerable damage in southern California. In San Diego, F. A. Rhodes, city engineer, reports the loss of the Rose Canyon bridge, a 20-ft. wood pile structure, cost to replace, $1,000; Sorrento bridge, same type and same cost; approaches to the Torrey Pines bridge, taking out about 60 ft. of concrete pavement, cost to replace, $3.000. Outside the city the county highways were bady washed in places, and on the Mussey Grade contract, held by Cook & Henno of Los Angeles, practically all the work done during the two months previous was washed out to bed-rock, this covering some 2 miles of work. A small bridge at the Mussey Grade also went out.

City May Purchase Light and Water Plants

Orlando, Fla., will vote Feb. 14 on a bond issue that includes $975,000 for the purchase and rehabilitation of the electric-lighting plant and waterworks now owned by the Orlando Light and Water Co. The price was arrived at by arbitration after both sides had secured estimates from engineers, varying as much as $500,000.

Of the bonds issued, $670,000 will be to purchase the two plants with about $150,000 each for rehabilitation, increasing production and extending the systems. The citizens will vote also on $340,000 for a sewer system.

Standard Specifications for Pressure Water Filters

The adoption of standard specification requirements for pressure water filters for various services is to come up at the annual meeting of the Associated Manufacturers of Water Purifying Equipment, which will be held at the Bellevue-Stratford Hotel, Philadelphia, Feb. 7. The association named includes in its membership nearly all the builders of water purification apparatus. M. F. Newman of Wm. B. Scaife & Sons Co., Oakmont, Pa., is president of the organization named above and heads its Committee on Standardization of Filter Sizes.

Practising Engineers Conference Arranged by A.A.E.

The American Association of Engineers will hold a conference of practising engineers at the Congress Hotel Chicago Feb. 22, Washington's Birthday. The tentative program includes the following subjects:

How to sell engineering service; experience of the practising engineer with licensing, (a) state reciprocity, and (b) licensing of engineering corporations; publicity for practising engineers; cost accounting for engineering service; bookkeeping for an engineering office; how to uphold the standards of services and fees; amendment of schedules of services and fees, (a) providing for other branches, such as mining and mechanical, and (b) to fit them to the practise appertaining to the several parts of the country; computing the practising engineer's income tax.

The conference will be in charge of the Committee on Services and Fees of Practising Engineers of the association, which consists of Langdon Pearse, chairman, Harvey N. Payne, Arthur Mullergren, Robert I. Randolph, C. T. Emrich, John W. Cunningham, George W. Fuller, Frank T. Payne, C. W. Hubbell, Brooks Baker, H. P. Letton, E. B. Latham, S. D. Foster and Frederick J. Amweg.

An invitation to attend the conference is extended to all practising engineers, whether members of the association or not.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN CONCRETE INSTITUTE, Detroit, Mich. Annual Convention, Cleveland, Ohio, Feb. 13-16.

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago; Annual Convention, Chicago, March 14-16.

ENGINEERING INSTITUTE OF CANADA, Montreal; Annual Meeting, Montreal, Jan. 24-25.

AMERICAN WOOD PRESERVERS' ASSOCIATION, Baltimore; Annual convention, Chicago, Jan. 24-26.

The Great Falls Engineering Society has recently been organized with 40 charter members at Great Falls, Mont. The officers are: E. T. Harlow, presi- and John S. Roth, secretary-treasurer.

The Society of Industrial Engineers, a member of the Federated Engineering Societies, has elected Joseph W.

Roe, head of the industrial engineering department of New York University, as president, succeeding L. W. Wallace, secretary of the American Engineering Council. W. G. Sheehan, of Detroit, has been elected secretary and F. C. Schwedtman of the National City Bank, New York, treasurer.

The North Dakota Society of Engineers will hold its 14th annual meeting at Jamestown, No. Dak., on Feb. 8 and 9. The secretary is E. F. Chandler, University of No. Dak.

The New York Post, American Society of Military Engineers, will hold its annual meeting, election of officers and dinner on Jan. 25. Final arrangements have not yet been made. For further information address Percy E. Barbour, secretary.

The Engineers Society of St. Paul elected the following officers at the annual meeting, Jan. 9: president, W. W. Walker; vice-president, D. W. Flowers; secretary-treasurer, G. H. Wilsey.

The Ohio Engineering Society will hold its annual meeting at the Engineers Club in the Southern Hotel at Columbus, Ohio, Jan. 25-26. Secretary, John Graham, Columbus.

The Michigan Engineering Society (Michigan Assembly of A. A. E.) will hold its annual meeting at Kalamazoo, Michigan Feb. 8 to 10.

The Engineering Society of Wisconsin will hold its annual meeting Feb. 24-25 at Madison, Wis. Secretary, L. E. Smith, Madison.

The Western Society of Engineers. at its meeting on Jan. 9, listened to a paper on the concrete arch viaduct at Akron, Ohio, by Louis R. Ash, consulting engineer, Kansas City, Mo. In the construction work, which was described by the contractor, J. O. Heyworth, Chicago, special difficulties were the shortage of labor, the design of an economical arch form, and the necessity of carrying out the work on a narrow right-of-way.

The Indianapolis Chapter, A.A.E. held a meeting recently at which C. E. Drayer of Chicago, secretary of the national association, spoke on the accomplishments of the organization. He said that during the past year the A.A.E. has obtained positions for 3,000 engineers and is responsible for salary increases amounting to more than $9,000,000.

Personal Notes

J. H. FRANTZ, head of the Columbus, Ohio, branch office of the American Rolling Mill Co., has been elected president of the Ohio Manufacturers Association by the board of directors.

RICHARD C. HALDEMAN has been elected president and John D. Spong secretary-treasurer of the Harrisburg Bridge Co.

W. B. WACHTLER, until recently manager of the Chicago district for the industrial bearings division, Hyatt Roller Bearing Co., has been promoted and transferred to the New York headquarters as engineer in charge of general application.

D. V. WILLIAMSON, formerly secretary-treasurer of the Williamson-Webb Co., sales engineers, Detroit, Mich., has been made sales engineer of the American Manganese Bronze Co., Holmesburg, Pa.

WILLIAM C. FRANK, assistant chief engineer of the Cambria Steel Co., Johnstown, Pa., has been made chief engineer, succeeding the Late F. H. Meyer.

ARTHUR B. ROBERTS, consulting engineer, Cleveland, Ohio, has been appointed director of public works by Mayor Kohler.

$3,500,000 *Railroad Contract Let*

The Ontario government has awarded the contract for the extension of the Timiskaming & Northern Ontario Ry. 70 miles northward from Cochrane, to Grant, Smith & Co. and Macdonell, Ltd. of Vancouver, B. C. The price has not been made public but is stated by Premier Dewey to be within the estimate of $3,500,000. Work is to begin at once to afford relief to the unemployed. The first stretch of the road from Cochrane for 43 miles to the second crossing of the Abitibi River must be completed by the fall of 1923, and the whole extension finished within two years.

DAVID M. EARLE, city engineer, of Worcester, Mass., has been reappointed by the common council.

THOMAS COYNE has been reappointed superintendent of streets, Marlboro, Mass.

ASHTON D. PEACE, chief engineer for the General Iron & Steel Co., Paxtang, Pa., has been elected president of the common council of Paxtang Borough.

LEWIS R. OWEN and J. LEE PLUMMER, Johnstown, Pa., were elected engineers for the boroughs of South Fork, Seward, Berlin and Brownstown.

O. P. THOMAS, Johnstown, Pa., has been elected borough engineer of Conemaugh, Pa.

J. I. COLONY has been elected borough engineer of Renovo, Pa.

GEORGE C. HALCOTT, who has been superintendent of public buildings in Worcester, Mass., for many years, has been re-elected by the common council.

CLAUDE B. BOYNTON, formerly construction engineer with the Anaconda Copper Mining Co., Great Falls, Mont., is now in charge of construction work for the Forest Lawn Memorial Park Association, Los Angeles, Cal.

LUTHER K. ZERBE, former superintendent of streets, Canton, Ohio, has left the city to practise civil engineering for himself.

W. E. CARVER has been appointed city engineer and JOHN A. GEILEY, construction engineer, of Canton, Ohio. Both appointments are due to the reorganization of the city engineering department.

B. H. DAVIS, city engineer, Iowa City, Ia., has been reappointed for one year.

Business Notes

CHARLES R. ROBINSON has accepted the vice-presidency of the Inland Steel Co. His headquarters will be in Chicago, but he will retain offices for the Niagara Metal Stamping Co. in Buffalo.

L. F. PIPER has been made manager of the recently-established branch of the J. W. Bishop Co., general contractors, in Bridgeport, Conn. Mr. Piper has been with the company at the main office in Worcester, Mass., for 20 years.

WALTER HASENDAHL has been made Los Angeles representative for the Orton & Steinbrenner Co., manufacturers of cranes, clamshell and orange-peel buckets and coal crushers.

THE MARSH-CAPRON CO., manufacturers of construction equipment, have re-established their own sales organization, placing ROBERT C. VELLER, former general sales manager of the Lockwood Engineering Co., in full charge of the selling force.

THE F. P. LYONS IRON WORKS, Inc., of Manchester, N. H., have established a Boston office in charge of G. S. WALLS and E. K. CARPENTER.

Obituary

LAWRENCE B. MCCABE, railroad, bridge and tunnel engineer, died recently at his home in Baltimore. Mr. McCabe was born in Havre de Grace 74 years ago. He was among the first engineering students to matriculate at Lehigh University. He was in partnership with his brother for thirty years, the firm under the name of L. B. McCabe & Bro., having built part of the first subway in New York, the Baltimore Belt Line, and the water tunnel from Loch Raven, Md., to Montebello.

THOMAS HIND, general superintendent of the East Coast Oil Co., died suddenly in Houston, Tex., where he had gone on a business trip. Mr. Hind had been an engineer for the Southern Pacific R.R. for twenty-five years and had recently completed rebuilding the lines which had been destroyed during the disturbances on the Mexican border. Mr. Hind was the author of the article on "Pneumatic Caisson Sinking in Mexico," which appeared in *Engineering News-Record*, Nov. 24, 1921.

HARRY K. SEITZER, for many years vice-president and chief engineer of the Union Bridge Co. of Kansas City, Mo., died suddenly at his home on Dec. 30, 1921. He was widely known for his work on deep bridge foundations on western rivers, particularly the O. W. R. & N. bridge, Portland, Ore., and the Harahan bridge at Memphis, Tenn.

LOUIS HAROLD, superintendent of transportation of the eastern lines, Grand Trunk Railway System, died at Montreal on Jan. 4. Mr. Howard had been with the Grand Trunk Ry. since 1881 and was regarded as one of the most efficient railway engineers in eastern Canada.

FRANK L. GIBBONS, formerly city engineer of Roanoke, Va., died recently at Charlotte, N. C.

Business Side of Construction

Facts and Events that Affect Cost and Volume

World Wholesale Prices

Latest Index Numbers — Decline From High—Peak Generally in 1920

Wholesale prices reached the peak in 1920, except in Germany (1921) and Holland (1918). How prices have moved in America, Europe and Australia since the peak is shown in the accompanying table. "An inspection of the price changes in the countries of the world since June makes it clear that the United States has been the first country in which relative stabilization of the general price level has taken place," says the Federal Reserve Agent, New York. Unsettled financial conditions have caused wide price fluctuations in European countries since June, while in the United States the range has been only four points, according to the Bureau of Labor Statistics. Construction cost has declined 20 per cent since June, according to *Engineering News-Record.*

Country	Latest Quotation	Per Cent Change During November	Per Cent Decline from High	Date of High
United States				
E. N. R. Construction Cost	169 (Jan. 1)	+ 1 5	38	June, 1920
Federal Reserve	110 (Dec. 24)	+ 1 9	55	May 17, 1920
Department of Labor	149 (Nov. Av.)	— 0 7	45	May, 1920
Dun's	136 (Dec. 1)	+ 0 5	38	May 1, 1920
Bradstreet's	123 (Dec. 1)	— 0.3	46	Feb. 1, 1920
Great Britain				
Economist	166 (Dec. 1)	— 2 8	47	Apr. 1, 1920
Statist	160 (Dec. 1)	1 2	49	May 1, 1920
U. S. Federal Reserve	130 (Dec. 24)	— 7 0	62	May 21, 1920
France	334 (Dec. 1)	+ 0 4	43	May 1, 1920
Italy	595 (Dec. 1)	— 0.7	11	Dec. 1, 1920
Japan	214 (Nov. Av.)	— 2.2	33	Mar., 1920
Canada	169 (Oct. 15)		36	May 15, 1920
Sweden†	174 (Nov. 15)	— 0.6	53	Dec. 15, 1918
Australia‡	156 (Oct. Av.)	....	34	Aug., 1920
Norway	274 (Nov. 1)		37	Oct. 1, 1920
Germany*	3,330 (Dec. 1)	+22.2	0	Dec. 1, 1921
Denmark	186 (Nov. 1)		54	Nov. 1, 1920
Holland	169 (Nov. 1)		57	Year, 1918

Index numbers are 100 in 1913, except as noted here. †July 1, 1913 to June 30, 1914 = 100. ‡July, 1914 = 100. *Middle of 1914 = 100. July, 1912, to June, 1914 = 100.

Building Mechanics Seventy-Two Per Cent Employed

According to a report made at the recent session of the Mason-Contractors' Association of the United States, 72 per cent of building trade mechanics in 51 cities from which reports were secured, are employed. The apprentice problem Secretary McGarvey of the association pointed out as being very serious, and asserted that reports from 800 contractors in various cities were to the effect that an average of but 20 apprentices were used. This is believed to be a fair average for the United States and Canada. Such a lack of apprentices, coupled with the war and natural causes of incapacitation, have resulted in a shortage of 40,000 bricklayers, according to the association estimate.

We'll make this section what you want it to be—provided you tell us frankly what you want.

Materials and Labor in Buffalo

Price Reductions Expected in Spring—Ample Stocks—Average Lumber Prices of Five Companies

ALTHOUGH it is impossible for *Engineering News-Record* to publish quotations weekly, or even monthly, for all the cities from which requests for this service have been received, still from time to time prices will be published in these pages for centers not covered in the regular price lists. Quotations in every case are gathered first hand by our correspondents staff. This week the Buffalo market is considered, the materials prices having been obtained from fifteen local sources, and the labor status from the local unions.

Sewer Pipe—While there has been no price decline in the last two months, a slight reduction is expected in the spring. Orders can be filled for immediate delivery, as an ample supply is maintained in the yards. Current prices per foot in carload lots:

3 in.	$0 0930	12 in.	0.4185
5 in.	0.1395	24 in.	1.3950
8 in.	0.2170	36 in.	4.3050

Paving Stone—Prices are unsteady and a drop is expected in the spring. Ample stocks insure immediate delivery from the quarries at Albion, N. Y., at $2.40 per sq.yd. for Medina sandstone.

Sand, Gravel and Crushed Stone—Slight reduction several months ago, but present prices are firm and no further decline expected in the spring. Orders can be filled for immediate delivery. Prices are per ton. Gravel is taken from the Niagara River and costs 75c. f.o.b. Attica, and in Buffalo 95c. and $1.10 for coarse and fine, respectively.

Crushed stone dropped 10c. per ton in 1921, but present prices of $1.50 for winter orders and $1.30 for summer are expected to hold. The winter price is higher because of the extra labor required to thaw the frozen stone and load it onto cars. Ample stocks at quarries in north Buffalo.

Cement—Carloads can be supplied in from three to eight days. The price is $2.34 without bags, f.o.b. city.

Lime—Warehouses well stocked. Hydrated finishing at $15 per ton; common lump $2.60 per bbl.

Brick—Immediate delivery of common brick from nearby plants. Reduction expected in spring from present range of $17@$18.50. Paving brick and blocks are obtainable in 10 days at $30 and $41, respectively.

Hollow Wall Tile—Adequate stocks in yards at following prices per 1,000: 4 x 12 x 12, $79; 8 x 12 x 12 (4 cell), $135, (6 cell) $153; 12 x 12 x 12 (4 cell), $211, (9 cell) $229.

Lumber—Prices are firm at present but reduction is expected in spring, particularly if freight rates are cut. Carload lots are obtainable in from three to six weeks. The following quotations are the average of figures submitted by five local companies:

Yellow Pine,	1 in. rough, 10 in. and under, 16 ft. and under	$38
Fir	1 in. rough, 10 in. and under, 16 ft. and under	45
Hemlock	1 in. rough, 10 in. and under, 16 ft. and under	36
Yellow Pine,	2 in. tongue-and-groove, dressed and matched, 10 in. and under, 16 ft. and under	36
Fir	2 in. tongue-and-groove, dressed and matched, 10 in. and under, 16 ft. and under	50
Yellow Pine,	8 x 8 in. and under, 20 ft. and under	43
Fir	8 x 8 in. and under, 20 ft. and under	46
Hemlock	8 x 8 in. and under, 20 ft. and under	45
Spruce	8 x 8 in. and under, 20 ft. and under	45
Yellow Pine,	12 x 12 in., 20 ft. and under	46
Fir	12 x 12 in., 20 ft. and under	50

Manila Rope—Price advanced 2c. per lb. in November, 1921, and is unsteady. Large stocks at 19c. per lb. for ¾-in. and larger, 19½c. for ⅝-in.

Miscellaneous—Asphalt is not bought in Buffalo. Wood blocks are not handled in the city and there is little demand.

Explosives — Price of dynamite dropped 25c. per 100 lb. in August, 1921, black powder dropped 10c. per keg. Warehouses carry from two to six carloads. Prices per 100 lb. 20 per cent low-freezing $22.75; 40 per cent gelatin, $22.75; 60 per cent, $29.25; 80 per cent, $33.50; black powder per keg, $2.60.

LABOR RATES AND AVAILABILITY

	Per Hour	Supply
Bricklayers	$1@$1.10	Fair
Carpenters	85 @ 87½c.	Fair
Hoisting Engineers	$1	Plentiful
Hodcarriers	40c.	Plentiful
Dockbuilders	81c.	Fair
Pile drivers	90c.	Fair
Foremen	$46 50 per week	
Structural Iron-workers	$1	Plentiful
Common Labor	30 @ 35c.	Plentiful

Next Week — Construction Outlook for Spring; Contracts Let Since Oct. 1, 1921, in the Important Sections of the Country.

142 *Contractors Bid on Nine New York Road Jobs*

Perhaps the keenest competition that has yet been recorded among Eastern highway contractors was in evidence on Jan. 10, when bids were submitted to the New York State Commission of Highways for the construction of 44.5 miles of highways an entailing expenditure around $1,300,000. The mileage was split up into nine contracts. The 142 contractors who presented bids seemed to prefer jobs which called for the construction of mileages around 5, for on one jo' of 5.89 miles twenty-six men bid; and on another of an even 5 mile: twenty-three bid. On a shorter job of 2.10 miles twenty-eight contractors bid. On two other jobs eight bids each were submitted, on another nine bids, on two more eleven each, and on the ninth eighteen bids were received. This makes an average of about sixteen bidders per job.

The engineer's estimate on the total 44.5 miles was in excess of $1,500,000 or an average of about $35,000 per mile. The total high bid was about $500 per mile less than the estimate and in only one case did the high bid equal the estimate of the engineer, in all other cases it being materially lower. The total low bid amounted to $1,300,336, or an average of about $29,000 per mile.

Congress Considers Menace of Tax-Exempt Bonds

The swelling flood of tax-exempt public bond issues has reached sufficiently serious proportions to cause Secretary Mellon of the Treasury to urge prompt passage of the McFadden resolution proposing a constitutional amendment prohibiting further issuance of such securities. Representative McFadden, chairman of the House Banking and Currency Committee, declared that credit is being impaired because of the enormous issues of the tax-exempt bonds. He continued:

"The issuance of tax exempt securities by the Government, the States and their political subdivisions makes possible the creation of two classes—the wealthy, free from the burdens of taxation, and the workers, who are forced to bear the burden of which the wealthy are relieved.

"If the issuance of tax exempt securities is allowed to continue, a social upheaval will occur which may be so far reaching in its effect as to undermine our constitutional Government.

"It has been estimated that approximately $15,000,000,000 of tax-exempt securities have been issued by the Government, States and political subdivisions. Of this about half represents the debt of States, cities, school districts and other political subdivisions, while the balance represents the obligations of the Government."

Masons Reduce Own Wages

A considerable decrease in the price of building materials is given as the reason for a voluntary reduction in wages of the Bricklayers' and Masons' Union of Cumberland, Maryland. The Cumberland masons have agreed to work for $1.12½ an hour, thus cutting their own wages 12½ cents an hour.

Year End Lumber Statistics

Reports for the final weeks of 1921 in the lumber industry show orders and production double those for the corresponding week in 1920 according to A. Fletcher Marsh, statistician of the American Wholesale Lumber Association. For the entire year orders exceeded production by 4 per cent and shipments exceeded production by 1 per cent. Southern pine orders and shipments exceeded production by 4 per cent but the production was 28 per cent under the normal cut. On the West Coast the cut was only two-thirds of normal for this season.

Representative Public Bond Sales in December

Sales of long-term municipal issues aggregated nearly $211,000,000 for December, as against $55,476,631 for December, 1920. This record total includes the $55,000,000 New York City issue of 50-year 4½ per cent gold corporate stock. Among the numerous municipal enterprises of the month were: Chicago, $7,725,000—5s; Buffalo, $7,630,000—4½s; and Jersey City, $3,500,000—5s. Following are some representative sales:

REPRESENTATIVE BOND SALES OF DECEMBER, 1921

State	Purpose	Amount	Maturity	Rate per Cent	Sold for	Dated
Louisiana	Penitentiary	$1,000,000	1-20 year serial	5	103.31	Jan. 1, 1922
Oregon	Road	58,000	.....	6	95.689	Nov. 28, 1921
County						
Allen, Ohio	Highway Imp'vt.	100,000	1922–26	6	100	Sept. 1, 1921
Baker, Ore.	Road	110,000	.....	5	103.35	Dec. 28, 1921
Douglas, Neb.	Road Paving	1,000,000	1937–41	5	100	Oct. 1, 1919
Douglas, Wis.	Road	20,000	.....	5	100	.....
Dugeness Irrigation District, Challam Co., Wash.	Irigation	23,000	Semi-annual	6	90	.....
East Lake Special Road and Bridge Dist., Florida.	Road and Bridge	600,000	.....	5	97.25	July 1, 1921
Fayette, Pa.	Highway	500,000	1941	4.75	106.156	Dec. 30, 1921
Freeborn, Minn.	Ditch	300,000	1928–42	4.75	101.	Jan. 2, 1922
Jasper, Ind.	Ditch Canal	12,817	.....	6	103.12	June 1, 1921
Knightsen Irrigation District, Contra Costa Co., Calif.	Irrigation	100,000	.....	6	94.10	Dec. 27, 1921
Lake, Ill.	Road	900,000	1939	5	102.04	Nov. 4, 1919
Marion, Ore.	Road	200,000	$30,000–1928 $85,000–1929–30	5.5	102.43	July 15, 1920
Merced Irrigation District, Merced Co., Calif.	Irrigation	3,120,000	1933–50	6	103.28	Jan. 1, 1922
Municipality						
Allentown, Pa.	Sewer	130,000	.....	4.5	101.47	Jan. 1, 1922
Avon Lake, Ohio	Road Improvem't.	10,000	1923–27	6	100	Oct. 1, 1921
Canton, Ohio	City Improvement.	13,850	1931	6	100	Mar. 1, 1921
Cresskill, N. J.	Street Improvem't.	22,000	$1,500–1923–26 $2,000–1927–34	6	103.34	Jan. 1, 1922
Cumberland, Md.	Gen'l. Improvem't.	250,000	Due $25,000 annually	5	107.43	July 1, 1920
Elmsford, N. Y.	Water System	150,000	$6,000 annually 1925–49	5.5	100.23	Dec. 31, 1921
Ft. Lauderdale, Fla.	Water Extension	27,000	1942	6	94.13	Nov. 1, 1921
	City Hall	15,000				
	Street Improvem't.	12,500				
	Park	5,000				
Fremont, Neb.	Water Extension	30,000	1941	5	100.00	July 1, 1921
Groton, S. Dak.	Water works	40,000	1941	6	101.08	Nov. 1, 1921
	Electric light	40,435				
Indianapolis, Ind.	Sanitary District	250,000	1926	6	104.65	Dec. 30, 1921
Lansing, Mich.	Electric Light	500,000	1930–36	4.75	101.14	Jan. 3, 1922
	Paving	200,000	1923–27	5	101.14	
	Sewer	100,000	1923–27	5	101.14	
	Bridge	100,000	1928–32	5	101.14	
Lincoln, Neb.	Water Wks. Ext.	100,000	1933 and annually thereafter	5	102.647	Jan. 1, 1922
Miami, Fla.	Dock	300,000	$5,000–1936–50 $225,000–1951	5.25	99.36	Jan. 1, 1922
	Street Railway	100,000	$10,000 ann. 1927–36			
New Brunswick, N. J.	Water	63,614	1923–51	5.5	109.682	Dec. 1, 1921
Durham, N. C.	Street Improvem't.	64,000	1923–58	6	100.00	Nov. 29, 1921
	Electric Light	35,000	1923–51			
Winnetka, Ill.	Filtration	86,000	1922–39	5	96.00	May 10, 1921

Trend of Business

Bonds—Fewer offerings have given the market an upward price tendency. Municipals less active. Victory bonds and the Fourth Liberty exceeded the previous high in the open market. Railroad bonds strengthened. Copper issues stronger owing to announcement that Anaconda expected to resume mining operations Feb. 1.

Money—Call loan rates average 3½ per cent, against 3½@5½ in the previous week, which is lowest since 1918. Money was plentiful last week, with demand light.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called in Construction News, pp. 21@29, are the following:

A Capitol building for Sacramento, $3,000,000.

A warehouse at Louisville, $1,500,000.

An excavation and dredging project at Ortonville, $1,371,000.

Large Contracts Let

Among this week's announcements of contracts awarded in Construction News, pp. 21@29, are the following large projects: A 15-story apartment hotel in Kansas City, Mo., under supervision of P. J. Branshaw, International Life Bldg., St. Louis, $1,000,000; a railway development from Cochrane to New Post, Ontario, $3,000,000.

Pacific Northwest Lumber Demand Strong

Demand for fir in the Pacific Northwest was unusual for the week ending Dec. 24, showing an increase of 10,000,000 ft., when the holiday season in other years has shown a sharp let-up of orders. Compared with 1920 the week's bookings were four times as great. A. Fletcher Marsh, statistician for the American Wholesale Lumber Association, reports orders 71 per cent of normal but only 310 out of an average of 375 mills reporting.

The increase in West Coast business was due apparently to the knowledge of a severe log shortage due to bad weather making customers come early into the market. Rail orders have increased since December 17,000,000 ft. out of a total increase of 24,000,000 ft. for both rail and cargo shipments.

New business for the combined associations was more than twice what it was a year ago. In yellow pine the 1921 volume was 150 per cent of 1920.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted. Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of January 5, the next, on February 2.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$2.63	$3.50	$4.00	$2.88	$2.91	$3.50	—$3.10	$3.85	$4.00
Structural rivets, 100 lb	3.50	5.00	5.50	3.43	3.90	4.25	4.50	4.00	6.50
Reinforcing bars, ¾ in. and larger, 100 lb	2.53	3.20	3.50	2.68	2.81	—3.37½	—2.75	3.75	2.75
Steel pipe, black, 2½ to 6 in. lap, discount	61%	57.65%	45%	57%	61.9-5%--44%	53.7%	55%	35.10	
Cast-iron pipe, 6in. and over, ton	47.30@48.30	45.00	48.30	44.10	47.80	52.00	50.00	55.00	60.00
Concreting Material:									
Cement without bags, bbl	2.30	2.55	2.55	1.97	2.24	2.90	2.84	2.94	3.10
Gravel, ¾ in., cu.yd	1.75	1.85	2.00	2.00	1.50	2.50	2.25	1.50	1.50
Sand, cu.yd	1.00	1.25	2.00	2.00	.50	1.10	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd	1.75@1.85	2.00	2.93	1.60	2.25	3.50	2.25	3.00	2.10
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	49.00	35.00	34.00	43.00+38.00		—45.00	32.00	19.00	
Lime, finishing, hydrated, ton	16.99	19.00	25.00	18.00	29.00	30.00	22.00	27.00	21.00
Lime common, lump, per bbl	3.00@3.49	1.50	2.75	1.40	1.40	2.95	—1.75	2.75	11.00
Common brick, delivered, 1,000	+18.40	9.00	12.65	11.00	15.00	14.00	15.50	14.00	16.00
Hollow building tile, 4x12x12, block	Not used	.0675	.13	.0821	.0752	.08	.12½	.10	.08
Hollow partition tile 4x12x12, block	.11120	.0675	.13	.0657		.10	.14½	.11	
Linseed oil, raw, 5 bbl. lots, gal	+.73	.78	.93	.76	+.84	+.91	.83	.79	.85
Common Labor:									
Common labor, union, hour	.75	.35		.72½	—.40	.50@.55	.62½	.50@.60	
Common labor, non-union, hour		.20	.35@.45	.35@.40	—.40	.35@.40	.56¼	.50	.20@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations are delivered except tiles, which are "on trucks." Common lump lime per 280-lb. net; both lump and hydrated quoted f.o.b. cars New York. Sand gravel and crushed stone are quoted alongside dock. Cement and steel pipe delivered to contractors on job. Gravel ready mixed $2 per cu.yd.

Chicago quotes hydrated lime in 50-lb. bags; common lump line per 180-lb. net.

Minneapolis quotes on fir instead of pine. Brick and hollow tile delivered. Cement on cars. Gravel, sand and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to contractors in yards at San Francisco.

Seattle quotes on Douglas fir instead of pine. Common lump lime per 180-lb. net.

Montreal quotes sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 94.7 cents). Bag change is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net.

Changes Since Last Week

Structural shapes and reinforcing bars at the Pittsburgh mills, continue at $1.50 per 100 lb. San. Francisco warehouses quote steel shapes at $3.10 as against $3.45. Slackening of business activities and efforts to get back to prewar prices have given rise to a reduction of 20c. on reinforcing bars in Denver warehouses and 25c. per 100 lb. in San Francisco. Denver quotes a discount of 44 per cent on black steel pipe as against 41 per cent, one week ago.

A drop of $5 per M. ft. b.m. in Douglas fir, base sizes, is quoted in Denver and 15c. per bbl. (180 lb. net) on common lump lime in San Francisco.

A fairly active demand for the principal construction materials continues, regardless of the season of the year. Activity in brick shipments has caused a return to the wholesale price of $15 per 1000 and the impending spring demand for paint materials is suggested in the price rise on linseed oil in Denver and New York.

The wholesale lumber demand in the East coast centers shows no perceptible decrease.

The West Coast Lumbermen's Association reports, for the week ending Jan. 7, 1922 as compared with the week ending Dec. 31, 1921, a falling off of 9,842,657 ft. in sales; increases of 7,083,873 ft. in shipments and 20,200,859 ft. b.m. in production.

The Builders Exchange of London, Ontario, has ordered a 15 per cent reduction in the building trades wage scale, effective Feb. 1, 1922. The new schedule awards bricklayers and plumbers 85c.; lathers and carpenters 70c.; sheet metal workers, painters, electricians and roofers 60c. and laborers 40@55c. per hr.

Local planing mills have cut wages 10 per cent and the average cost of building materials has been reduced 25 per cent.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, President

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren, Editor

Volume 88 — NEW YORK, JANUARY 26, 1922 — Number 4

A Bouquet

SOMEONE deserves a bouquet. At last week's meeting of the American Society of Civil Engineers the members were decorated with large badges carrying their names in letters so large that they could be read easily at a distance of five or six feet. This promotes acquaintance. We know many engineers by name and are glad of an opportunity to meet them, provided we do not have to kiss them before being able to decipher the name as was the case with the older badges. The new badge was a happy thought.

Am. Soc. C. E. Technical Sessions

LAST week's annual meeting of the American Society of Civil Engineers brought with it an innovation—the technical sessions. Heretofore, the program has consisted of a business session, of excursions, the president's reception and the smoker. Considering the circumstances, this first attempt had at least sufficient success to warrant trying it again next year. The attendance at the technical meetings was fairly good, and would have been better but for very apparent competition. On Thursday, excursions were offered as alternatives to the sessions. On Friday, when highway problems were under discussion, the competition was 900 miles away, in the form of the convention of the American Road Builders Association. Considering these competitive features, the attendance at the technical sessions was encouraging, and warrants further trial of the plan.

Road Building As a Great Industry

AMPLE evidence was furnished at last week's convention in Chicago of the American Road Builders Association to support the claim that highway construction has developed into one of the nation's great industries. As Webster defines it, an industry is "any department or branch of art, occupation or business, especially one which employs much labor and capital and is a distinct branch of trade." Road-building, today, clearly meets these specifications. While the professional side of the field—design, construction, and research—was by no means neglected at the meeting, the outstanding features of the technical sessions had a clearly defined financial and business slant, while the Good Roads Show, requiring the entire floor and gallery space in the Coliseum, in addition to its Annex and two other adjoining buildings rented for the occasion offered to engineer and contractor the products of 185 manufacturers representing the greatest and most diversified aggregation of road-building equipment ever before assembled at one time. It was a distinct commercial triumph. Many people still think of road building as nothing more than a pick-and-shovel job whose chief requirement is a plentiful supply of common labor. Such impressive demonstrations as last week's Good Roads Show quickly change this conception. This year's road-building program, according to figures cited by Thomas H. MacDonald, chief of the U. S. Bureau of Public Roads, will involve an expenditure of $720,000,000 outside of city limits, while last year's expenditures amounted to $600,000,000. Operations have reached such a tremendous scale that mechanical plant of great diversity and, in many instances, of enormous size and weight has been developed. The building of a modern road, therefore, is not confined to construction operations in the field. As a necessary part of these activities manufacturers have built up a great industrial organization whose service consists in supplying machinery to speed progress and reduce costs. Thus the army of labor involved in road building is now organized in two great divisions, one in the factory and the other on the work of actual construction.

Road Plant Selection

THE Good Roads Show, with its aisles flanked by ponderous paving mixers, rugged excavating equipment, highly developed material-handling plant and transportation units in the form of motor trucks, industrial locomotives, and tractors, represented an investment, in manufacturing facilities, of many millions of dollars. It served to indicate, as nothing else could have done, the broad service which the manufacturer offers to the contractor—and the financial pitfalls which contractors may encounter by failing to exercise a nice discrimination in the selection of the type and quantity of mechanical plant best suited to their particular work. The farsighted manufacturer—the man who is looking ahead to the development of the road-building industry along sound lines—will keep this point clearly in mind in his sales promotion work. Efforts merely to sell the maximum volume of construction equipment, without regard to the particular needs of the individual purchaser, will, in the end, defeat their own purpose.

The Highway's Business Side

THE business side of road construction was reflected elsewhere than in the exhibits of construction plant at Chicago. Much of the time at the technical sessions was devoted to matters of highway finance and administration. During recent years great sums have been made available for road construction, and engineers have concerned themselves mainly with the conversion of these funds into improved roads. Now, however, highway officials are exhibiting a desire for a closer scrutiny and analysis of the various sources of revenue for road-building. Throughout the country the indications are pretty clear that the general taxpayer is carrying about as heavy a load as he may reasonably be expected to shoulder. On the other hand, as was emphasized at the convention, the state highway department organizations have been geared up to handle construction programs which involve a greater outlay each year. This work cannot be prosecuted economically by

spasmodic spurts followed by periods of comparative idleness. Steady, uniform progress is essential, and it is necessary that the supply of funds shall be sufficient to maintain these operations on the large scale to which they have now been built up. The impression left by a discussion of this general subject at the convention was that there is in prospect a readjustment of the sources of highway revenue and that transportation may have to assume a larger share of the cost than it has carried in the past. In any event highway financing promises to outrank in importance any other subject in the field, for road-building, as a national industry, has "arrived."

Organized Contracting Makes Progress

CONFIDENCE in the ability of organized contracting to serve the construction industry is strengthened by the policies announced and the program of action laid down by the Associated General Contractors at their annual convention held last week in Cleveland. As summarized in the news section of this issue, the convention work developed along four general lines: Improvement of the ethics of contracting practice; standardization of construction procedure and contractual relations; improvement of business methods, and co-operation with government departments and organized engineering in stabilizing the construction industry. The progress accomplished and the performance promised are not equal in all directions and this more than any other thing indicated that organized contracting has not fully allocated its responsibilities. Not perceiving its way clearly, it is temporizing.

Lack of determination is most evident in the convention action on the situation disclosed by the legislative investigations of construction and contracting in New York and Chicago. Some more virile and positive action than an expression of sympathy with the "purpose" of these investigations seems required and should have been confidently expected by the building public. It does not meet the situation to declare that no member of the association has been convicted of complicity or to exhort all members to adhere to honest practices. Responsibility cannot be evaded by changing names from contractor to constructor or by drawing distinctions between general contracting and the contracting trade. The building public will not accept fine distinctions as a substitute for the drastic housecleaning which is needed in many branches of the contracting business. The Associated General Contractors at Cleveland were looked to for a program of constructive effort to eradicate questionable practices of the sort disclosed by the Lockwood and Daily investigations and they failed to satisfy anticipations.

This disposition to temporize with bad conditions is all the more surprising when is contemplated the vigorous disciplinary action which the convention took governing the procedure of contractors operating outside their home territory. In this situation, one of great danger to the harmony of the contracting business, the convention acted with admirable promptitude and vigor. The action binds the constituent chapters of the association into a stronger general body and does much toward stabilizing the labor situation.

Another indication of the disposition of organized contracting to reconstruct its business is found in the program laid down for standardizing construction methods and equipment and developing generally the technique of construction. This is not a task which will be accomplished in a year or even in several years but it needs to be prosecuted with all the energy that can be brought to bear so that contracting can without challenge assert its supremacy in skill in constructing.

Collaboration was set forth by the convention proceedings as, finally, the great duty of associated contractors. During the year which has just passed, this has been an outstanding feature of association work. It will be extended during the present year. This policy of reaching out into the work of solving the problems of associated industries offers perhaps greater promise of the ultimate success of organized contracting than any other accomplishment of its brief life of three years. The association has over a thousand members, its membership now represents probably 80 per cent of the capital invested in general contracting and it has a budget of $175,000 for its year's work, it therefore has a power for co-operation with which organized engineering should in turn enlist itself.

Paying for the St. Lawrence

IN ITS complete form the report of the International Joint Commission on the projected St. Lawrence waterway will be a formidable volume. The advance galleys of the report—minus the appendices—which have just come to this office promise many hours of solid reading for an understanding. One thing, however, stands out from the recommendations which were printed in these columns last week and which are elaborated in the report; the cost of the project as proposed by the commission will weigh much more heavily on the United States than on Canada. The 50-50 proposition heretofore considered is far from being realized.

The commission quite clearly believes in the proposed improvement. It recommends definitely a treaty between the two countries to carry it out and equally definitely sets down the principle that each country should assume first cost, maintenance and operation charges for the power developments, which will lie in the respective national domains.

Navigation works costs are not so definitely apportioned. On the principle that each country should pay according to benefits, the costs during the "construction period," which lasts until five years after completion, are to be "determined upon certain known factors such as the developed resources and foreign and coastwise trade of each country within the territory economically tributary to the proposed waterway." Thereafter, the ratio is to be adjusted upon the freight tonnage of each country actually using the waterway. Assuming it possible to come to an understanding as to the "factors" referred to in the foregoing quotation, it is obvious that the first cost of the navigation works will be borne mostly by the United States—and this includes the cost of the Welland canal and of the projected lower canals all lying wholly in Canadian territory. Any subsequent adjustment on the basis of tonnage moved apparently will affect only operation and maintenance charges—a small percentage of the first cost which is assessed mainly against this country.

In the Wooten-Bowden estimate roughly $140,000,000 is for power and $112,000,000 for navigation. According to the recommendations of the commission, of this total the United States would pay about $160,000,000

and Canada $92,000,000, as near as can be judged from the relative economic tributaries elaborated in the report. In other words, Canada would pay for her own water power and contribute toward the navigation end just about as much as the cost of the work already done on the Welland canal.

If such a proposition is seriously put before Congress the St. Lawrence scheme will have hard sledding.

Arches and the Palm Beach Accident

SINCE structural engineering first began, masonry arches built on good foundations have justly been regarded as almost indestructible. Their record of performance is correspondingly good. In particular, no case comes to mind of failure of an arch during construction, when the arch itself was complete but not all of the load had been applied. Against such a background of fact the Palm Beach bridge collapse stands out in striking contrast. It puts a bad blemish on arch history, and had the collapse occurred three days later, with traffic on the structure, loss of life would have made it a much worse blemish, an indictment of the whole profession. Even as the case stands it is such an indictment; the world expects better of its trusted builders than to let completed arches that are still supported by their centering collapse beneath the very feet of the builders.

Comparison of present practice with older experiences is not altogether proper, for modern arch construction is of a new kind. A hundred arches exist today and dozens of new ones are built, where one existed or was built in the period of supreme domination of the stone arch, partly for the reason that the modern arch is much cheaper than its progenitor. One of the necessary steps in this decrease of cost and multiplication of number has been close study of economy, made possible by advance in the science of mechanics; but the more highly economical design, while in many respects safer, has not the same surplus of strength that used to be provided in the massive stone barrel-vaults and ponderous abutments. Materials, types and service requirements have changed; stone, a substance of great strength, has been replaced by concrete, a material that starts out with low strength; thick arches sprung between abutment piers and stiffened by backing masonry have given way to thin rings bearing against correspondingly thin supports and carrying a superstructure that adds no strength; and the relative magnitude of the traffic loads has been multiplied. Further, modern work is more hurried: arch bridges are today built in months where formerly years were taken for construction. Comparisons with stone arch experience must take account of these changes.

In the Palm Beach accident a most interesting set of possible sources of trouble presents itself, and the case is therefore of remarkable value for professional study. Foundation and pier stability, the elastic continuity of a series of arches, too great structural flexibility, weak material, and incautious construction practices all invite attention. Fuller data than given in R. F. Ensey's report in this issue are required but certain reflections are warranted even now.

Mr. Ensey suggests that failure of Pier 9 may be primarily to blame for the collapse. The engineers also report finding defective conditions at the pier base. What sort of failure, if any, occurred here is yet to be explained. Vertical crushing of any large amount seems unlikely with the foundation on rock, but tilting might occur under the action of the arch moments. A pier which is shown by drawings as being flat-bottomed and stable may be so built as to have a rounded base, and the effect of such a condition on arch stresses is rarely computed. Middle-third calculations for pier bases are one of the commonplaces of arch design, perhaps to the degree that they get less real thinking than desirable. One fact worth remembering is that even the prettiest middle-third base pressure may not prevent an imperfectly-founded pier from rocking enough to alter the stress action of the arches. Only thoroughly competent field engineering will make a foundation rigid enough for the purpose. Both for this reason and to allow for imperfect seating of the base, it may in some cases be safer practice to analyze arches for pivoted or rocking piers.

At best a series of arch spans, to which the preceding applies, is not a simple subject for analysis. From one point of view, it is on the side of safety to design each arch as independent, but unfortunately such procedure would ignore the transmission of deformation, i.e., the increased flexibility of the structure. The engineers of the Palm Beach bridge have been led by *ex post facto* consideration of this continuity to a remarkable hypothesis concerning the failure, as follows: The spandrel filling, which contrary to their intentions was being placed complete in one spandrel space and then in the next, was a pumped "sand" that was virtually a liquid when deposited but became very stiff by draining. The east abutment space being filled first, the filling subjected the first arch to unbalanced hydrostatic loading and this by elastic transmission distorted all the arches, humping them up to the west. When the space over the first pier was then filled, it should have balanced the load on the first arch and restored its symmetry; but, the abutment fill having by this time set, the first arch could not resume its unstrained shape, and the result was merely an increased distortion of the other six arches. This process continuing for four or five spandrel spaces, the arches were squeezed westward very sharply (the draw is said to have become jammed). Then the filling was started at the draw end, and the remaining spandrel spaces were filled from west to east. A reversed straining action thus affected the last three arches, resulting in sharp humping up at the middle of the arch last to be filled. Result, rupture of this arch upward! The hypothesis is ingenious, if rather paradoxical.

Obviously, such possibilities compel one to look with more respect upon continuous-arch theory than has been accorded it hitherto. It is timely to reflect whether we have not been carrying the process of paring down reinforced-concrete arch designs too far. It is easy to design a structure of this type that is safe when built but unsafe to build. Some such have been designed, and some have been built. Despite low bids, economy in construction is not to be secured this way, in the long run; and even apart from economy a conservative judgment, taking into account such special factors of flexibility and weakness as above suggested, would characterize a few of the recent designs of reinforced-concrete arches as too light. If we can return to the state when an arch will be to all intents indestructible after closure of the ring, we will be in sounder position

FROM JOB AND OFFICE

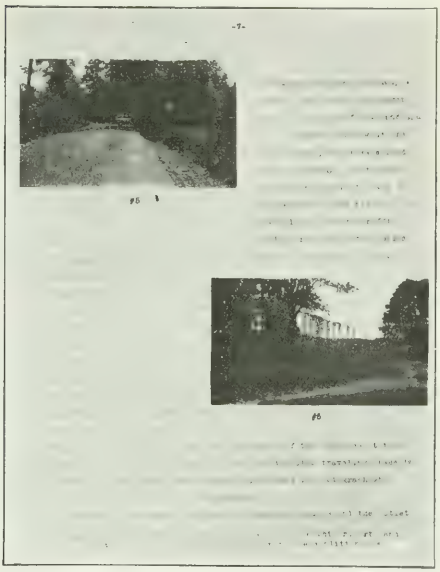
Hints That Cut Costs and Time — *For Contractor and Average Engineer*

Photographs in Engineering Reports

By B. DUNCAN MCCLAVE
McClave & McClave, Engineers, Cliffside, N. J.

THE explanation of existing conditions very often acts as a great aid to the engineer's clients when these explanations are supplemented with photographs or cuts. The expense of having cuts made for small reports precludes their use in a great many instances. The use of photographs, however, is quite inexpensive and can be used by the engineer to show his clients pictorially a point upon which emphasis is made in the report.

The usual method of showing a photograph is by



PHOTOSTAT OF REPORT ILLUSTRATED AS DESCRIBED HEREIN

pasting it on a report. This method is not as satisfactory as the engineer desires. Accordingly we have devised a method which is very practical and we recommend it to our colleagues in the preparation of small and inexpensive engineering reports. The procedure is as follows:

1. Type the report leaving sufficient untyped space at the proper place in the report for the negative to be inserted.

2. Cut some Vandyke or blueprint paper the exact size of the paper on which the report is written (Vandyke paper will give a sepia photograph and the blueprint paper will give a blue photograph. Care should be taken as to the stock so that the paper will approximate in size as well as in quality, the paper on which the report is written).

3. Cut a piece of opaque paper slightly larger than the report paper. In this make an opening the same size as the negative and in the same location on the sheet as is desired for this photograph according to the rough draft of the report already typed and referred to in paragraph 1.

4. Print the negative with the opaque covering between the Vandyke or blueprint paper and the illuminating source.

5. Care must be taken to wash the Vandyke paper with Vandyke salt and also have the blueprint well washed so that the print may be real white with the exception, of course, of the photograph.

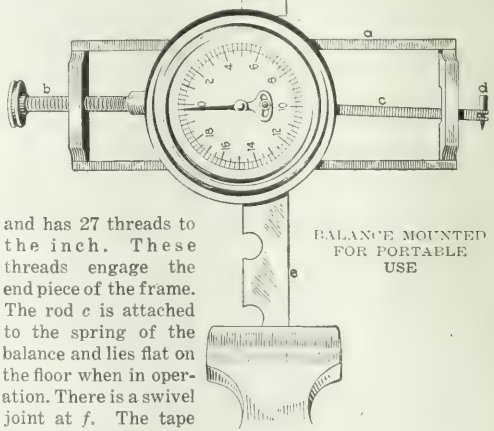
6. Retype the report upon the sheet on which the photograph has been printed.

We have found this method quite successful for small work and heartily recommend it in spite of the fact that it requires additional care and time over the methods already in practice.

A Balance for Standardizing Tapes

By WALTER S. WEEKS
Associate Professor of Mining, University of California

THE most convenient place to standardize a tape is the concrete or brick floor of a building. It is usually inconvenient to build a permanent support for a balance so I have devised a convenient portable arrangement which can be placed on the floor and held in place by weights. The balance used is a Chatillon "No. 33, Serial H" reading to 20 lb. The frame of steel, shown in the accompanying sketch as *a*, is 12 in. long and wide enough to hold the box-like cover on the back of the balance. The screw *b* is ½ in. in diameter and has 27 threads to the inch. These threads engage the end piece of the frame. The rod *c* is attached to the spring of the balance and lies flat on the floor when in operation. There is a swivel joint at *f*. The tape is held by the pin *d*. The wings *e* are flush with the bottom of the frame and lie flat on the floor.



BALANCE MOUNTED FOR PORTABLE USE

The surveyor should have a high-grade tape standardized while supported. This is done by the Bureau

of Standards. Tapes may be obtained with the temperature corrections etched at one end.

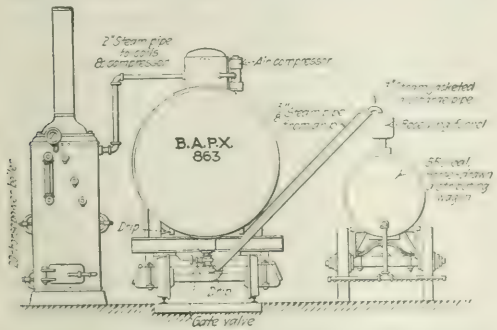
This standard tape is stretched out and the standard pull applied with the balance and an exact 100 ft. is marked off. The working tape is then stretched between the points with the end that is away from the balance held on one of the points.

Steam-Jacketed Pipe Facilitates Unloading of Tank Cars

By A. D. Blakeslee

C. W. Blakeslee and Sons, Contractors, New Haven, Conn.

For the past several years we have been building bituminous macadam pavements by the penetration method applying the bitumen under pressure from tank wagons drawn by a steam roller. This material comes to us in tank cars and we have a boiler alongside the siding and heat the material enough so that we can handle it and load it into our tank wagons. We then haul it to the job and heat it to the required temperature.



SPECIAL ARRANGEMENT FOR TANK CAR UNLOADING

In transferring the material from car to tank wagon we first used a hand pump in the top of the car and then let it run by gravity from this pump into the wagons. Later we tried using the air compressors with which the tank cars were equipped. This air would force the bitumen out of the bottom of the car up through a pipe into the wagons. We could load two wagons very satisfactorily this way, but when they returned for the next trip, after being away for about two hours we found that the material in the pipe all cooled off so that it was impossible to use the air pump, therefore we replaced our stand pipe with a steam-jacketed pipe.

We now take the steam from the drips of the coils in the car and turn this into the steam jacket. We have found this to work very satisfactorily and are using this method right along. It saves two laborers at the car and about one day's time in unloading, for now we are able to get started sooner than when we pumped by hand. In addition to this, it saves us a great deal of annoyance for the hand pump was continually getting broken and out of order.

Cars are generally placed on our siding about 2 p.m. and if we get them connected and steam on by 4 o'clock the same afternoon we are generally able to start unloading the following morning about 10 o'clock. It then takes us the rest of that day and two more days to unload a car of about 7,500 gal. and apply the bitumen on the street.

Air Lift Removes Sand Plugs From Deep Wells

By Dennison Fairchild

Supervisor Bridges and Buildings, Northern Pacific Ry., Duluth, Minn.

Air lifts have been successful in two cases observed in removing sand plugs in deep wells. One well, with an 8-in. casing 145 ft. deep (from which about 100,000 gal. of water was pumped daily), became clogged with sand to such an extent that it practically stopped the supply. A test developed 14 ft. of sand and small gravel. A ¾-in. pipe to the sand was inserted and air forced to the bottom, the rising bubbles keeping the water disturbed and the sand in suspension, and it was thrown out very quickly and at little expense. In another case, the well was 236 ft. deep with an 8-in. casing, and the sand was beginning to shut off the supply and get into the pump. There was available only 150 ft. of ½-in. pipe which was connected up with a compressor. The rising air created enough suction to lift the sand and the water was clear and running free of sand at the end of 25 minutes.

Device for Spreading Gravel Evenly

By Allen P. Child

Kansas City, Mo.

A bent lever attached to the hinged door of a dump-body truck is used by the Iowa Highway Commission for spreading gravel evenly on roads. The lever has the lower end, at a point 2 or 3 in. from the fulcrum, bent at right angles with the main portion. The fulcrum



BENT LEVER ON TRUCK DOOR CONTROLS OPENING

is attached near the bottom edge of the door and on the center line. The short arm of the lever has several holes bored in it and a chain attached to the floor sill of the body bottom is carried out and fastened in one of the holes. When the lever is hooked at the top, the door is held tightly closed. As the lever is lowered, the door opens to any desired amount determined by the

length of chain. Dry gravel sifts through as evenly and smoothly as desired. Wet gravel requires jiggling of the lever and a larger opening. Although the device costs little to attach, it is necessary to have a man to operate it.

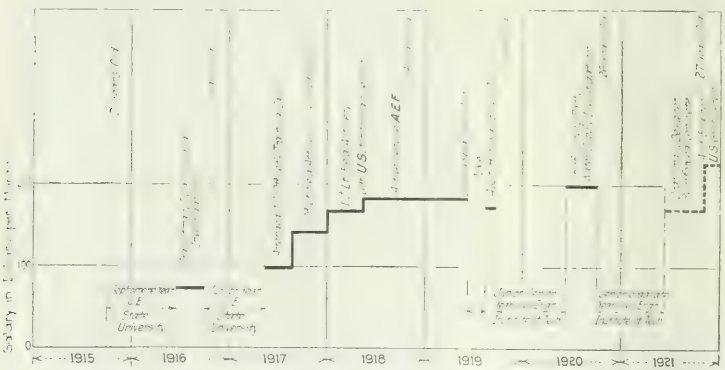
Charted Personal Record Used as Aid in Application for Employment

By K. B. Skardon

Assistant Engineer, U. S. Railroad Administration, Chicago

LETTERS of application for employment will always play an important part in bringing engineers to jobs and jobs to engineers. In many cases final decisions must be made with no other information available than that submitted in a letter written by the applicant. This is especially true if it is desirable to fill the vacancy without the delay and expense necessitated by conferences.

The writer has had occasion recently to apply for engineering positions by letter. He has found it difficult to condense the necessary facts and to present them in a convincing manner, in short, to write a letter of application which speaks for him in his absence. Some thought on the subject led to an experiment in arranging pertinent facts graphically. Reference to the accompanying chart will show the results.



PROFESSIONAL RECORD CHART GIVES VARIED INFORMATION OF APPLICANT

It is felt that a better idea of the applicant's experience and training is obtained when the facts are placed on a chart. The chart gives a continuity to the various events of a career which would be difficult to obtain without its use. The element of time used for the abscissas brings out duration of employment in various capacities. Salaries used as the ordinates are good measures of progress—in fact the usual measure applied to a man's record when he faces the job of finding another position.

Sufficient data may be entered on the chart to give it life, and additional information usually furnished in a letter of application may be enclosed in definite form for each period on the chart. The letter proper may then be confined to an introduction and consideration of acceptable salary, time possible to report for work or conference and other pertinent data not recorded on the enclosures.

The chart, with supporting data should also serve as a valuable record for an engineer who is interested in following his own progress and achievement with the idea in mind of analyzing it and profiting by the analysis. He can give definite direction to his efforts and improve his experience at the points where weakness is indicated. The chart may also serve for reference as a personnel record in organizations employing technically trained men of various capacities.

FROM JOB AND OFFICE

Hints That Cut Costs and Time

An Improved Stadia Rod

By E. B. Debler

INASMUCH as approximate accuracy only is wanted on stadia surveys of any great extent, homemade rods both for vertical-angle reading and for spotting distances, often surpass in legibility and ease of reading level rods of standard make. In the following paragraphs such a rod, developed on work with which I have been connected, is described.

The board should be 2½ in. wide, of sufficient thickness for requisite strength dependent on the material used and given one coat of dead black paint. The numbers are 3-in. aluminum house numbers available in novelty and hardware stores.

Sketch "A" on the opposite page represents the arrangement for vertical angle work and sketch "B" for level work. Where both types of work are simultaneously done the two sides of the rod may be used for the two scales. The "A" scale is based on the use of the top interval only, the accuracy therewith being in keeping with other factors in stadia work generally.

The "0" of both scales is at a distance above the bottom of the rod corresponding to the average set up for the instrument in use, usually about 4.8 ft. for a transit and 4.5 ft. for a plane table.

The graduation for scale "A" may be one-half foot for each number or in case of instruments incapable of easy adjustment may be made to fit the instrument by observing the intercept on the rod for a measured distance. The range may be increased by the addition of a mark below the zero corresponding to 500 ft. of distance.

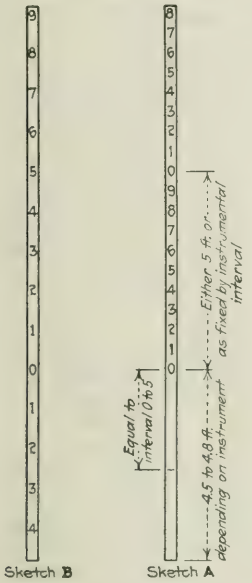
For scale "B" the numbers are a foot apart. Additional subdivisions of the rod may be accomplished by the use of brassheaded tacks though this is usually not necessary for the average instrumentman as the tops and bottoms of the figures for the angle scale represent 25 ft. under or above the hundred, with but 50 ft. between the edges of the numbers.

The cost of the rod is but a fraction of the cost of any well-painted rod and its legibility for shots of any distance is far superior to that of any painted rod.

In operation the middle hair is trained on the zero and the full distance read direct. For vertical angle

FROM JOB AND OFFICE

For Contractor and Average Engineer



work the instrument is also thereby properly set. All HI calculations are eliminated, only ground elevations being recorded.

Errors due to instrumental height not corresponding with the "0" of the rod are small and compensating and may be disregarded.

The especial advantages of this rod are the elimination of mental processes necessary for the determination of distance required with most rods and the superior legibility of the rod due to contrast of reflection of light from the bright metal and black surfaces, the former making for speed and accuracy and the latter increasing the range of visibility.

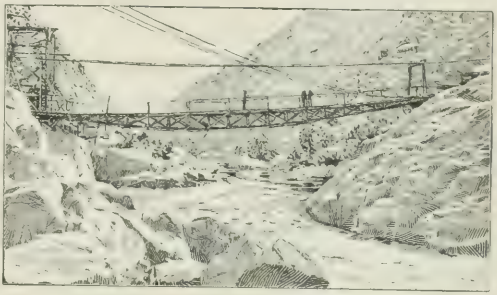
Patrol System for Ditch Maintenance

As a remedy for the almost universal condition of neglect of drainage ditches, due partly to inadequate legislation for maintenance, the introduction of the patrol system as used on highways was suggested at the recent meeting of the National Drainage Congress by S. H. McCrory, chief of the division of agricultural engineering, U. S. Department of Agriculture. In his opinion it would be advisable to provide for a superintendent of ditches, particularly in counties having a large amount of drainage. He should be a full-time employee with experience in drainage work and should have authority and funds for patroling the ditches and keeping them in good order. The authority must be centralized in the hands of one man who would be the executive officer of the district and be responsible for the proper maintenance of all drains within that district. This would not only secure better drainage but the farmers would more nearly realize the benefits that they have been led to expect from improved drainage. If this is to be accomplished, however, the provision in drainage laws in regard to maintenance must be made mandatory and not optional.

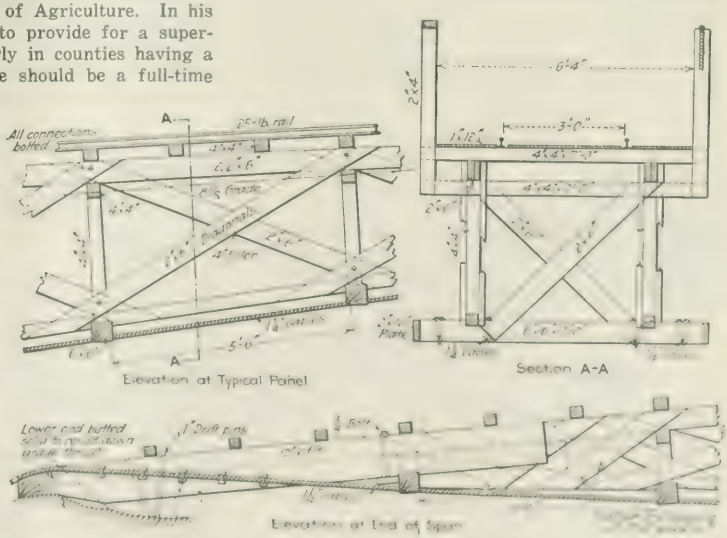
Temporary Bridge Has Rigid Deck Truss and Cables for Bottom Chords

To effect a temporary crossing of the Kern River, California, for delivering construction materials, engineers of the San Joaquin Light & Power Corp. designed a bridge with a 110-ft. span consisting of a rigid deck truss built of timber and whose bottom chords were composed of four 1¼-in. cables. This design afforded the desired capacity of 6 tons, the comparatively high degree of stability required for the operation of narrow-gage cars and made it possible to build the bridge quickly at low cost. Moreover, this design did not require falsework which would have been difficult at this site.

The cables were first anchored firmly in place, great care being taken to make sure that all four of them had equal sag. Transverse members of the truss, i.e., those that were to have bearing on all four cables, were then put in place, these pieces having previously been notched to insure even spacing of the cables. A working floor was then made by laying loose boards on these cross-pieces and the truss was erected in place. As at first assembled the structure was held in position



SUSPENSION BRIDGE WITH RIGID DECK TRUSS



DETAILS OF TIMBER TRUSS OF SUSPENSION BRIDGE

lightly, care being exercised to obtain a uniform distribution of the load. The structure was then tied firmly together, the workmen being evenly distributed during this operation to obviate any distortion to the bridge.

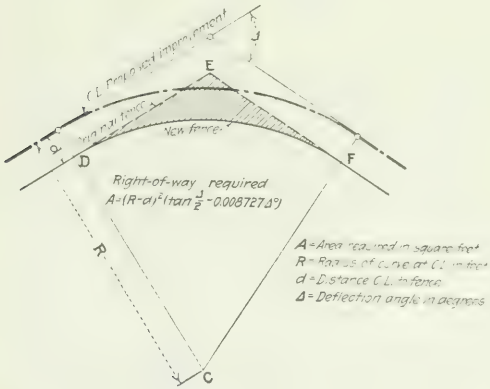
The timber members were proportioned to carry the live-load only, while the cables carried both dead and live-loads. By making the joints secure and fastening the cables rigidly at the panel points, the structure was expected to act as an inverted bow-string truss. Had the joints been left loose, or if the diagonals were not strong enough to carry the loads the action of the structure, it was pointed out, would have been between that of a bow-string truss and a stiffened suspension bridge.

The cost of the structure, including an adjacent 45-ft. span, and general overhead charges, was in the neighborhood of $2,000.

How to Get Circular Right-of-Way Areas

By M. E. Webster
District Office Engineer, Division of Highways, Illinois

IN THE design of every section of road there is present the problem of securing right-of-way. This problem resolves itself into two parts: The buying of a strip between fence lines, and the securing of additional area at curves. In order to facilitate the computing of the area of right-of-way required in the latter case the formula given herewith was derived. Assuming that



GRAPHIC APPLICATION OF FORMULA

the distance from the tangent line to the fence line is substantially the same around the curve, the relation between the area required, the radius of the curve at the center line and the angle Δ is as follows:

$$A = (R—d)^2(\tan \frac{\Delta}{2} — .00872\Delta^\circ)$$

In this equation the units of R and d are in feet, the $\tan \frac{\Delta}{2}$ is the natural tangent and Δ in the term $.008727\Delta$ is expressed in degrees. This gives the area in square feet.

Example:—

$R = 300'$; $\Delta = 90^\circ$; $d = 30'$. Substituting

$A = (300—30)^2(1—.78543) = 15{,}642$ sq.ft.

FROM JOB AND OFFICE

Hints That Cut Costs and Time

The formula is developed as follows:

Area required = Area $CDEF$ — Area circular sector CDF (1)

Area $CDEF = DE \times DC$ or, since $DC = (R—d) = DE$

But from circular curve formulas $T = R \tan \frac{\Delta}{2}$

$$\therefore DE = (R—d) \tan \frac{\Delta}{2}$$

$$\text{Area } CDEF — (R—d)^2 \tan \frac{\Delta}{2} \quad (2)$$

$$\text{Circular Area } CDF = \frac{\Delta}{360} \times \pi (R—d)^2$$

$$\log \pi = 0.49715$$

$$\log 360 = 2.55630$$

$$7.94085 = \log .008727 \quad (3)$$

$$\text{Circular Area } CDF = .008727 \times \Delta \times (R—d)^2$$

Combining (2) and (3) in (1)

$$\text{Area required} = (R—d)^2 \tan \frac{\Delta}{2} — .008727\ \Delta\ (R—d)^2$$

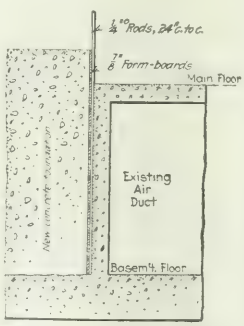
$$= (R—d)^2 (\tan \frac{\Delta}{2} — .008727\ \Delta) \quad (4)$$

Removing Forms From 1-in. Space

By R. C. Reese
Architectural Engineer, Pittsfield, Mass.

A SUCCESSFUL method of removing forms from a very narrow space is illustrated by the accompanying sketch, as it was employed in remodeling a steam electric plant.

It was desired to construct a concrete turbine foundation about 9 ft. wide and 10 ft. high in the power house basement, with a clear space of about 1 in. between the new foundation and an existing air duct to prevent the transference of vibration from one to the other.



FORM FOR EASY REMOVAL FROM NARROW SPACE

A series of ½-in. plain, round reinforcing rods was placed vertically between the existing wall and the ⅞-in. horizontal form boards, with the ends of the rods projecting about 2 ft. above the wall. After the concrete had set the rods were pulled out by the traveling bridge crane in the building, with surprisingly little difficulty; in fact a lever pulling rig could have been used. When the form boards were driven out horizontally there resulted a clear space of just about 1 in. between the two walls which serves its purpose admirably, is neatly finished, and was obtained with but little difficulty.

FROM JOB AND OFFICE

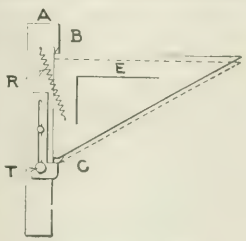
For Contractor and Average Engineer

Device for Cross Hatching

By P. Léniz
Engineer and Contractor, Santiago, Cuba

A HATCHING device which I have used in my office for many years with very good results is described in the following paragraphs.

It is composed of a triangle *E* and a guide *A* as shown in the sketch reproduced herewith. This guide has two projecting parts or stops; *B*, which is fixed, and *C*, which is movable and is tightened by means of the screw *T*. The triangle and the guide are united by the spring *R* in a manner such that the triangle is always touching the stop *B*.



CROSS-HATCHING ARRANGEMENT

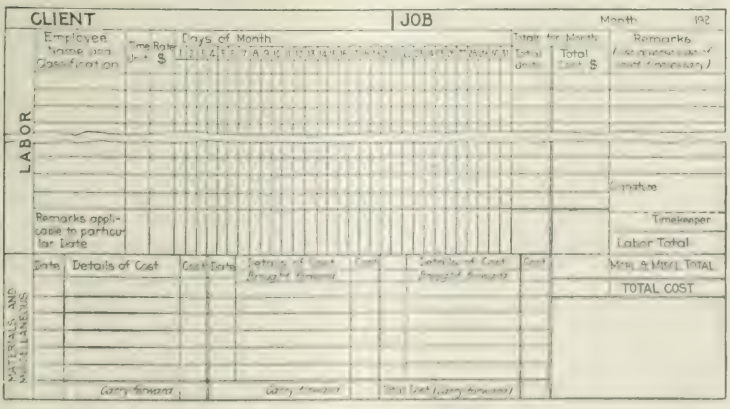
To use the device proceed as follows: Draw the first line with the instrument in the position as shown in the figure. Hold the guide *A* and at the same time move the triangle *E* downward until it touches *C* as indicated by the dotted lines. The triangle is held firm. Loosen the guide *A* and the spring *R* pulls the guide *A* until *B* engages the triangle. The instrument is then ready to trace the second line, etc. The stop *C* is movable in order to vary the spacing between the lines of the hatching and is fixed by means of the screw *T*.

Cost Sheet for Engineers in General Practice Is Complete in Detail

By Edwin P. Arneson
Walton & Arneson, San Antonio, Tex.

A COST sheet which has been found satisfactory for recording labor costs and miscellaneous expenditures on field work by a firm engaged in general engineering practice is illustrated by the drawing. The sheet is a "blue-line" print, 11 x 16 in., punched on the left margin for fitting, when folded, a standard "I-P" binder 8½ x 11 in.

The chief of party carries this sheet in his computation book. On the upper part of the blank he keeps the time of his party. On the lower part he lists his expense account. The sums of both classes of expenditure are united into a total cost of the job for the month. At the end of the month the sheet is turned into the headquarters office where time checks are prepared and the chief of party is reimbursed for his expenses on the firm's account. The cost sheet is then filed in a standard letter file.

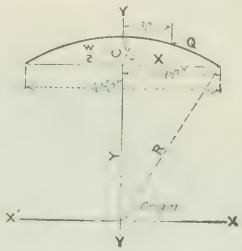


FIELD ENGINEER'S COST SHEET

Determining Tangential Offsets for Road Crowns

By E. M. Crawford
Effingham, Illinois

IN CONSTRUCTING roads and streets it is sometimes desirable to have a crown that is an arc of a circle instead of a parabolic section. A useful method of figuring the tangent offset for a circular section is given below. It can be used to make corrections on grade stakes for earth-road work, or to find the offsets when making paving templets. In this class of work the degree of curvature is so small that ordinary tables cannot be used.



In determining the offset for any given point on the tangent, you have given the width of the surfacing *W* and the height of crown *C* (see accompanying figure). Here, $W = 10$ ft. and *C*, 2.5 in. (the slope being assumed ½ in. in 1 ft.).

Then $X^2 + Y^2 = R^2$

But $R = Y + 2.5$, and $X = 60$ in.

$3{,}600 + Y^2 = (Y + 2.5)^2$

$= Y^2 + 5Y + 6.25$

$Y = 718.75$

$R = 718.75 + 2.5 = 721.25$ ft.

To find the tangent offset at any point on the tangent such as *Q*, find the value of *Y* on the curve at that point. Subtract the value of *Y* from the radius and the result will be the required offset.

Example:

At *Q*, $X = 30$ in.

$X^2 + Y^2 = R^2$

$900 - Y^2 = (721.25)^2$

$Y = 519{,}301.5625$

$Y = 720.62$

and $q = 721.25 - 720.62$

$= 0.64$ in.

Erection of Hurricane Gulch Arch Bridge in Alaska

Cantilever Erection of Most Northerly Railway Structure in America—Hydraulic-Jack Adjustment of Backstays Instead of Wedge and Screw Toggle—How Arch Members Were Transferred Across Gulch

By E. G. Amesbury
Assistant Engineer, Erecting Department, American Bridge Co., Pittsburgh, Pa.

ERECTION of the 384-ft. steel arch of the Alaskan R.R. over Hurricane Gulch, about half way between Seward and Fairbanks, was completed in August, 1921. The methods by which the erection was carried out included several decided novelties, which the results proved well adapted to the needs of the case.

This arch is the second steel bridge erected on the government railway in Alaska, whose main line between Seward and Fairbanks, 467.6 miles, will soon be completed. It is located 284 miles north of the terminus at Seward, and to the writer's knowledge is the farthest north and west of any steel railway bridge on the American continent. However, a steel viaduct will shortly be erected on the same line 63 miles farther north.

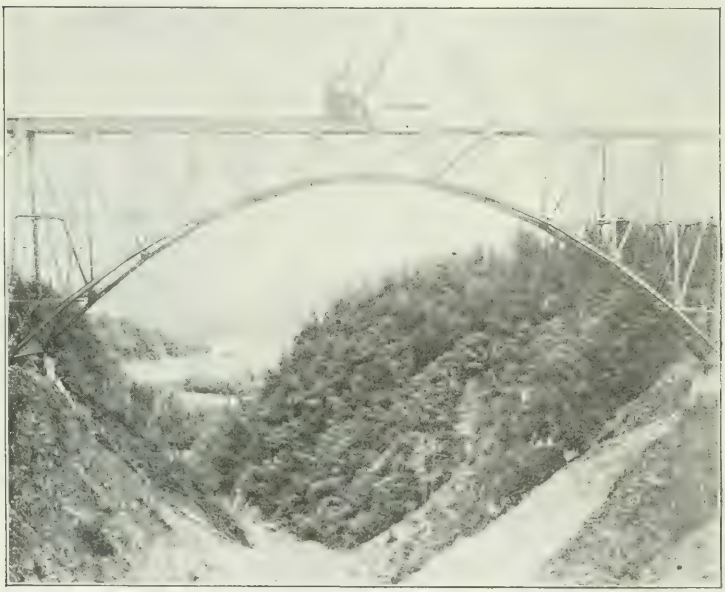


FIG. 1. SETTING THE CLOSING MEMBER, HURRICANE GULCH ARCH, ALASKAN R. R.

Field Conditions—The Hurricane Gulch structure is a single-track deck bridge 914 ft. long located on tangent. The arch span, 384 ft. long, is flanked on either end by a 120-ft. riveted-truss deck span, beyond which there is at the south end a 50-ft. plate-girder span and at the north end a steel viaduct 240 ft. long. The arch is 125 ft. 3 in. deep at the ends and 25 ft. 3 in. at the center. Its top chords are spaced 14 ft. apart; the trusses are battered 1:6. Base of rail is about 296 ft. above the bottom of the gulch. The heaviest member is the end section of the bottom chord, weighing 12½ tons. The total tonnage in the arch is 911 tons; the rest of the structure contains 535 tons of steel.

Track had been laid to the southern end of the structure before erection of steel started. A yard was established alongside of the railroad a few hundred feet south of the bridge, through which all material, for both south and north ends, was handled with a locomotive erecting crane, and where it was assembled and riveted as far as possible.

It was planned to erect the arch by the cantilever method, each half to be built out from the shore and held back by steel backstays. Cantilever erection made a double-ended erecting operation, which introduced the problem of getting material across the gulch for the north half of the arch and approach spans. It was impracticable to transfer material around or down through the gulch and it could not be brought in from the north; therefore the only two ways open for feeding material to the organization on the north half of the structure were (1) cableway transfer, and (2) lowering into the gulch with an erecting unit standing on the end of the south half of the arch and outhauling the members with another unit on the north half. Both were used, but, contrary to the original intentions, all the arch steel was transferred by the second method.

To facilitate erection, the center of gravity of each bottom-chord member was figured in the drawing-room, so that hitches could be applied at such points on the chords that they would hang in their relative permanent position while being placed.

Backstays—A locomotive erecting crane began the erection work by setting the 50-ft. plate girder span at the south end, and then placed falsework for the 120-ft. span and erected this span. Thereafter the steel backstays for the half arches could be constructed. Steel anchorages embedded in concrete had been placed some weeks before. (Fig. 3.)

The vertical anchorage load on the south side consisted of a heavy concrete pier, which is now used by the railroad as a permanent pier for supporting the shore end of the 50-ft. girder span. The anchorage load on the north end consisted of a heavy block of concrete upon which two viaduct pedestals were built and 268 tons of railroad rails piled for additional weight.

The Alaskan Engineering Commission (Col. Frederick Mears, chairman and chief engineer) had built

a 4-ton cableway across the gulch near the site for the transportation of supplies and freight. This cableway was used to transfer the steel, erecting equipment and falsework material across the gulch for the north 120-ft. approach span and viaduct towers.

The backstay bars connecting the anchorages to the 120-ft. approach spans (which in turn connected to the ends of the top chord of the arch) were telescopic in action, as may be seen from Fig. 3. There were two pairs of backstay bars to each anchorage, or a pair to each truss, and in the telescopic joint of each pair was provision for inserting a 500-ton hydraulic jack, to be operated by a steam-driven hydraulic pump when the halves of the arch span were lowered to their permanent position. During erection these bar systems were shortened about 8½ in., which caused the ends

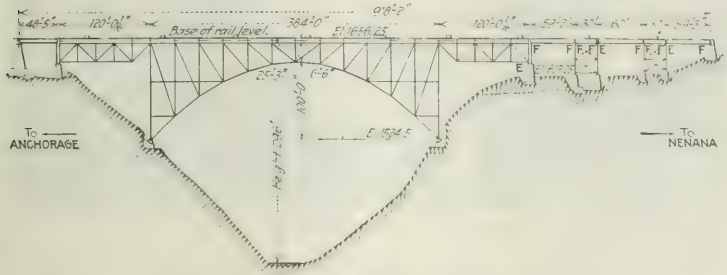


FIG. 2. OUTLINE OF HURRICANE GULCH ARCH

of each half of the arch at the center to be slightly elevated. They were held in this position by steel shims in the telescopic joint of the backstay bars until final closure. The pair of 500-ton hydraulic jacks for each anchorage was connected by a copper tubing system to the hydraulic pump, and when pressure was applied the jacks loosened the steel shims in the telescopic joint of the backstay bars, which allowed the shims to be easily withdrawn and the two halves of the arch lowered in a few minutes to a bearing on a pin in each bottom chord at the center, forming temporarily a three-hinged arch. So far as the writer can ascertain, this is the first time telescopic backstays with hydraulic jacks for adjustment have been used for closing an arch.

The shoes of the arch were set at their proper distance apart by means of direct measurement with a 500-ft. steel tape corrected for temperature. The tape was standardized and marked by the maker to measure the distance of 384 ft., the length of the arch, while supported only at the zero and 384-ft. marks, under a tension of 50 lb. The fact that the arch closed and fitted very satisfactorily showed that there was no appreciable error in the measurement.

North Side Erection—The north half of the arch could not be erected until the north 120-ft. approach span was in place. As soon, therefore, as the south 120-ft. approach span had been erected, the falsework under it was removed and transferred in sections across the gulch by cableway. The bottom sections being slightly altered to fit the new location, it was re-erected to support the north span. The highest bent under this span was 95 ft. 6 in. high. After two panels of the north 120-ft. span had been erected with a stiffleg derrick sitting on the ground, a hoisting engine and a light A-frame steel derrick were placed on the top chords to erect the rest of the truss and arch span. The A-frame derrick was moved out panel by panel as the work proceeded, but the engine remained in one place.

Transferring Arch Material—As some of the members of the arch were too heavy to transport over the cableway, it was planned to lower them to the bottom of the gulch by a locomotive erecting crane standing on the outer end of the south half of the arch (Fig. 4) and pick them up by the derrick on the north side. This was first done with the heavy members of the end panel.

In carrying out this transfer the load falls of the A-frame derrick on the north end were lowered to the bottom of the gulch and hitched to the member. Then both sets of falls were taken up simultaneously, at such rate that the member was brought up along the slope of the gulch and landed on the ground below its final erected

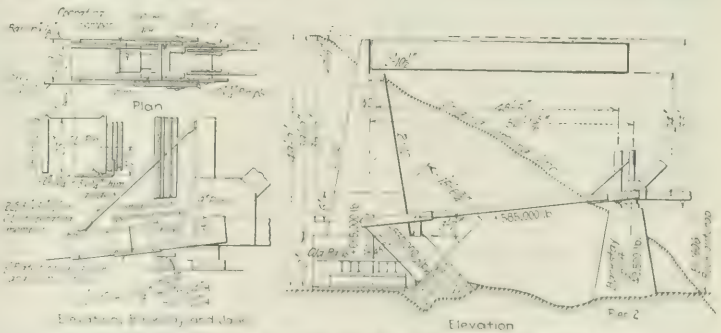


FIG. 3. SOUTH ANCHORAGE AND ERECTION BACKSTAY WITH HYDRAULIC-JACK RELEASE

position. The locomotive-crane falls were then released and the member lifted up to its place in the arch by the A-frame steel derrick. On account of the great depth of the gulch, the members could be transported over the maximum gap of 192 ft. between erecting units without causing more strain on the boom in each unit than when the total load was supported independently and vertically underneath by either boom. It was found that the method worked very well, and in consequence all material for the north half of the arch was transported across the gulch in this manner rather than take the light members over the cableway.

The stringers for the arch span and deck spans were designed to set on top of the floorbeams. This allowed them to be riveted up in pairs in the yard, permanent ties placed thereon and each panel of stringers and ties erected as a unit with locomotive erecting crane.

Closing the Arch—When the two halves were com

pleted, they were lowered to junction by the jacks in the backstays. The top chords, as intended by the designers, did not take a bearing. Therefore the structure was made into a two-hinged arch for live load by field-drilling and riveting splice plates to the top chords. The arch was designed to be closed and riveted into a two-hinged arch at a temperature of 50 deg. F.; the temperature when the closure actually took place was very near this figure.

The final erecting operation was the placing of the 30-ft. and 60-ft. viaduct girders for the north approach. These were transported across the arch and erected by locomotive erecting crane, the viaduct tower material

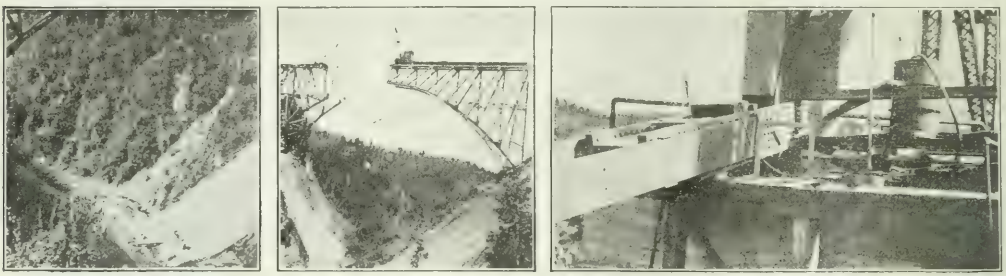


FIG. 4. TRANSFERRING ARCH STEEL ACROSS THE GULCH—BACKSTAY WITH JACK

having previously been taken over the cableway and erected with a derrick.

Actual erection of this bridge was started June 8, 1921, and 60 working days afterward, or on Aug. 16, the first train passed over the structure and track-laying was commenced on the north side of the gulch.

The design was approved by Modjeski & Angier, Consulting Engineers, Chicago, and the work was fabricated and erected by the American Bridge Co., Albert Reichmann division engineer, and C. S. Garner manager of foreign erection. The field work was in charge of H. M. Braford as foreman and the writer as resident engineer.

A New Kind of Technical Association

Organized on the basis of entertaining themeselves with their own talent the 100 members of the Scientech Club have held together long enough to be a fixture in Indianapolis. It has an attendance of about thirty each Monday noon at luncheon. As in the Rotary Club those who do not attend once in four consecutive meetings are automatically dropped from membership and membership includes engineers, architects and chemists, all technical men regardless of classification. A strict time schedule is adhered to. They meet at 12:15, allow 15 min. for assembling and 15 min. for introductions in which various stunts are employed as introducing by first name and by business getting as much fun out of it as possible. The remaining 45 min. are devoted to discussions usually of an economic nature bearing on the relation of the profession to public welfare. No one not a member may address the club without the consent of the directors. Once a month a shop talk is given by one of the members who usually discusses the business or some interior problem of his own organization. A mimeographed weekly news letter contains reports of the previous meetings and running comment on current technical events.

Electrification of Railways at Large Industrial Plants

THAT electrification of the industrial railway systems at large manufacturing plants offers possibilities of reducing the operating expenses of such systems in handling raw material, finished products and waste products was the opinion expressed by D. M. Petty, superintendent of the electrical department of the Bethlehem Steel Co., in a paper presented before the Philadelphia section of the Association of Iron and Steel Electrical Engineers. This paper, of which a brief abstract is given below, is along the lines of a paper on electric traction for railways at steel mills, noted in *Engineering News-Record*, Oct. 20, 1921, p. 652.

All the advantages of electrification on main lines will apply even more to industrial lines because of the intermittent service of yard and switching locomotives. Maintenance, repair and depreciation are less for an electric locomotive. The operating labor will be less and the engineman's pay could be somewhat less, since less skill is required in operation.

The overhead trolley system is the lowest in first cost, but cannot be used in a yard where locomotive cranes or similar machines are operated. For yard work, a sliding shoe about 3 ft. long mounted on a pantagraph or a reversible hinge is preferable to a trolley wheel, as it provides for turnouts and avoids the necessity of accurate alignment of the trolley wire. But the amount of current that can be taken from a wire is limited to about 1,000 amperes at 5 m.p.h. and becomes slightly less as the speed is increased. In the third-rail system, the bottom contact plan is the more satisfactory, as it is easier to protect and can easily be stepped over by men working in the yard. There are difficulties in applying this system to congested yards, but these difficulties may be overcome by a careful layout of switches and crossovers.

Contact systems, with energized boxes in the track engaging a long shoe on the engine, are at a disadvantage in yards, but a few miles of line are operated by such systems. Storage battery locomotives, larger than those used so extensively in mines, offer many advantages. Batteries with cells of sufficiently large capacity have been wanting, but manufacturers are working along this line and high-capacity cells of both alkaline and acid batteries will soon be available. Batteries may be charged while on the engine, or duplicate removable sets may be provided to keep the engine in continual service. Disadvantages are principally in the first cost of the battery and its short life. Thus a lead battery for a 60-ton locomotive would cost about $25,000; its renewal would cost $21,000, and its life would be from three to five years. Such a battery is not yet available.

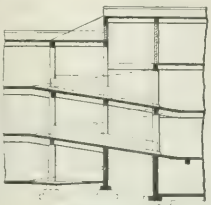
A combination storage battery and current collecting locomotive, such as has been used in mining work, may be adapted to industrial plants where the track layout precludes the general use of current distribution, but where the

use of an ordinary storage battery locomotive would involve excessive weight and power.

Conclusions—(1) The time is ripe for the electrification of industrial plant railways; (2) the storage battery should be avoided if local conditions permit; (3) the under-running third rail is the best collector system for heavy work and low voltages; (4) a combination locomotive should be used where yard congestion prohibits the use of a third rail; (5) where long hauls must be made, a voltage higher than 250 volts must be used, but the locomotives must be arranged to operate also at 250 volts in the yard and, if the conditions demand it, to operate on a storage battery.

New Ramp System for Garages

A NEW type of garage which is the first building incorporating the d'Humy Motoramp system has just been completed at Poughkeepsie, New York. The d'Humy system is based upon the construction of a building in practically two sections, the floors of one-half the building being halfway between the floors in the other half. By this modification ramps half the usual length may be used to connect the various floors a half story apart. These short ramps may be so arranged that they permit continuous travel up or down through the building. The new garage at Poughkeepsie has been constructed for the Nelson House Co., Inc., and is a three-story structure approximately 100 ft. square.



Section A-A
Showing full building height

Because of the fact that the ramps are half lengths, they are short enough to be employed as connecting passages between the main car storage aisles. As a consequence, in the average building a d'Humy Motoramp system will not only take up less space than an ordinary ramp, but it will permit the storage of two cars more per floor than if a single elevator were used. In the Nelson House garage, the ramps are about 7 ft. wider than is necessary and consequently the building does not give as high storage capacity as it otherwise would.

One of the advantages which is claimed for the d'Humy system is that the sides of the ramps may be left open, it being unnecessary to box them in as is the usual practice. The open construction affords the operator of a motor car a long view ahead, whether rising or descending.

The architect on the Nelson House garage was Edward T. Smith, of Poughkeepsie, and its builder, Edgar V. Anderson of that city. Information contained in this article was submitted by the Ramp Building Corporation, 115 Broad St., New York City, owner of the d'Humy Motoramp patents, from whom license rights may be obtained.



FIG. 1. RAMPS OF SHORT LENGTH IN NELSON HOUSE GARAGE

Co-operative Studies of Ozone for Air Purification

A CO-OPERATIVE study of the use of ozone to deodorize and purify the air of buildings by oxidation of organic matter and the possible killing of bacteria has been begun at the Pittsburgh Experiment Station of the United States Bureau of Mines in co-operation with the Research Bureau of the American Society of Heating and Ventilating Engineers, which is housed in the same building as the Experiment Station. Attention is being given to an accurate determination of the percentage of ozone and oxides of nitrogen produced by different types of ozone machines and to methods for determining the very small quantities of ozone and oxides of nitrogen that may be present in the air treated by these machines. Later on the United States Public Health Service will co-operate in the studies of the health and sanitation phases of the subject. The work is being done under the direction of A. C. Fieldner, supervising chemist and superintendent of the Pittsburgh Station of the Bureau of Mines, and Dr. R. R. Sayers, chief surgeon, Bureau of Mines by G. W. Jones, assistant gas chemist, Bureau of Mines; W. P. Yant, assistant analytical chemist, Bureau of Mines and O. W. Armspach, engineer, American Society of Heating and Ventilating Engineers.

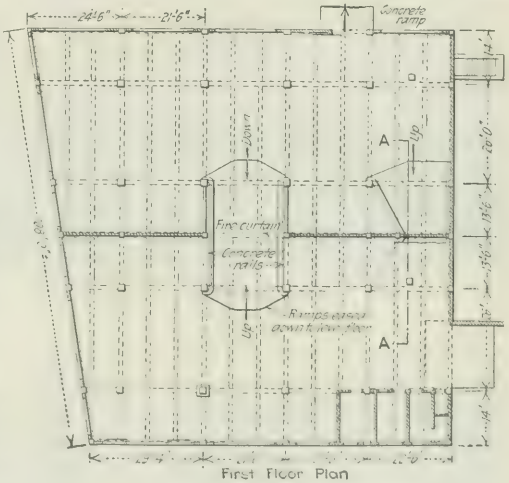


FIG. 2. PLAN AND SECTION SHOWING RAMP ARRANGEMENT

Floor plan of Nelson House Garage at Poughkeepsie. Construction is of reinforced concrete throughout, the beam-and-girder being used.

Collapse of Palm Beach Concrete Arch Bridge

Facts of Accident and Conditions of Work Reported from Inspection Made for Engineering News-Record —Pier Foundation Weakness Most Probable Cause of Collapse—Light Design Believed Contributory

TWO spans of a concrete arch bridge under construction at Lake Worth between Palm Beach and West Palm Beach, Fla., collapsed on Dec. 29 as reported briefly on page 35 of our issue of Jan. 5. Twelve hours after the first collapse a third arch failed. The fallen arches, each about 63 ft. in the clear, were part of a series of seven spans forming the easterly portion of a new highway bridge across the lake, replacing an existing timber trestle with steel draw. They were barrel arches with earth fill, and the filling was practically completed, the plan being to open this section of the bridge to traffic in temporary condition on Jan. 1. In spite of the advanced stage of construction, all seven spans were still on their centering, and this centering was supposed to be fully wedged up. The centering of four spans 10 to 13 are apparently undamaged and the centering under them does not appear to be disturbed.

At the time of the collapse the arch concrete was of various ages from 26 days up to two months or more, the collapsed spans being the youngest. The spandrel fill was being put in by hydraulic dredge pumping, the material being "sand" from the lake bottom. Filling was started at the east end and progressed westward span by span, rather than in uniform distribution. The preceding summarizes the essential points of the general facts available immediately after the collapse.

On account of the exceptional nature of this accident—failure of masonry arches and especially of spandrel-filled barrel arches being practically unknown —*Engineering News-Record* requested a Florida





FIGS. 1 AND 2. PALM BEACH BRIDGE EAST PORTION, BEFORE FAILURE
At left, general view; at right, roadway surfacing in progress on Span 8.

the three collapsed spans vanished with the superstructure and the visible portion of the two intermediate piers. The bridge was being built for Palm Beach county by the A. S. Hecker Co., of Cleveland, under designs by Harrington, Howard & Ash, of Kansas City.

The collapsed spans were those adjoining the draw; the numbering being from the west end of the bridge, in which the draw was to be Span 6, they represented Spans 7, 8 and 9, with intermediate piers 8 and 9 (the draw abutment pier being pier 7). Spans 8 and 9 and pier 9, between them, fell in the first collopse, while Span 7 and its easterly pier 8 fell in the second collapse. Pier 7 remained in place, though the part above water is tilted eastward (*toward* the collapsed spans). The



FIG. 3. CENTERING OF SPAN 10
Typical of all spans.

engineer with large experience in concrete work, R. F. Ensey, M. Am. Soc. C. E., of Eustis, to inspect the wrecked bridge and report on the facts and pertinent conditions. His report is given below.

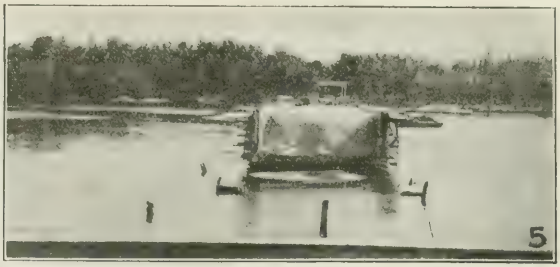
An investigation of the accident for the county by the designing engineers, who were also carrying out the supervision of construction, had been begun immediately after the accident. A formal report to the county by E. E. Howard of the engineering firm, dated Jan. 7, was made public on Jan. 9, and is reproduced directly following the present article. The engineers have advised us that a more technical report will be issued later.

History—Work on the construction of the bridge was begun on Sept. 12, 1921, under a contract let on a second bidding after the first bidding showed the bond issue of $250,000 previously voted to be inadequate. The contract price was $284,900. It was arranged to build the seven concrete arch spans east of the draw and the embankment or causeway forming the east approach this season, and have this part of the structure ready for traffic by Dec. 1, 1921, under penalty of $100 per day's delay. The period was later extended two weeks, and further delay postponed the anticipated time of opening to Jan. 1.

About noon on Dec. 29, the second and third spans from the draw, spans 8 and 9, collapsed and fell into the water. Span 7, next to the draw, was left standing alone. It is said that a seven ton road roller stood upon this span but was hastily removed after the collapse. About twelve hours later, in the middle of the night, this span also collapsed, pier 8 going with it, while pier 7, the abutment pier at the east end of the draw, was left in tilted condition, being tilted *toward* the collapsed section of the bridge.

Bridge Design—The structure was to consist of a 174-ft. steel swing span, five concrete arches and a causeway ap-





FIGS. 4 AND 5. TWO VIEWS OF COLLAPSED PORTION

At left, before failure of Span 7; at right, after failure of Span 7 (abutment pier in foreground, Pier 10 and Span 10 in background)

proach to the west, and seven concrete arches and a causeway approach to the east. The arch spans are 69 ft. long center to center of piers, giving a clear opening of about 63 ft. The abutment piers at the draw are 19 ft. thick and the others 9 to 9½ ft. thick, with tops 2 ft. under water, carrying skewbacks 6 ft. thick. The total length of bridge including causeways is 1,885 ft. The roadway is 30 ft. wide, and cantilevered sidewalks of 5 ft. each make the total width about 40 ft.

The arches are reinforced-concrete barrel arches, 12 in. thick at the crown and 24 in. thick at the skewbacks. The spandrel walls are reinforced, but are broken by expansion joints at the skewbacks and at two intermediate points in each span. The reinforcement of the arch ring consists of ⅝-in. longitudinal bars 7½ to 15 in. apart, ⅝-in. transverse bars 4 ft. on centers in the lower face, and ½ in. transverse bars 8 to 12 in. on centers in the upper face. Dowel bars alternately 9 and 18 ft. long connect the arch barrel and the skewbacks. All reinforcement was deformed. The piers contained no vertical reinforcement, and apparently no bond was provided between skewbacks and piers.

Foundations—The piers were constructed in sheet-pile cofferdams, the material within which was dipped out with buckets and the bottom finally cleaned to rock with a 6-in. centrifugal pump. Concrete was placed under water by tremie; except in the case of the smaller piers the concreting was not continuous. According to the contractor's superintendent, two holes were drilled at each pier 6 ft. into the rock without going through it. The rock is a soft coral rock, into which usually steel sheeting can be driven and sometimes even pine piles.

Centering—Centering for the arches was designed and built by the contractor's superintendent. It consisted of timber framework founded on the piles of the old bridge, of the general type illustrated in the photographic view, Fig. 3, upon which were placed pony bents supporting the arch lagging. No braces, or practically none, were in evidence. The uprights of the centering were fitted up tight against the lagging supports, wedges being used in a few cases to take up slack. As already stated, all of the centering was in place at the time of collapse, though the side forms of the spandrel walls and the forms of the sidewalk cantilevers had been removed in large part.

Conditions After Collapse—The three arches, 7, 8 and 9 and the two piers between them are missing. Abutment pier 7 is standing, but tilted 21 in. toward the missing spans; the pier base, however, is not tilted, and there appears to be a separation in the pier below the water surface.

With the skewbacks gone, pier 8 is still in place, with top several feet under the water surface. Pier 9 has entirely disappeared; the cause of this has not been determined. Pier 10, now forming the west end of the remaining arch spans, stands apparently intact; a temporary fill of sand has been pumped against its west face to increase its stability.

The dowel rods between arch barrel and skewbacks pulled out of the arch concrete easily, especially at pier 7, where practically all pulled out clean. At pier 10 only six dowels pulled out.

Inspection of the concrete suggests excessive use of sand with scant use of very poor larger aggregate. The concrete has, in fact, the appearance of mortar, in most cases. When first removed most of it could be crushed in the fingers. The proportions of the concrete are said to have been 1: 2: 3 for the piers, and 1:2½:3½ for the superstructure.

Comments on the Conditions Found—The design is of exceedingly light type. While no doubt it would be found of sufficient strength when completed, yet it affords scant leeway for contingencies of construction. It is questionable to the writer whether sufficient care was taken to determine the nature of the foundation upon which the safety of the structure depends. The uncertain nature of this coral reef is well known to the writer. In places it is not more than one or two feet thick, increasing in thickness abruptly or disappearing altogether. Instances have occurred where pine piles have been driven through it without difficulty.

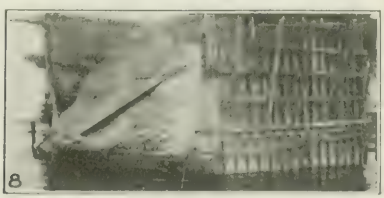
Placing the pier concrete by tremie is apt to produce doubtful results, especially where the process is not continuous. It is probable that the tilting of pier 7 is chargeable to the existence of a joint between two successive days' work. It is to be noted that reinforcement in the piers might have aided materially in stabilizing the structure.

The concrete proportioning should have resulted in a satisfactory concrete, with good materials, mixing and placing. However, the concrete does not appear good.

Probable Cause—Without careful investigation of the conditions under the water at the site of pier 9, it would be







FIGS. 6-8. BEFORE AND AFTER THE SECOND COLLAPSE

At left, Span 7 before its fall; at center, Pier 7 after fall of span, showing its tilt toward the fallen span; at right, skewback end of Pier 7, showing reinforcing rods pulled out of arch barrel concrete

difficult to fix the direct cause of the failure positively. From the conditions found, the presumption is that the cause is to be sought in the collapse of pier 9. I am informed by representatives of the contractor and engineers that no determined, systematic effort has been made to find out what became of pier 9, which would probably throw light on the failure if it did not reveal the cause.

A theory has been advanced locally that the disaster was caused by the successive filling of the arch spandrels from one end, causing an increasing wave of disturbance to travel over the structure until the distortion resulting became destructive. This theory does not seem to the writer to be tenable. The filling of one spandrel space would certainly result in setting up unsymmetrical distortions, but the filling of the next space would counterbalance these, and the arch would then function normally. The factor of safety should be ample to provide for these construction strains, and no permanently transmitted distortion would remain except in consequence of damaged foundations.

While the failure of pier 9 seems the most likely cause of the accident, contributory causes are to be sought in the following:

1—The unusually light type of design and reinforcement.

2—The poor quality of the concrete at critical points.

3—The doubtful nature of the foundation strata, which should have been rigidly developed at each pier over its entire extent.

4—The tremie concreting, and discontinuous concreting, in combination with the omission of vertical reinforcement in the piers.

Credits—I have to add that the information from which the preceding statements and comments have been compiled was obtained from interviews with the engineers' representatives, the contractor's representatives, and local officials, coupled with my personal inspection.

Engineers Report Collapse Due To Improper Filling Method

No Indication of Faulty Materials of Structure or Foundation Failure—Filling Caused Unsymmetrical Loading

AN INVESTIGATION of the collapse of the Palm Beach bridge on Dec. 29 was carried out for the county by the consulting and designing engineers, Harrington, Howard & Ash, of Kansas City, immediately after the failure. It was conducted by E. E. Howard of the firm, in co-operation with the contractor, the A. S. Hecker Co., of Cleveland. The report, made public by the Board of County Commissioners of Palm Beach county on Jan. 9, places the responsibility on unsymmetrical loading caused by the method of filling adopted by the contractor, and in effect, absolves the structure itself from all part in the accident.

The essential portions of the report follow:

We conclude that the accident and resulting damage was caused by improper method of placing the sand spandrel filling over the arch ribs. This filling was placed in a manner which produced unsymmetrical loading of the arches contrary to the stipulations of the specifications. This work was very hastily done as the contractor was pushing all operations with speed in an attempt to open this portion of the bridge to traffic.

There are no indications of faulty or deleterious materials of construction or of failure of supporting bed rock. It can be demonstrated mathematically that the method of placing the spandrel filling which was followed would almost certainly cause failure in such a structure which would be stable and perfect under symmetrically placed spandrel filling.

Part of Pier 7 now standing will have to be removed and certain imperfections in the under-water base concrete which have been developed will have to be repaired and the upper portion of the pier rebuilt; and other portions of the fallen structure restored and replaced. Work will proceed on the other piers and spans not yet begun and on other parts of the structure without change of plans or specifications. The restoration of damaged parts will probably be made toward the last of the job.

Complete record has been made of statements of those who saw the accident, of all observations, measurements, etc., as well as special calculations of loading conditions, etc. If you desire further information or a full technical report demonstrating the above conclusions we can have same ready within a short time.

Jan. 7, 1922. HARRINGTON, HOWARD & ASH,
Consulting Engineers.
By E. E. HOWARD.

Information received from Harrington, Howard & Ash subsequent to the date of the report just above states that examination of the foundations by diving revealed defective pier-base construction which contributed to the failure. An additional statement by wire supports the theory of unsysmmetrical loading:

Further anaylysis of arches under loading existing at faliure confirms views previously expressed but further investigation of effect of defective concrete mentioned in Mr. Howard's report is essential to determine the extent to which it contributed to failure. We plan to make a complete statement when investigations are finished.

HARRINGTON, HOWARD & ASH.

Kansas City, Jan. 20.

Test Work at Underwriters' Laboratories

EXTENSIVE test and research work was carried out at the Underwriter's Laboratories, Chicago, during the past year in connection with building materials and other items of engineering construction. The work included both investigation of the value of new materials and tests to check the maintenance of quality of old ones. Some notes condensed from a report just issued by the Laboratories follow.

Building Materials—Tests were made on a new type of hollow metal window frame and sash which has come to the front during the year. This type is distinguished by heavier material than heretofore used in so-called sheet metal windows. The term "steel plate window" applied to them is likely to be adopted by the Laboratories as a type designation to distinguish them from sheet metal and solid steel windows.

In roof coverings, greatly increased use of asphalt saturated rag felt shingles as compared with the old roll roofing was revealed by the test applications. Asbestos felt shingles are also being developed. These changes are considered to mean a decided advance in the fire protection afforded by roof coverings.

The manner of assembling, or form of construction, is in most cases a more important factor of fire resistance and structural strength than are the properties of the material itself. It is probable that for this reason the Laboratories will soon issue reports on the usual forms of wall and other constructions, giving their ratings in hours of fire resistance (1 hr., 2 hr., etc.).

In routine testing of small hardware it was found that sash chains do not seem to show consistent results in the yearly tests, but display excessive variation in ultimate strength. Door checks show quite uniform results on re-examination. Testing of safes grew to large volume during the year; it appears that standardization of test conditions will be necessary if uniform results are to be obtained.

Sprinkler and Hydraulic Fittings—About 4,500 old sprinklers taken from service were tested during the year. Investigation of breakage of dry pipe valves covered all of the valves on the market; modification of the design of some of the valves resulted from the work. Work on fire-pump controllers, additional hydrants and other important hydraulic appliances of fire prevention or fire fighting is under way and in prospect.

Gases and Oils—A great amount of work was done in tests of gasoline discharge devices, underground storage tanks, and fuel oil burners. Related work of investigation dealt with first-aid fire extinguishers, acetylene generators, gasoline lighting devices, gas producers, waste cans, fittings for dangerous liquids, hot-air furnaces, and gasoline-engine-driven electric lighting plants. The most important work in this range was done on first-aid hand fire appliances. A classification of these appliances was accomplished. Similar classifications of other devices investigated are likely to follow.

Electrical Work—Less work was done on standard wiring devices than hitherto, but more on a large variety of special appliances. Progress in development of standard appliances such as sockets, attachment plugs, snap switches, wire and conduits, seems to be almost negligible. Portable devices, however, developed great activity. A new form of portable cord, rubber sheathed cord, was developed during the year; it is expected to prove very useful under severe service conditions. Standardization of Christmas tree lighting outfits is in sight, to improve the trade of equipment available in this field. Much work was done on enclosed switches, a new product produced in response to objections to open-knife switches. Special testing machines for these switches were built.

Accident Prevention—Hazards in the newer household appliances, such as pressure cookers, sewing-machine needle guards, wringer guards, and the like required to be investigated. Boiler and elevator safety appliances demanded increased attention. Standards for tests of elevator limit stop devices were developed and brought into use. In the automotive field, work was done in four general divisions: Locking devices and test alarms, bumpers and safety fenders, classification of automobiles as to fire and dust hazards, and test of units and accessories such as rear traffic signals, heaters and head lamp lenses. Burglary protection developed into an active field of work during the year, nearly fifty new appliances and systems being examined.

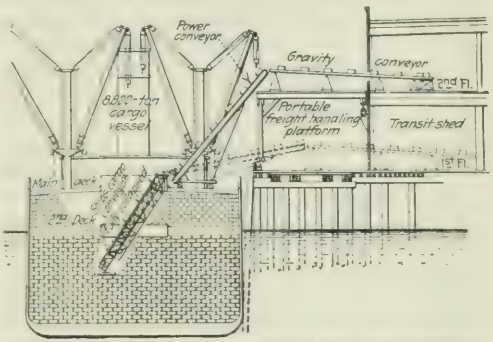
Electricity Production by Utility Power Plants

Electricity production at public utility power plants in the United States for the year 1920, according to the report of the United States Geological Survey for 1920-21, totaled 44,004,000,000 kw.-hr. Of this water power contributed 16,545,000,000 or 37.6 per cent, and fuel power 27,459,000,000 or 62.4 per cent. The increased output over 1919 was 13.1 per cent total, and the increase for water power was 13.3 and for fuel power 12.9 per cent. The fuel used in 1920 was 37,244,000 short tons of coal; 13,123,000 bbl. of fuel oil; and 24,702,000 M. cu.ft. gas, with percentage increases over the preceding year of 6.1, 18.2 and 15.4. The statistics are based on monthly reports from utility companies having an output of 10,000 kw.-hr. About 95 per cent of the 3,900 power plants in this category made returns.

Telescopic Conveyor Halves Time of Handling Ship Cargoes

By G. F. Nicholson
Chief Engineer, Port of Seattle

A LABOR-SAVING device that will double the speed with which vessels can be loaded or unloaded has been developed by the engineering department of the Port of Seattle and will be put in service at that port in the near future. It consists of a compact conveyor which is lowered bodily into the hold of the vessel, its upper end resting on the hatch coaming. By means of a power operated extension that can be thrust out from or drawn inside the main framework, the lower end of the conveyor is kept close to that part of the hold where cargo is being stowed or unloaded. The conveyor is operated by electric motors served by leads from an energy source on shore and at its upper end delivers to or receives from the ordinary power conveyor.



CONVEYOR FULLY COLLAPSED IN HOLD OF VESSEL

The length of the conveyor extended is 45 ft. and when telescoped, that is, with the extension drawn in to the maximum, the length is 29 ft. The overall width is 5½ ft. and the overall depth 4½ ft. Unlike the ordinary conveyor it does not stand upon a truck and can be suspended or supported at any convenient angle. Extensible supports are provided so that the conveyor can be supported at both ends, at one end and the center, or at the two ends and the center. The weight is about three and a half tons which is easily handled by the ordinary ship's boom. The power equipment consists of a 10-hp., 440-volt a.c. induction motor, operating at 1,200 r.p.m. and an auto starter. Silent roller chain drives are used for both conveying and telescoping.

The capacity of the conveyor is roughly rated at 125 tons per hour with an operating speed of 75 ft. per minute. Previous to the adoption of this conveyor, for example, the rate of unloading salmon at Seattle averaged 800 to 1,000 cases per hour. With the conveyor the average rate is about 2,000 cases per hour. While designed primarily for handling cased goods, sacked goods of every description and bales of hemp, cotton, etc., up to 500 lb. in weight are handled. The maximum size pieces which can be conveniently handled are 2½ x 1½ x 5 ft. Larger or heavier goods can be handled by the ship's booms without interfering with the operation of the conveyor as it takes up only a small section of the hatch opening.

The estimated cost of the equipment is $2,100 per conveyor, including extension. Patent applied for.

Road Builders' Convention Stresses Financial and Administrative Sides of Highway Work

Need for Readjusting Sources of Revenue for Road Work Indicated—Material Prices Stated To Be Out of Line with Reduced Labor Cost—Tilt on Motor Vehicle Taxation—Research Results Reported

HIGHWAY financing occupied the top rung of interest in the program of papers and discussions—well balanced as to diversity of subject matter and of marked technical excellence—which the American Road Builders' Association presented at its nineteenth annual convention held Jan. 16-20 at the Coliseum, Chicago. With the road-building and maintenance programs of the 48 states involving the expenditure, exclusive of paving work within city limits, of $600,000,000 in 1921 and promising to reach a total of $720,000,000 for the current year, the need of a balance-sheet showing the relationship between outgo and sources of revenue for highway improvement was clearly indicated. Highway engineers today face a condition in which road construction and maintenance have lagged, during recent years, far behind the development of traffic and a vast program of work must be carried on during the next few years to bring the state highway systems to a point where they can handle efficiently the immense volume of passenger and commercial transport which is demanding service. Coupled with this situation is the country's general economic condition, in which the general taxpayer is carrying a burden which is close to a limiting amount. Papers and discussion at the convention indicated that, in the near future, it may be necessary to readjust the sources of revenue for highway improvement by shifting a greater part of the load upon transportation.

Technical Program Comprehensive

Among the score or more of other subjects considered at the convention, motor-vehicle legislation, traffic analysis and highway research were in the forefront. Design and construction, of course, received considerable attention, but interest in them, while keen, was clearly subordinated to those subjects which had to do with highway economics.

Attendance at the technical sessions ranged from 100 to 200 members, while the Good Roads Show, containing exhibits of 185 manufacturers of equipment and materials, requiring the entire available floor space in four buildings—the Coliseum, the Annex, and the Greer and Wilson Buildings—was the most impressive indication thus far offered in proof of the fact that road building has developed into one of the nation's big industries. A separate article dealing with the exhibit appears in the news pages of this issue.

The convention closed with the election of a nominating committee consisting of R. A. Meeker, Fred W. Sarr, W. D. Uhler, W. D. Sucro, and I. W. Patterson. If rumors which were current at the convention can be credited, there exists in the association's membership an element which feels that the organization is not assuming the position of leadership in the road-building field which the great opportunities before it make desirable. Some of the members feel that the association's work has expanded to such an extent as to justify the employment of a general manager and several assistants. It is expected that some action on this proposal will be taken at the forthcoming annual meeting this year.

With about 110 members and guests present at the first session Jan. 17 Col. H. L. Bowlby, president of the association, in his opening address, outlined the history of the organization and made a plea for closer co-operation among its members. Difficulty had been experienced this year, he said, in finding sufficient floor space for exhibits at Chicago, and unless conditions can be remedied before next year's convention, he indicated that it might be necessary to stage the event elsewhere than Chicago in 1923.

Bituminous Construction

Bituminous construction and the use of local mineral aggregate was the feature at the opening technical session on the afternoon of Jan. 17. H. W. Skidmore, Chicago Paving Laboratory, discussed bituminous foundations, stating that 15,000,000 sq.yd. of "black base" were in successful use today. He pointed to economies in this type of foundation by following the general practice of using 5 in. of "black base" as against 7 in. of concrete. Using information collected from contractors, he stated that a saving of from 25c. to 50c. per square yard could be effected by the use of bituminous instead of concrete foundation. In Providence, R. I., sheet asphalt has been laid successfully on both plain broken stone and bituminous penetrated base, and granite block also has been used on bituminous base.

Wider use of local materials as mineral aggregate was advocated by W. A. Welch, chief engineer, Palisades Interstate Park Commission, New York, who maintained that a leading consideration in the quality of mineral aggregate should be its freedom from fine silt and dust which prevent adequate binding with a bituminous material. Where soft aggregate is used, or the stone is brittle, too heavy a roller compacts the material so closely that penetration of the bituminous binder becomes impossible. Mr. Welch has had equal success with tar and asphalt as a binding material.

Simplification of specifications for asphaltic materials was advocated by L. M. Law, chief chemist, New Orleans Refining Co. The narrow limits sometimes specified for asphalt consistency, he said, increased costs and complicated the work at the refineries without resulting in a product of superior quality. Five-point limits specified for consistency, he believed, are too severe, especially in view of the fact that with ordinary laboratory methods errors of three points, either way, are common.

In his paper on "Specifications for Mineral Aggregates," Roy M. Green, Western Laboratories, Lincoln, Neb., pointed out an objection to what he termed "standardized specifications." Where such specifications are copied blindly by engineers in various localities, the use of local mineral aggregate is frequently precluded and the resultant cost of work increased.

Designating highway finances as the subject of outstanding importance in the road-building field today,

Thomas H. MacDonald, chief, U. S. Bureau of Public Roads, in a paper on "The Highway Outlook," emphasized the need of establishing a highway balance-sheet, national in scope, indicating the expenditures and the returns involved in the development of systems of highway transport throughout the states. Mr. MacDonald's address was, in effect, a broad economic survey of conditions as related to the nation's highway activities, and served as the keynote of a day's session given over largely to the consideration of highway finance. The highway outlook, Mr. MacDonald said, is not determined by any narrow or limited considerations, but by all of the broad social and economic relationships with which road development has intimate contact.

The United States, Mr. MacDonald believes, is facing a competitive industrial period such as has never before been seen. Beginning in 1914, a flood of needed internal improvements has been dammed back in cities both large and small, and includes the construction of buildings, highway improvements, water supply, and sewerage. In highway development, particularly, has the country lagged behind in proportion to the vast increase in the use of roads by motor vehicles.

In describing the national highway balance sheet, Mr. MacDonald placed on one side (1) Funds available; (2) the economic situation; (3) prices and costs for highway improvements. On the other he listed (1) Deferred highway improvements; (2) returns from highway investments; (3) need for easy and cheap transportation facilities.

During the year 1922 it is estimated that for construction and maintenance of highways, outside of city limits, $720,000,000 will be expended; unforseen limitations, however, may materially reduce this total. Expenditures during certain previous years have been as follows:

Year	Expenditures for Highway Construction and Maintenance
1904	$ [illegible]
1914	240,263,000
1917	279,415,000
1918	286,101,000
1919	389,425,000
1920	500,000,000
1921	600,000,000
1922	720,000,000

An analysis of the sources of revenue for highway improvement during 1921 discloses the following apportionment: Motor vehicle license fees, 19 per cent; state road bonds, 7 per cent; local road bonds, 33 per cent; state taxes and appropriations, 12 per cent; federal aid, 14 per cent; county, township and district taxes and assessments 14 per cent; miscellaneous, 1 per cent. Of the expenditure during 1921, about $420,000,000 went into construction and $180,000,000 into maintenance.

Turning from highway finances to the general and economic situation, Mr. MacDonald quoted Secretary of Agriculture Wallace as saying that high freight rates, while not the only factor in the recent industrial depression, are a large one in retarding agricultural recovery. A condition which relates directly to highway financing is the one in which the farmer finds himself at present In Iowa farmers are receiving for corn a price equal to only 65 per cent of the pre-war level; for oats, 61 per cent of the pre-war normal; and for cattle and hogs less than the pre-war normal. In addition they must pay for labor, 132 per cent; for rental on land values, 160 per cent; and for freight rates, 150 per cent of the pre-war level. There exists in the case of the farmer, therefore, a "spread" of from 60 to 70 per cent between what he receives for his product and what he must pay for his necessities. The purchasing power of the crops was stated to be lower today than at any time in the country's history.

The fall letting of highway contracts has been responsible, in large measure, for a reduction in labor costs on road construction, and the chief of the U. S. Bureau of Public Roads made the definite statement that state highway authorities now should not hesitate to let contracts for grading, excavation and similar low-cost types of work in the belief that present prices are not reasonable. Materials, however, have not taken their proper cut in cost, according to Mr. MacDonald. Producers of road-building material and equipment, he pointed out, must meet the lowered labor costs to a greater extent than they have in the past, if highway development is to proceed on the scale which traffic demands.

Illustrating how highway construction has lagged behind motor traffic developments, it was pointed out that between the years 1910 and 1921 the potential number of motor vehicles demanding highway service had shown an increase of 1,800 per cent, while the actual expenditures for the construction and maintenance of roads during this period had increased only 400 per cent.

As indicating the excess of deferred highway improvements, it was shown that in 1910, with 501,000 motor vehicles, highway expenditures totalled $120,000,000, while in 1921, with motor vehicles increased to a total of 9,750,000, the expenditures for highway construction and maintenance aggregated $600,000,000. Due to conditions, some of which, such as the war, were unavoidable, we have been "slackers" in road maintenance for the past half dozen years, according to Mr. MacDonald.

In concluding his address, the chief of the U. S. Bureau of Public Roads maintained that we cannot support a program of highway development as large as that of 1921 without redistributing sources of revenue. Such a redistribution might involve a reduction of taxes on property and an increase in taxes on transportation, in qualification of which Mr. MacDonald pointed out that by higher taxes on transportation he does not have specifically in mind an increase in license fees for passenger automobiles and motor trucks.

Figures presented by Mr. MacDonald showed that during 1921, deducting the amounts paid as motor vehicle fees and distributing the balance on a per capita basis, the cost of highway improvement for the entire country amounted to $4.40 per individual, equivalent, roughly, to a little more than 1c. a day.

Material Prices Out of Line

The discussion following Mr. MacDonald's paper brought out the fact that reduced labor costs for highway construction obtained generally on rural work, but had not extended to so great an extent into the cities. A recent letting of $300,000 worth of gravel road in Oklahoma showed prices as low as those existing in 1914. A number of the speakers agreed with the statement that material costs, in comparison with the present reduced labor rates, were distinctly out of line.

Greater co-operation of all parties interested in the construction of roads was advocated in an address by William Ord, of the Lakewood Engineering Co. He

called upon the American Roadbuilders' Association to assume a position of leadership in this work, which would involve, he contended, the employment by the association of an able general manager and several assistants. An opportunity for co-operation, emphasized in the discussion by Henry G. Shirley, engineer of Baltimore Co., Md., is presented by the separate meetings of the American Association of State Highway Officials and the American Roadbuilders' Association. There bodies, he maintained, should meet at the same place and at about the same time, thus giving highway officials, engineers and contractors an opportunity of attending both meetings. As things now stand, attendance at one session often precludes that at the other, due to the time necessary and the expense involved in making two trips.

Motor Vehicle Taxation

The general subject of motor vehicle legislation, with particular reference to the matter of license fees or other forms of securing revenue, was treated in several papers and elicited a spirited discussion. D. C. Fenner, of the International Motor Co., indicated that the uniform vehicle law drafted by the Motor Vehicle Conference Committee, will probably be revised at an early date, such revision to take the form of a set of general principles in place of the specific detail which it now contains. His statement of principles regarding taxation was that the users of the road should pay for its maintenance, but that construction should be met by some form of general tax.

Prof. Arthur H. Blanchard, University of Michigan, endorsed the financing principle of payment of road maintenance costs by motor vehicle fees, leaving to the state or the county the financing of construction. Higher license fees are needed, in Prof. Blanchard's opinion, to discourage what he characterized as the "wild-cat" highway transport operator.

Decided opposition to Prof. Blanchard's statement of financial principles was voiced by A. R. Hirst, state highway engineer of Wisconsin, who maintained that the motor vehicle operators should participate in the cost of both construction and maintenance. He believes that an equitable distribution would result from placing one-third of the cost of highway construction and maintenance on motor vehicle operators and two-thirds on property in the form of some general tax. Mr. Hirst favors a tax on the valuation of a motor vehicle instead of on the basis of horsepower or gross weight, and in addition, a tax on gasoline. The one-cent gasoline taxes prevailing in about fifteen states, he said, are too low, and the prospect of gasoline taxes amounting to 5c. or 6c. per gal., in his opinion, are near at hand. Wisconsin has been engaged in a bitter fight over the subject of motor vehicle legislation. This year, he predicted that an increase in motor vehicle fees would be put through by the state legislature. The trouble in the past, he said, has not been with the man who owns or drives an automobile or truck, but with a few organizations of motor vehicle interests who oppose any changes in motor vehicle licenses irrespective of their amounts.

Following a paper on highway financing in Minnesota, by Commissioner C. M. Babcock, Charles M. Upham, state highway engineer of North Carolina, spoke on "The Business of a Highway Commission." The point of view he presented was that the state commission is an agency which "purchases" roads that can be maintained at minimum cost and at the same time furnish the tax payers satisfactory vehicle transportation, operated at minimum expense. Under a recently authorized $50,000,000 road-bond issue, North Carolina plans to place under contract this year work aggregating $20,000,000. Faced with the necessity of constructing a large mileage of highway, North Carolina has adopted the principle of building what Mr. Upham designated as "sub-grade" or "progressive type" roads. They are roads which are graded, provided with satisfactory drainage structures, and built with a sub-grade of selected materials—sand clay or top-soil—which will be used now to carry moderate traffic with the idea, at some future date, of constructing a hard surface pavement without loss of any of the previous steps in construction.

Experiments in North Carolina have indicated the desirability of improving the so-called sub-grade highways by placing upon their surfaces a single layer of 2-in. stone which is thoroughly rolled and then treated with an application of bituminous materials. Upon such a reinforced or armored sub-grade highway, according to Mr. Upham, can be constructed practically any hard-surface type which may be required in the future. In the meantime, a bituminous surfaced roadway is supplied, capable of carrying moderate traffic at a reasonable maintenance cost.

Brick Paving Changes

Brick and asphaltic construction were treated in two papers, the first by W. W. Horner, chief engineer, Sewers and Paving, St. Louis, and the other by Prevost Hubbard, chemical engineer of the Asphalt Association. After outlining the work which the National Paving Brick Manufacturers Association had done in reducing varieties of paving brick from 66 to 11, Mr. Horner discussed construction details from the point of view of economic cost. A 4-in. depth, he believes, provides all that is needed for the heaviest traffic, and a 3½-in. brick may be used to good advantage for moderate traffic. As for the brick only 3 in. in depth, Mr. Horner questions whether the reduced life of a pavement of this type is sufficient to justify the small saving in first cost involved in the reduced depth. Engineers generally, he believes, have been unable to approve the choice of the plain, wire-cut, lugless brick which has been the subject of so much controversy during recent years. Of the three types of bedding for brick pavement—plain sand, sand-cement and green concrete (monolithic)—the sand-cement mixture is considered the most desirable, regardless of the kind of filler used. On a concrete foundation Mr. Horner prefers a cement-grout filler, but on a flexible foundation or clay soil, a bituminous filler is preferable. The claim that the ease of penetration with bituminous fillers justifies the omission of lugs is not supported by Mr. Horner's examination of pavement and reports from engineers.

A triaxial diagram, designed as a quick means of determining the proper proportions of sand for sheet asphalt paving mixtures, formed the subject of Mr. Hubbard's paper.

Concrete Highways

In the session given over to concrete highways, Duff A. Abrams, of Lewis Institute, Chicago, stated that the maximum permissible size of coarse aggregate of

concrete in highway work is undergoing a marked change. Several years ago a size as large as 2 in. was considered radical, but now it is common to have aggregate of 3 in. or more in road work. Tests, as ordinarily conducted, for hardness, toughness and cementation value, in Mr. Abrams' opinion, are of little value, and laboratory determinations of wearing resistance have only a remote bearing on the actual wearing resistance of concrete roads in which aggregates are incorporated. Mr. Abrams sounded a warning against the taking of too small samples of material for testing. In the case of fine aggregate, he believes, a 50-lb. sample should be the minimum and in the case of coarse aggregate, 100 lb.

The life of a concrete pavement depends as much on surface finish as on any other factor, according to a paper by H. Eltinge Breed, consulting engineer. New York City. Care in securing smooth surfaces will reduce impact of vehicular traffic to a minimum and thereby produce a lasting pavement. There are, Mr. Breed has found, five causes of surface unevenness: (1) Foreign materials in the aggregate; (2) non-uniform aggregate; (3) poor workmanship in striking off and finishing; (4) cracks, longitudinal and transverse due to frost action, changes of temperature or unequal bearing power of the subsoil; (5) uneven joints, perhaps the most common cause of surface trouble.

The general remedies for surface unevenness are: More strict specifications, exacting good material and workmanship; use of steel reinforcement; division of the road longitudinally; and wide spacing of joints, with the use of dowels. Mr. Breed advocated the reduction of the number of transverse joints to a minimum through the use of longer slabs.

The discussion of Mr. Breed's paper brought out the danger from the employment of steel forms of too light a weight where a finishing machine is employed. The opinion was expressed, also, that the weights of many of the finishing-machines now on the market are excessive.

Highway Widths

Single-track concrete roads, treated in a paper describing work in Vermilion County, Ill., by P. C. McArdle, encountered decided opposition on the ground that any single-track route is inadequate for present-day traffic. The justification for the use of this type in the case of Vermilion County, Mr. McArdle pointed out, was a financial one, since it was necessary to connect the important towns of the county with funds which would have been inadequate had a double-track road been used. Mr. Hirst, of Wisconsin, raised the point as to whether any road should be designed to carry an odd number of traffic lanes, such as three or five. He was of the belief that where a two-lane road needed widening, provision should be made for four lines of traffic. The three-lane road was considered unsafe for traffic. It seemed to be the consensus of opinion that an 18-ft. road was the minimum for two lanes of traffic. The Wisconsin practice, where adequate funds are available, is to construct a durable type of pavement to a minimum width of 18 ft.; where the appropriation is small the road is not reduced in width but is constructed of a low cost type, such as gravel.

An analysis of the traffic census results made late last year in Connecticut, and described in the Jan. 12 issue of *Engineering News-Record*, p. 48, was presented by Dr. J. G. McKay, of the University of Wisconsin; this paper will appear in a later issue of this journal. Dr. McKay recommended the classification of roads, with maximum load limits specified in each case. The Connecticut result indicated that overloading of trucks was not restricted to any one group of commodities carried, thus controverting the theory that the bulk of overloaded trucks carry building materials, such as sand, stone or brick. A summing up of the results indicated that, so far as carrying capacity is concerned, 39 per cent of the Connecticut trucks were found to be overloaded; of this number, 37½ per cent were overloaded on the rear axle, and 40 per cent overloaded on the front axle. The figures indicated, also that 88 per cent of the motor trucks exceeding a gross weight of 25,000 lb., the Connecticut limit, were overloaded.

Research

Highway research was treated in three papers by Clifford Older, chief highway engineer of Illinois; Dr. W. K. Hatt, director of highway research, National Research Council; and A. T. Goldbeck, U. S. Bureau of Public Roads. The ground covered by these addresses was much the same as that in recent issues of *Engineering News-Record.*

The technical sessions were concluded by papers on study of gravels, by W. F. Purrington, New Hampshire Highway Department; cost keeping, by A. R. Losh, U. S. Bureau of Public Roads; and highway contractors' problems, by H. H. Wilson, of Winston & Co. Phillip Sharpless, of the Barrett Co., urged highway engineers against devoting all of their thought to the so-called high types of hard-surfaced road to the exclusion of the lower-cost types, which must be the main dependence in the less thickly populated sections of the country and which can be built economically with the use of local materials in most cases.

Resolutions

At its final session on Jan. 20 the convention adopted the following resolutions: (1) Endorsing the policy of federal aid applied to a definite policy of highways, as provided for in the Federal Highway Act of Nov. 9, 1921, and supporting the Woodruff bill (H. R. 8978) authorizing a federal-aid appropriation for roads of $100,000,000 annually for 5 years, beginning July 1, 1922; (2) condemning advertising signs along highways as a public nuisance and urging legislation for their elimination; (3) advocating grade crossing elimination and condemning the railroads for their "attitude of negation" in respect to such work; (4) objecting to present freight rates on road building materials as inequitable and calling upon the Interstate Commerce Commission and state railroad commission to review and revise existing rates; (5) endorsing the Advisory Board on Highway Research of the National Research Council and pledging support for a policy of efficiency and permanency in highway department personnel; (6) favoring a minimum width of 20 ft. for all trunk highways or roads carrying dense traffic; (7) commending the work of the association's president, Col. H. L. Bowlby; (8) expressing appreciation of the work of the U. S. Bureau of Public Roads and its chief, Thomas H. MacDonald; (9) commending studies of the relationship between subgrade, traffic and road surfaces; (10) favoring membership

for the United States in the International Road Congress; (11) urging the resumption of the publication of the U. S. Bureau of Public Roads' official journal *Public Roads;* (12) endorsing the centralization of road work in Alaska under an inter-departmental board.

Co-Operation Is Keynote of New Federal Highway Bill

Abstract of Address Given at Omaha Convention, American Association of State Highway Officials, by Thos. H. MacDonald

WE comprehend now as we have not understood in the past, the influence exerted upon our national life by transportation. To supply adequate and increased transportation facilities is the motive which has influenced the American people to increase the number of motor vehicles in use since 1910 more than 1,800 per cent. To provide the complement of the motor vehicle, the improved highway, is the underlying reason why the larger funds have been made available from state and federal sources. The proper combination of these two to serve a definite purpose in the nation's economy is highway transportation in the making.

Transportation Increase

More enlightening than any statistical quotation is the graphic picture of motor-vehicle registration and highway funds. The widespread opposition to state programs of highway building during the years from 1910 to 1916 when motor vehicles were pyramiding at an unforeseen rate, the increased funds made available following the Federal-Aid Act of 1916, the stagnation of actual expenditures during 1917 and 1918, the competition of industry of 1919 for materials, labor, and even more important, for rail transportation—all these have played a major part in producing the wide difference between the improved highways demanded by 9,300,000 motor vehicles and the new mileage constructed.

The record for 1920 and 1921 is better, but let each state highway department make plain to the people of its state that for less than three years of the past five since large funds became available, have conditions permitted highway construction on an increasing scale. The facts which are true of construction are true also of maintenance.

The conclusions are self-evident.

1. During the period 1910-1921, the potential number of motor vehicles demanding highway service increased more than 1,800 per cent; our actual expenditures for construction and maintenance increased about 400 per cent.

2. During the period 1910-1918, motor vehicles increased more than 1,100 per cent; highway expenditures 14 per cent.

3. During the period 1918-1921, motor vehicles increased about 700 per cent; and highway expenditures about 260 per cent. But even these figures do not truly represent the differential between the demands for highway service and our actual production.

Those who are a part of these organizations have the good fortune to be engaged in their chosen field when the greatest development that can ever come is taking place. The first two or three years of something more than a decade of major road building have passed. What has gone before has been largely preparatory. What will come after must be largely standardized, largely routine. The highway organizations that come after will not have such opportunities to render good, or, equally true, bad service, or be able to progress so far in a limited time in advancing highway engineering and administration, and in combining the motor vehicle and improved highways into scientific highway transportation.

It is not possible to define for a definite period of time the exact progress made for the United States as a whole, for there is no fixed point common to all the states. Yet, from the standpoint of highway service, I list our outstanding progress for the past two years in this order:

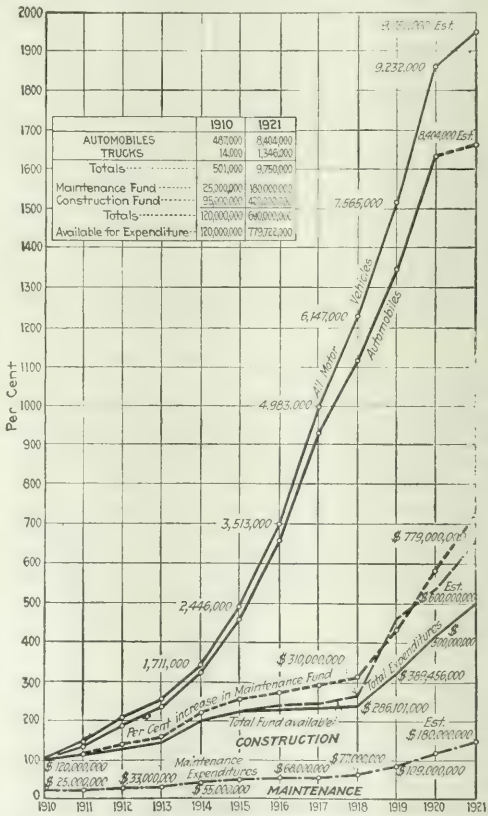
1. The increased highway service made possible through the establishment of proper methods and the expenditure of more adequate funds for maintenance.

2. The increased highway service resulting from new construction.

3. The adoption and enforcement of better engineering standards.

4. The improvement in the administration of highways as a public utility.

Although the new construction has been very large, the mileage of highways of all types that have been brought to a serviceable condition or restored after a period of inadequate repair, is still greater. The outstanding results secured from the distribution of the large quantities of war surplus materials and equipment are found in the better and more extensive highway maintenance made possible. The bureau estimates that by the end of the year war surplus



PROGRESS IN ROAD CONSTRUCTION AND MAINTENANCE COSTS AND AUTOMOBILES IN UNITED STATES, 1910-21

to the amount of approximately $150,000,000 in value will have been distributed for use in highway improvement.

As of Nov. 25 the records of the bureau show that of the total allotments to the states under the two first appropriations, $266,720,000, there has been placed under agreement with the sales federal-aid funds in the sum of $213,048,000 for 28,491 miles of highways. Of this mileage there has been completed the equivalent of 21,000 miles. You will note, therefore, that there now remains the balance of $53,702,000 to be placed under agreement from the old appropriation. From the new Federal Highway Act appropriation of Nov. 9, there was apportioned to the states $24,375,000 and $48,750,000 because available Jan. 1, 1922.

There can be no doubt as to the clear intent of the law to provide for a system of roads which shall include those which are now and which after improvement are to become

the major traffic lines. The different states of improvement to which the states have progressed, and all the variations between them of topography, of population distribution, of industries, of development of natural resources, must necessarily be reflected in the laying out of the system. These details must be worked out between the states themselves and between the states and the Bureau of Public Roads. Because of these wide variations, it is only possible to suggest some of the major considerations. We do not minimize the importance of the local traffic. To care for this class properly will, in general, always be the first objective of highway improvement. Our conception is rather that a choice of highways shall be made which, regardless of the order of improvement, will eventually join into a well-conceived network crossing both county and state boundaries.

As some of the principles which we must properly work out, the following are suggested:

1. The development of parallel lines to divide heavy traffic through thickly populated districts.

2. The development of direct, short-mileage routes, although on these routes there may now be a less amount of improved roads than on routes now followed.

3. The building of inner or outer belt lines around congested centers.

4. The reconstruction of weak sections for heavy truck traffic.

5. The widening of main routes near the largest cities or between cities where the distance is short enough to carry uniform traffic.

6. Proper connections with the routes of adjoining states.

Possibly there are many questions as to the future surfacing policies. The changes in types and specifications which will be sought from time to time by the bureau will be based upon the more accurate knowledge which is being obtained rapidly through research and through the detailed studies of the behavior of modern designs under traffic. The requirement of the 18-ft. surfacing is construed to mean that this is fixed as the minimum two-way road, where the construction is to be considered complete as first put down. This requirement will not preclude the building of a narrower pavement in those districts where the traffic does not yet justify the two-way width. I am yet to be convinced that we may not properly build now in many sparsely populated districts one-half of the final width of pavement in order to complete mileage between points, if all the other work is done to provide for the full width construction later.

Maintenance Provisions of Act

To insure maintenance, the strongest possible requirements have been written into the law. The department may not slight its responsibility, and the attitude of the whole national administration demands the utmost fidelity in the continuous upkeep of the highways built.

The bureau earnestly hopes that it will not be required to take over a single mile of highway for maintenance, but the responsibility is imposed, and this provision of the law will be enforced to the letter. It is a well-established principle that proper maintenance will result only if some form of patrol is organized that places direct and continuous responsibility upon someone for the condition of each mile of road, and the bureau will not consider that the states are properly living up to the requirements of this act until such a system is established.

Mutual Responsibilities Imposed

The Bureau of Public Roads will proceed under the provisions of this act on the assumption that each state will recognize the mutual responsibilities imposed upon the state and upon the federal organizations, and will bring its operations at once into harmony with all the provisions. Also, that each state will in fairness recognize the greater responsibilities, restrictions and requirements imposed upon the bureau. The bureau does not seek initiative. It does not seek to direct the states but to co-operate with them. There is now a plan of action for the guidance of both organizations that is so clear and so explicit that neither can escape the responsibilities imposed.

Referring once more briefly to the diagram, it is evident that a great misconception exists in the public mind as to the service which is being rendered by the highways. During the long period that construction and maintenance were lagging far behind the increase in traffic, it is not to be wondered at that our highways showed a material depreciation. Through the war period, with the greatly increased use of heavy traffic units, particularly at just the seasons of the year when the road surfaces are carried on weakened subgrades, some roads did break up seriously. But this depreciation in general has not continued, and more than this, the effect of the lag in maintenance has been practically obliterated by the increased maintenance during the past three years, and by the reconstruction of the weaker sections, until our roads are in a far better condition today than they have ever been in our history. This fact in itself controverts successfully any general accusations against our modern highways of failure to carry the loads imposed.

Provision for Transportation Paramount

The whole purpose of highway building is to make possible highway transportation, and the cost of the transportation must be reduced as low as possible. Therefore, restrictive legislation which limits too greatly the loads to be hauled on the highways should not be tolerated, as it is against a proper public policy. Legislation regulatory of the traffic on the highways should take into account that there are many factors which govern the traffic depreciation of our highways. Laws which blindly fix some maximum weight to be moved on the highways may prohibit the really profitable traffic and allow less economical and more destructive vehicles to operate practically unchecked. Both weight and speed are major factors in their destructive effects upon the highways, but the distribution of the load, the relation of the sprung and unsprung weights, the tire equipment—all have an important effect.

From the research of the past two or three years, and from the practical experience of the highway organizations, we are accumulating sufficient knowledge to engage understandingly on a determination of the character of legislation which will result in a sound public policy. The solution of highway transportation lies in the proper adjustment, no less of the motor vehicle to the road than of the road to the motor vehicle.

Because the system will for a long time be non-uniform in its carrying capacity, much discretion should be allowed the state highway departments in determining the loads which are to operate upon specific sections of highways, and further, much discretion should be allowed the departments in the making of seasonal restrictions where climatic conditions are such that there are periods when the roads, normally fully capable for carrying heavy loads, are for a short time carried on uncertain subgrades. Here is an opportunity for the highway builder and the motor truck manufacturer to co-operate to serve the public's interest.

Need To Preserve Existing Mileages

One other point is causing the public much concern. It is often stated that highways have gone to pieces and must be rebuilt. Engineers have been prompt to develop methods of improvement which are salvaging practically the full value that was originally invested in the highways. For example, some of the older macadam roads in New York State, lightly built, which are now heavy traffic lines, have been widened by concrete roadways on either side preserving a strip of macadam, say 6 ft. wide in the center, thus giving a 24-ft. usable surface by the addition of 18 ft. of new construction. The remainder of the macadam width is scarified and the material spread to form a better base under the new construction.

This is only one example of so many successful operations of like reconstruction that it may be taken as a principle that if roads are well maintained when traffic becomes so heavy that reconstruction is necessary, the major part of the investment can be preserved and be built into the new highway as an integral part. It is my judgment that our heaviest traffic lines of the future will be developed in this manner, for we must recognize the principle that at the present time the big task is to get a mileage of surfaces that can be maintained under the traffic. The principle that we should remember is to do the fundamental work right.

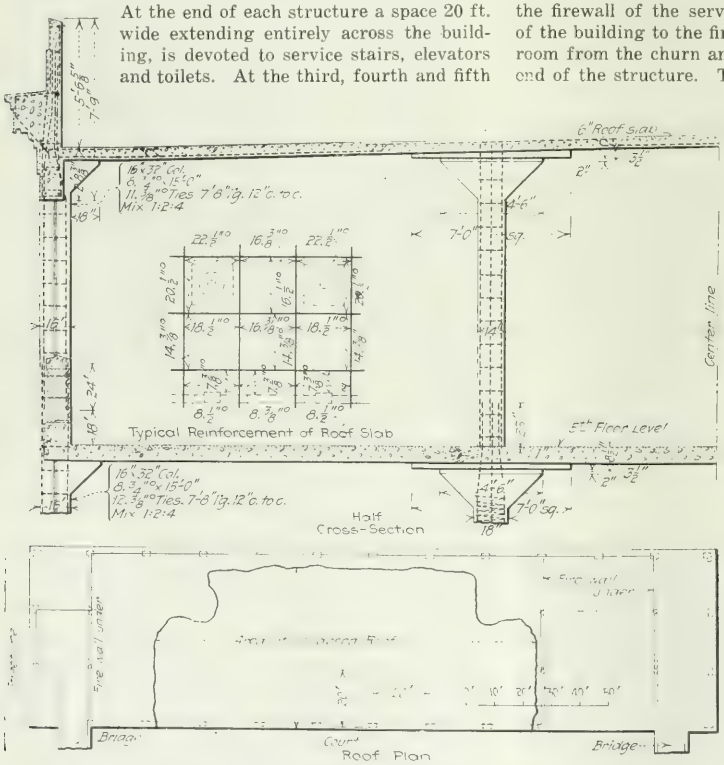
Liquified Rubber Fire Wrecks Concrete Roof

Highly Inflammable Liquid in Tanks Catches Fire and Severely Tests Strength of Reinforced-Concrete Building in New Haven—Construction Joints Planes of Weakness

By A. B. MacMillan
Chief Engineer, Aberthaw Construction Co., Boston, Mass.

ON THE evening of Nov. 30, 1921 a severe fire broke out in the top story of one of the buildings of the Seamless Rubber Co.'s plant on Hallock St., New Haven, Conn. The extent to which the structure, on the one hand, suffered damage and, on the other, resisted tremendous heat offers interesting material for study.

The main element of the Seamless Rubber Co. plant consists of three structures, each 240 x 60 ft. and each separated from its neighbor by a court 60 ft. wide. At the end of each structure a space 20 ft. wide extending entirely across the building, is devoted to service stairs, elevators and toilets. At the third, fourth and fifth stories these service areas are connected by means of inclosed reinforced-concrete bridges. Level with the second floor, the court between each two buildings is roofed with continuous skylights, which afford additional well lighted space for manufacturing purposes.



DETAILS OF RUBBER DIPPING BUILDING WHERE SEVERE FIRE OCCURRED

The construction of the plant throughout is of reinforced concrete, with brick spandrel walls under the sash, which is of steel glazed with clear glass. Partitions and fire walls are of tile plastered on both sides with cement plaster. The floor and roof design offers a typical two-way reinforcement flat slab with drop panels supported by round interior columns. The columns are spaced 20 ft. apart, on centers, each way, and divide the building into twelve bays longitudinally, and three transversely. The drawing herewith shows the detail of that part of the building affected by the fire.

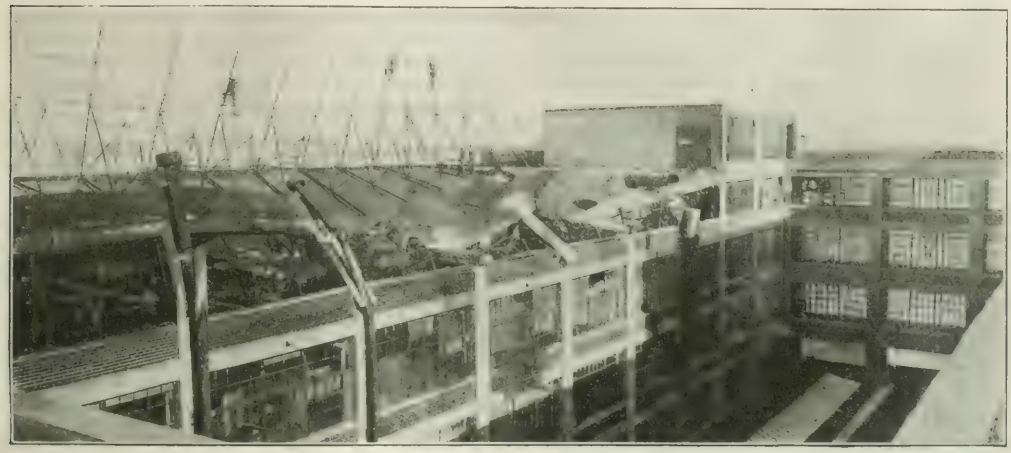
It is to be observed that the fire, which occurred in the dipping room on the fifth floor of Building No. 1, was confined to a limited area 160 ft. long by the width of the building. To be exact, it extended from the firewall of the service area at the Hallock St. end of the building to the firewall which divided the dipping room from the churn and the tank room at the opposite end of the structure. The dipping room where the fire occurred was devoted to the one process, used in manufacturing rubber gloves and other similar articles which are made by successive dipping of molds in liquified rubber.

Forty dipping tanks, each having a capacity of 600 gal. of mixed benzine, benzol, rubber and other ingredients, were located in this room. Into these tanks the molds on which liquified rubber was to be deposited were dipped and raised by specially devised mechanical apparatus. The hazard of a process which employed large quantities of highly explosive liquids was realized by the manufacturers. It was not the intention to carry on this process in the main plant. But, during construction, conditions arose which made it desirable to concentrate this process, with all others, in one connected group.

The buildings in addition to their precautionary construction were well equipped for fire fighting. A sprinkler system had been installed throughout which in time of need could draw water from a tank of 100,000 gal. Standpipes were placed at several places and were fed by two fire pumps each having a capacity of 1,000 gal. of water per minute at a pressure of about 100 lb. These fire pumps, further, were arranged to draw directly from the salt water of the harbor. In the department in question additional precautions were taken to remove inflammable gases by means of pressure and exhaust fans; and, as a further safeguard, the dipping room, churn room and tank storage room were all piped so that in emergency valves could be opened and each or all of the rooms be filled with live

steam. The possibility of utilizing the foamite system of fire fighting had been considered, and while it had not been adopted, tanks of the solution had been installed.

Yet, in spite of precaution, fire came. About 8:30 o'clock in the evening as the molds were being raised from one of the tanks, a minor explosion of gas occurred. It was instantly followed by a rush of flame which scorched the workman in attendance at the tank. The other men on the floor endeavored to put out the fire, but their efforts were vain and they were forced to abandon the room. Then the steam lines were turned on, the automatic sprinklers operated, the fire doors were closed and a general alarm was sounded. Shortly after the fire had gained headway the glass in the sash gave way, allowing free play to the wind, which was blowing vigorously against the long side of the building. This fanned the blaze into increasing violence.



LOOKING TOWARD TOP FLOOR OF WING AFTER THE FIRE

The firemen who fought the fire state that for concentrated fury their experience offered no parallel. It is reported that, not long after the beginning of the fire the top of the roof slab was bright red hot. The first signs of failure of the roof slab, however, became apparent several hours later, in the settlement of portions of the roof slab, a collapse which continued until the area shown in the drawing was wrecked. Several conflicting statements as to the time within which failure began have been received. These allow varying periods, from the third hour to the sixth hour after the fire began before any apparent signs of collapse were noted. It is possible that the exact sequence of effects produced by the fire will remain unknown; but in general the progression was probably much as follows:

The first influence of the intense heat would be to cause expansion in the roof slab, local at first, but gradually becoming general. If the statement made by the firemen that the top of the slab was red hot is ignored, and only objective evidence is credited, a temperature of not less than 600° F. at the top of the slab was reached. This is indicated in the fact that the pitch and felt forming the roof covering was reduced to a brittle cinder. Heat was approximately 600°, provided direct flame did not attack the roofing, would, I believe, be necessary to produce such destructive distillation of the roofing material.

Using the coefficient of 0.000006 for expansion and taking the normal temperature of the roof at not more than 70°; allowing the length of the heated slab to be 160 ft., we have 600° — 70° × 160 ft. × 0.000006 which would mean a movement of the roof amounting to approximately 6 in., provided the surface was uniformly heated from one end to the other. Such extensive general heating probably did not obtain. On the other hand the degree of heat at the bottom of the slab was, without doubt, far in excess of the 600° suggested.

If the statement made by observers that the fire progressed successively from one tank to another is credited, it is conceivable that an area of the slab might be heated to a degree that would cause failure by compression of the concrete, provided the surrounding concrete acted as a restraining member and resisted the expansion of the hot area. The probability of failure would be augmented by the inequality of heat distribution through the slab. An intensity of heat greater at the bottom than at the top would cause more rapid and extensive expansion at the bottom of the slab than would occur at the top.

The tendency of such expansion would be to produce deflection at the center of the panels. Stresses in other members, such as the columns, and surrounding slabs acting to resist the movement of the heated area, would result. If we assume that an isolated portion of the slab may have been subjected to local heat, then it is apparent that the concrete in the isolated portion would have experienced combined stresses from bending due to its own dead-load acting as a beam, and direct thrust due to the expansion caused by the heat against the resistance afforded by surrounding concrete and steel. Considering the ability of the slab, acting as a strut, to transmit stress, it is apparent that bending, due to inequality of expansion and to the dead-load, would cause an eccentricity of the axis of the strut; and, as the least diameter of the strut cannot exceed the thickness of the slab it is

further apparent that its ability to carry load as a strut would be reduced in proportion to the length of the area heated.

If the ultimate strength of this concrete, which was composed of one part portland cement, two parts sand and four parts trap rock, be assumed at 3,000 lb. per square inch, and its modulus of elasticity at 2,500,000, then a change caused by an increase of one degree in temperature would result in a stress of 2,500,000 x 0.000006 or 15 lb., and an increase in temperature of 200° F. might be expected to overcome the ultimate strength of the concrete.

In so far as may be determined, however, failure of the concrete did not begin to take place until temperatures vastly greater were attained. This doubtless is due to the gradual yielding of various parts of the structure. That expansion occurred and that corresponding yielding took place may be judged from the cracks which appear in the columns and beams within the service area of the Hallock St. end of the building



NEAR VIEW OF FLAT-SLAB FAILURE FOLLOWING FIRE OF LIQUID RUBBER

which the flames did not actually reach. Owing to the conditions which existed at the time of my own visit, it was possible to make similar observations satisfactorily at the opposite end.

A second effect which may be noted is that the shafts of the round interior columns were invariably spalled badly just below the column head; and the columns that failed, and are not so covered up with derbis that they may not be examined apparently gave way within about one-quarter of their height from the top, while a secondary break occurred one-quarter of the height up from the bottom.

It is reasonable to conclude that the weakening of the neck of the column, due to spalling under the intense heat, combined with eccentric stresses from the expansion of the roof slab, caused one or more columns to fail, whereupon the unsupported weight of the slab was sufficient to cause the gradual collapse of the other parts of the structure where heat was most intense.

That such conclusion accords with the facts is further supported by the position in which the various fallen fragments of the structure lie, and from the appearance of the bars which project from these portions still standing. These projecting bars exhibit tapering ends drawn to about ¼ in. in diameter by tension.

It is further interesting to note that the wall columns in falling fell in toward the floor. Without doubt the joints in these columns at the top of the wall beams, where pouring began formed a plane of weakness. The design drawings require the reinforcement in the fourth story columns to project thirty diameters into the fifth story above the joints at the wall beam, so as to form a lap with the reinforcement of the fifth story columns. The majority of the wall columns that failed did so through the pulling out of this lap. In the case of one column the bars did not actually pull out but were torn apart.

Ponded Water Safety Factor

Practically all of the roof or wall material which collapsed fell inward on the fifth floor, and the skylight in the area below suffered only the damage of broken glass from the dropping of a few bricks from the spandrel walls. Fortunately the floor scuppers provided along the wall proved insufficient to carry away the tremendous flood of water that was poured on the fire. Hence a pond collected, which measured in depth from the floor to the water line on the partition walls not less than eighteen inches. This providential pond probably prevented the burning naphtha from pouring out through the scuppers and spraying the surrounding buildings with unquenchable fire. It also served effectively in protecting the floor slab from damage. An examination of the under side of this floor slab disclosed but one longitudinal crack and that of little importance—which may be attributed to the fire. Virtually no water leaked through the floor slab, either at construction joints or elsewhere; but water did escape under doorways and flow down stairways and elevator shaft, thus causing some minor damage to materials in the plant.

The firewalls of plastered tile and the tin-clad fire doors which fixed the limit of the room area served their purpose effectively in stopping the progress of the fire. The surface of the fire-wall shows many craze cracks, but only in one or two places has the plaster been spalled. This may be attributed partly to the deep and generous keys in the face of the tile and partly to the fact that the covering plaster was composed almost entirely of portland cement and sand, only sufficient hydrated lime being added to make it workable.

The remarkable feature of the whole conflagration is that, despite the severity of the flames the resulting damage was confined to the actual area in which the fire originated. Hardly more than 10,000 sq.ft. of floor space out of a total of 300,000 sq.ft. in the plant was put out of commission. That such localization of damage could result under similar fire conditions with any other usual type of construction is unimaginable. Reinforced concrete has again met severe test and justified itself.

As the clearing of the debris of the damaged floor proceeds it will be possible to observe and to study more carefully the indications which will be revealed and hence to draw conclusions more accurate than any now possible. Yet it is fair to conclude that there is no fire fighting safeguard adequate to overcome the hazards of the dipping process and afford sure protection to the building where they are housed. Such

process should be completely segregated; preferably in one-story buildings, probably of timber construction, so situated that even if fire occurs adjacent structures will be protected both from communicated fire and from the effects of all too possible explosions.

Some Further Observations on the Rubber Company Fire

By J. Wm. Moffett
Chief Engineer, the Sperry Engineering Co., New Haven, Conn

THE recent fire in the fifth story of the Seamless Rubber Co.'s Building No. 1 again demonstrated the futility of the word "fireproof" except in a relative sense, and the inefficiency of our modern fire-fighting apparatus under certain conditions. In this case the fire protection consisted of a wet pipe sprinkler system with the usual supplies, a steam jet system, and fire alarm boxes on each floor which promptly brought out the city fire department.

The fuel that fed the fire, a rubber cement with a naphtha vehicle in open tanks, was practically consumed before the fire was quenched. The high temperature maintained for several hours would have brought down any building structure no matter what the materials. An area of roof slab approximately 60 x 160 ft. collapsed, dragging down interior columns and the pilasters on the south side of the building. The pilasters on the north side remained standing undoubtedly due to lateral stiffness afforded by a cornice approximately 24 in. wide. There is no such cornice on the south side.

The sequence of events was apparently as follows: The flames from the tanks were more or less concentrated on the areas of the roof slab immediately above. The burning continued until the cement in the concrete was calcined and permitted the heat to reach the reinforcing bars. The bars were heated to a temperature at which they were drawn out to a pencil point by the dead load of the slab, whereupon they snapped and allowed large sections of the slab to sag.

The construction is flat slab. The flames were also attacking the interior columns at their highest plane of weakness or just below the junction of the shaft with the flaring capital. The photographs indicate very clearly what happened in the way of destroyed cement with spalling off of fireproofing on the outside of the 14-in. diameter columns. The great flexural stress caused by the sagging slab pulled over these weakened supports and dragged down the south pilasters at the same time.

The pilasters were 16 x 32 in. with eight ¾-in. round bars vertically and ¾-in. round ties 12 in. on centers. The bars from the pilaster below were extended up about two feet to act as dowels for the pilaster above. The concrete on the outside face broke away leaving the dowels sticking up. The ties were put in as a single hoop. If there had been cross bonds or ties through the center of the member this individual item of the failure might perhaps have been retarded.

Those who advocate cable clamps for bonding reinforcing bars probably would consider this good material. If the bond between the dowels and the main reinforcement had been positive, the cantilever beam action in the column would have been maintained until either the elastic limit of the outside bars had been reached or the concrete had failed in compression at the inside face.

It was of interest to note along the main lines of fracture of the slab the free ends of many rods as well as the tapered ends of the broken bars. As noted above, the concrete along these fractures was so friable that the trap rock aggregate could readily be picked out and the sand matrix crushed between the thumb and finger.

The concrete in the floor slab on which the fire occurred was apparently not greatly damaged, probably due to the protection of 12 to 18 in. of water from sprinklers and fire hose. The scuppers in the side walls must have been partly choked with the rubber cement, some of which floated on the water. There are several cracks which developed mainly along center lines of columns.

Large cracks opened in lintels at both east and west stair towers at the ends of the building, mute witnesses of the great expansion of the building under high temperatures. It seems strange that more well defined cracks are not in evidence in the pilasters supporting the fifth floor.

A remarkable feature in connection with the fire is that 6-in. terra-cotta partitions, with ½ in. of cement plaster on each face, served as effective fire walls at each end of the flame swept section. A standard three-ply tin clad fire door, although warped out of shape, and a pair of Kalamein doors with the wood under the metal covering deeply charred, held back the destroyer of the concrete structure. [Further data on the fire in this building appear in the *Quarterly* of the National Fire Protection Association, Jan. 1922.—Editor.]

Municipal Construction Cost Records Must Be Kept in Minnesota

CONSTRUCTION cost records of all municipal work in Minnesota over $1,500 in amount are made compulsory by Chapter 274 of the 1921 statutes. This act was originally drafted by the Northwestern Association of General Contractors. It applies to cities, counties and all other political subdivisions of the state. Under the act, whenever any political subdivision decides that any public work or construction is necessary, whether it is to be done by day labor or by contract, an estimate of the cost must be made and if the estimate exceeds $1,500 then the actual figures must be published in the official newspaper. When the work is carried out cost records must be kept and on completion these records must be published. The records and accounts must be open to public inspection at any reasonable time and certified copies of the same must be supplied at cost to any citizen who desires them and pays the required fee. The statutory provision as to the nature of the cost records is as follows:

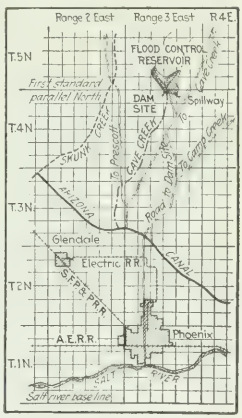
> The said account shall show in accurately tabulated form, under appropriate heads, the totals of all classes, kinds and descriptions of work performed and of materials entering into such public work or construction, and the cost to such municipality, political subdivision or public agency of each, including the cost of all materials, supplies and services furnished or paid for by said municipality, political subdivision or public agency, and the cost of all labor, when said work or construction is done by contract the prices paid to the contractor for, and the amounts paid to him for each class, kind or description of work performed, and materials furnished; and in all cases, the cost of all overhead, the cost of engineering, and all other expenses involved in the total cost of such public work or construction, which total shall be tabulated and distinctly shown

Progress on Flood Prevention at Phoenix, Ariz.

Joint Bodies Interested in Control of Cave Creek Perfect Plans for Construction of Multiple-Arch Dam

FOLLOWING the flood in Cave Creek at Phoenix, Ariz., on Aug. 31, 1921 (*Engineering News-Record*, Sept. 15, 1921, p. 464) steps were taken toward controlling the flow in the stream by the construction of a dam in its headwaters. James B. Girand, of Phoenix, was put in charge of the work. Progress on the project to date has been obtained from him, as follows:

Cave Creek has a drainage area of about 210 square miles, and is rarely in flood; disastrous floods are probably three to five years apart. The creek loses itself on the desert just north of the Arizona Canal where its channel disappears and it is spread out over a considerable area extending from a point west of Glendale to the western portion of the city of Phoenix. The last disastrous flood occurred during the past summer, and while the damage was variously estimated at from $50,000 to $500,000, it was probably nearer the former. It broke the main Arizona canal in twenty-one places and deposited a considerable amount of silt in this canal which necessitated cleaning it out at considerable expense; it also covered some of the fields with silt and destroyed crops in others. The water stood about 2 ft. deep at the state capitol building and flooded the basement, causing considerable damage to records stored there.



PHOENIX, ARIZ., AND VICINITY, SHOWING LOCATION OF CAVE CREEK CONTROL DAM

It is proposed to stabilize the flow to a maximum of 1,500 sec.ft.; it was thought that the peak of the last flood probably reached 33,000, but only lasted for perhaps thirty minutes. The reservoir created by the dam will contain approximately 13,000 acre feet, with natural spillway about one mile east of the dam-site. The dam is some 1,700 ft. long.

It was originally intended to build an earth-fill type of dam, but it is now proposed to build a multiple arch. Bids were asked for the earth-fill type, of a design made by the board of engineers appointed by the various parties in interest, which parties consist of the state, because the state house was directly in the path of the floods; the county, because of the roads and bridges in the path of the floods; the city, because of the streets and irrigation ditches in the city; the Salt River Valley Water Users Association, because of its main line canals and numerous laterals; the Paradise Verde Irrigation District, which project is in an embryonic stage, but is situated north of the Salt River Valley Project and which contains a considerable area, directly in the path of the floods from Cave Creek. Added to this, of course, is the interest of the public who have their homes, farms, etc., in the vicinity.

In asking for bids the board insisted that bidders might submit alternative plans. There were only four bids received from two different contractors, and only one bid on the dam as designed by the board. As this bid practically exhausted the appropriation, the contractor's earnest money was returned to him.

Lynn S. Atkinson, of Sacramento, submitted two bids, one for the earth-fill type of dam and the other for the multiple arch, which had been designed by John S. Eastwood. The bid of the latter design was accepted by the control board, and Mr. Atkinson is now preparing to enter into a contract with the board to begin its execution. The location of the dam with relation to Phoenix and the surrounding country is shown in the map herewith. The dam site is reached by paved road to the Arizona Canal, and then a fairly good cross-country road, the total distance being about 22 miles. The dam will contain some 18,000 to 20,000 cu.yd. of concrete, with 42-ft. bays and an extreme height of some 60 ft. above the present bed of Cave Creek, with footings extending to an impervious cemented conglomerate of varying depths up to 28 or 30 ft. It is to be provided with control gates and automatic siphons.

Supervision of construction is in charge of Mr. Girand, who is operating directly under the board of engineers appointed by the various parties in interest, as stated above. They are: V. A. Thompson, city manager, for the city of Phoenix; Thomas Maddock, state engineer, for the state; Harry Vernon, county engineer, for the county; C. C. Cragin, chief engineer, for the Salt River Valley Water Users Association, and E. W. Michaels, for the Paradise Verde Irrigation District.

Why Engineers Should Join State Engineering Societies

IN a letter of appeal to the engineers of Iowa, J. H. Dunlap, president of the Iowa Engineering Society, included the following reasons, aside from the technical aims, why all engineers should become members:

The chance to serve the state by assisting in the work of such committees as the committee on legislation, the committee on professional practices, the committee on standard contracts, services and fees. Proper laws, proper professional ethics, proper services in return for fees, all need your active co-operation.

The chance of becoming acquainted with the members of a society numbering 550 members, scattered over the entire state, through attending annual meetings, district club meetings, council meetings and committee meetings. What engineer should sentence himself to a hermit's death so far as knowledge of his technical brethren is concerned?

The chance of helping to interpret the engineer to others and to himself by wise methods of publicity, so that his services may be in proper demand. Why do your brothers have to accept work in competition with each other and at cut-throat prices? What are you doing to increase the service of engineers, in order that increased recognition may result?

The chance of furthering good citizenship in local communities by directing our district clubs into ways of increasing service. Why not conceive a community as a big engineering enterprise, and then do your part to assist in directing the enterprise? To whom does this government belong, to you, or to the other fellow? Why disenfranchise yourself and become a man without a country, by neglecting to assume the responsibilities as well as the privileges of citizenship? Are you passing the buck at this point, indulging in the famous American game?

Airplane Forest Patrol Makes Good Western Record in 1921

IN VIEW of the discontinuance of the appropriation which made possible the co-operation of the Air Service and the Forest Service in patroling forested areas by airplane, interest attaches to the results of the past season's work in spotting forest fires from the air. The effectiveness of air patrols equipped with radio, is shown by the statement of the Forest Service that during the 1921 fire season in California of 595 fires reported by airplane, 288 were "spotted" within one-quarter of a mile of exact location and 422 had been reported to Forest Service men within ten minutes after discovery. In Oregon this season 653 fires were reported. Of this total 482 were reported by radio from airplanes and of these 339 were reported to Forest Service stations within ten minutes of discovery by the aërial observer.

It is now pointed out that radio compasses at the



VIEW OF FRESHLY STARTED FIRE FROM AN AIRPLANE

landing fields could be used very effectively in locating a plane circling over a fire. With radio compasses at two or more ground stations whose distance of separation is known, the exact position of the fire could thus be readily located on the map. This plan would obviate the necessity for an observer in the plane, as the pilot could easily trip an automatic transmitter that would operate while he was over the fire. The season's experience in California has shown that radio amateurs for operating the ground stations can be readily secured.

Many instances are cited to show the superiority of airplane observation for this work as compared to the lookout stations maintained by the Forest Service: in case of large conflagrations Forest Service officers can be taken for aërial reconnaissance, thus saving invaluable time in organizing the fire fighting forces. Where necessary serial photography may be used as an aid in planning method of attack. In the case of small fires in rough country the aërial observer can spot the location more accurately and usually quicker than the "lookout" or observer stationed on a mountain peak. These mountain stations, however, are to be continued even if the plan of air patrol is again made possible.

Research in Civil Engineering as a Career

Large Possibilities for Benefit to the Community—Field for Activity Wide—Governmental Research Agents Underpaid

By Alfred D. Flinn
Chairman, Division of Engineering, National Research Council

CIVIL engineering is less commonly in mind in connection with research than are electrical, mechanical, chemical and metallurgical engineering. Nevertheless, new facts about materials and methods and other data on which to base the safe and economical design, construction and maintenance of the great variety of structures embraced in the practice of the civil engineer are much needed. Research in civil engineering fields as a career distinct from professional practice, offers fewer opportunities for immediate connection to the manufacturing industries with the possibilities for inventions and patents, so often alluring to young men. Possibilities for benefit to the community, however, are large, although yielding less tangible commercial rewards.

Yet civil engineering in its greater projects utilizes, in some measure, all results of research in mathematics, physics, chemistry and other branches of science and the developments in the more specialized fields of engineering. Need for research in civil engineering subjects has been less keenly realized because so many of these subjects have come to be commonplace. Everyone feels contemptuously familiar, for example, with the dirt we tread beneath our feet, but many an engineering structure has failed, or has been more costly for lack of real knowledge about various kinds of earth. We need to know much more about the earths as the support under foundations for highways, railroads and structures; about earths as materials for dams and dikes; about the pressure of earth against retaining walls, and about the movement of earth in landslides. We need to know more, also, about the art of constructing foundations with regard for the supporting earth or rock.

Fields For Research

Transportation of goods and passengers on highways, railways, waterways, and airways, demands thorough restudy for it is being profoundly affected at this time, by invention and by sociological changes. Not alone the structural features of the ways of transportation and the vehicles used thereon, demand improvement, but the broad economic and social problems connected with transportation need fundamental examination.

Harbors and railway terminals, with all their appended facilities, have many problems of great consequence unsolved in the modern sense. Here again there are not only physical problems, but questions of economics and of the organization of our great communities.

Hydraulics, although a field in which there has been much experimentation, has numerous problems for which better solutions are desired, especially for application on large scale. Such problems relate to stream control, water-power development, aqueducts, pipe lines and sewerage systems.

American engineers pride themselves on their wonderful steel bridges and skyscrapers, but much ignorance is concealed in every one. Occasionally some great disaster sounds a warning that more and better

knowledge is needed. A judicious combination of experiments and mathematical studies might improve our systems of design and methods of construction leading to greater safety and economy.

Portland cement has come to be one of the most important engineering materials. Not enough is known about its manufacture nor its use in concrete for many purposes. The chemist and the mineralogist should co-operate with the engineer in extending the studies already made, of which there have been many.

Town, city and county planning have been popular fads with engineer, architects and reformers in recent years. While the subject has received some serious study, the underlying principles deserve to be the subject of much more thorough research than has been expended upon them. Several novel solutions of our great community problems have been offered. Their examination and further attempts to solve these problems demand broad and thorough knowledge of many branches of civil engineering, economics, government and sociology.

Disposal of sewage and trade wastes demands research so that our sources of water supply and our rivers and harbors may be protected from dangerous and offensive pollution, and that the pollutions which have already been perpetrated may be ameliorated. For research in this field, co-operation of engineers, chemists and technologists is requisite.

Civil engineering devotes its attention chiefly to subjects of immediate utility to mankind. This desire for foreseen and definite utility distinguishes the work of engineer experimenters and students from much of the work of scientists, particularly in so-called fundamental research. The subjects mentioned are only examples which have occurred to the writer as illustrative of the opportunities and needs for research in the fields of civil engineering.

Research in civil engineering has been done in many instances by special assignment incidental to large engineering projects or through the enterprise of some individual who has either supported himself in the work or obtained special support from some benefactor. Professors of civil engineering in the technical schools conduct some researches in connection with their courses of instruction or on special engagements. Such governmental organizations as the Bureau of Standards, the Reclamation Service, and a few of the state bureaus, have men more or less constantly engaged in research in civil engineering. A few salary rates of the Bureau of Standards are given as examples of those paid by governmental organizations. This bureau has only a small number of men engaged in research in civil engineering. The salaries of these men range from $1,400 to $4,000 a year. Those carrying on independent researches receive between $3,000 and $4,000. This present scale of salaries is admittedly not adequate compensation for the work. In special research assignments, in private or corporate offices, compensation is determined by the importance of the work or probable value of results, or is simply the salary, already fixed by other considerations, of the member of the staff selected for the research assignment.

Support for research in civil engineering is less likely to be found in industrial establishments than for research in electrical, mechanical or chemical engineering. Men who enter the civil engineering field of research must, apparently, be supported by universities or endowed institutions or technical societies, or be employed by federal or state governments. Patentable inventions are less frequent and less likely to yield large returns in civil engineering than in other branches. Knowledge gained in early years devoted to these studies, should give men of proper natural capacities equipment of great value for the higher practice of the profession, with consequent broader possibilities for usefulness and commensurate rewards.

Silt Roads Periodically Flooded To Maintain Wearing Surface

ALMOST the entire area of the Imperial Valley in Southern California is covered with a deposit of very fine Colorado River silt, many feet in thickness. Rainfall is rare (about 2 in. per annum) and the topography of the valley is uniformly flat; the maximum slope of the ground seldom exceeding 1 or 2 ft. per mi. The road construction problem is therefore wholly a question of surfacing. Unless the roadways are treated in some way, the dry silt grinds up quickly under traffic and wheels sink deeply into soft material. A large percentage of the roads in the valley are below the level of irrigation canals and it has become the custom to maintain a wearing surface by periodically flooding the roads with water from the ditches.

The practice in road construction throughout the irrigated territory is to grade the roadway to a width of 40 or 50 ft. with a flat dike in the center, elevated from 12 to 18 in. above the traveled way. The traffic uses either side of the road alternately, each side being graded to a width sufficient to provide for simultaneous travel in both directions.

When the grading or scraping is finished the roadway is flooded to a depth of 3 to 6 in. from the nearest irrigation ditch and travel is diverted to the opposite side of the roadway. After the water has soaked away and the road has become nearly dry, it is leveled with a very large blade leveling machine drawn by a traction engine and is then dragged with a correspondingly large drag until the surface is smooth and hard.

Under ordinary conditions when this treatment has been completed the road is in excellent condition and will remain so from three to six weeks or longer, according to the amount and kind of traffic.

Surfaces that have been finished in this way can be used safely for automobile speeds up to 35 mi. per hour. When the wear has been sufficient to break through the crust formed by the water treatment chuck holes appear and the surface breaks up rapidly. The traffic then has to be diverted to the other side of the roadway and the flooding process repeated.

Occasionally, through accident or carelessness in irrigation, both sides of the roadway are simultaneously flooded. The roadways are then practically impassable and traffic has to take to the top of the central dike. Under this condition frequent delays are entailed because the dikes are ordinarily made wide enough for one-way traffic only.

Prevalence of Typhoid in England and Wales

The total number of cases of typhoid fever reported in England and Wales for the year 1920 was 3,109. For a population of 37,426,800 this gives a rate of 8.3 per 100,000. Typhoid deaths in 1920 were 520, or 1.4 per 100,000.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Exclude Extra Fine Aggregate

Sir—In his letter in your issue of Jan. 5, 1922, p. 33, Professor Hatt comments on the use or crushed limestone and crusher dust, in place of sand for concrete, in connection with the failure of concrete construction where such fine aggregate was used. At the end of the letter he states that he has submitted this question of disintegration of concrete where such aggregate is used to various chemists without a solution.

It seems to me that the question is not one altogether of chemistry. The way I see it is as follows:

Crusher dust is composed of a large percentage that passes a 200 sieve and of course a larger percentage through a 100 sieve. Properly ground cement has specified percentages of material passing these same two sieves, viz.: 75 per cent and 95 per cent, respectively. The difference between the two materials is that one is properly calcined or burnt while the other is not.

The mixtures for concrete are so proportioned that the cement will completely fill the voids left by the next courser material. When, however, crusher dust is permitted to be used in the mixture, it displaces the cement, which only in part is used for cementing the mass, while the remainder simply adds to the mass. The result is that when exposed to the weather the limestone dust is freed and separates out from the concrete, causing disintegration.

The remedy is to specify that no fine aggregate (or say no more than 3 per cent) that passes through a 100 sieve shall be used in concrete.

M. HIRSCHTHAL,
Concrete Engineer.
D. L. & W. R.R.

Hoboken, N. J.
Jan. 12.

Information Desired on Bridge Floor Fires and Prevention or Protection

Sir—Your issue of Dec. 29, 1921, carried a news item (p. 1078) with reference to the proposed work of the joint committee which has been formed to consider fire-protection principles as applied to wooden highway bridges and bridge floors, and mentioned the fact that the committee desires information on the subject of floor fires from engineers who are connected with the design and maintenance of highway bridges. May I be permitted to use the columns of your paper to explain the matter more fully and, in behalf of the committee, to make a further appeal for the co-operation of those engineers who may be able to furnish desirable data?

The possibilities of this study were first suggested by disastrous fires which have occurred on long steel bridges and the committee is therefore particularly interested in various types of wooden floors on steel spans but it also has a general interest in all types of timber bridge construction, for it is felt that some of the principles involved may apply as well to timber trestles as to steel trusses.

Some of the points which have been suggested for consideration are as follows:

1. Prevalence and importance of bridge fires. This applies particularly to the thousands of comparatively small country bridges, as fires on important bridges are usually reported in the technical press.

2. Causes, usual points of origin and spread of bridge fires.

3. Descriptions of bridge fires and the bridges on which they have occurred.

4. Methods which have been used for preventing fires or for rendering timber construction more fire-resistant.

5. Provisions which have been made for fighting bridge fires.

6. Differences which may have been noted between plain and creosoted material.

7. Types of floor construction which appear to have fire-resistant qualities.

8. New ideas for practical methods of fire prevention, fire fighting, or to render timber construction more fire-resistant.

It is the hope of the committee that it may be able to secure a comprehensive discussion of the various points involved in this important subject, to the end that conclusions may be reached which will be of value to engineers who are responsible for the safety of bridge structures.

Communications may be addressed to the writer, who is acting as secretary for the committee.

E. F. KELLEY,
Senior Highway Bridge Engineer.
Bureau of Public Roads.

Washington, Jan. 6

Age Effects Account for Molded vs. Core Concrete Strengths

Sir—The article on the "Relation Between Molded and Core Concrete Specimens" by H. S. Mattimore, in *Engineering News-Record*, January 12, 1922, on p. 73 bears on a problem that is of considerable interest and importance at this time.

I am rather surprised however that an engineer of Mr. Mattimore's caliber and broad experience in testing work should find in the data listed any evidence of a tendency toward higher strengths in cored as compared to molded concrete specimens and can only believe that other data must have influenced his interpretation. The apparent difference may be more logically explained by a study of the relative ages of the test pieces when broken. For instance the average strength of the 100 molded specimens in Table I is 2,724 lb. per square inch at an average age of a little over 19 days while the average of 4,665 lb. per square inch for cored specimens corresponds to an average age of 243 days.

The importance of the normal effect of age may be readily seen in the following Table which is derived from Table I of Mr. Mattimore's article by combining results on test pieces of approximately the same ages.

TABLE A—VARIATION OF COMPRESSIVE STRENGTH WITH AGE

No. of Spec.	Ages Included Days	Average Age Days	Log. of Age	Mean Compressive Strength
41	7	7	0.845	2,096
59	28–30	28	1.447	3,162
16	60–90	77	1.886	4,540
25	140–150	146	2.164	4,622
47	300–330	306	2.485	4,695
12	400–460	420	2.625	4,764

It should be noted that the first two items of this table represent molded specimens and the balance cored ones.

D. A. Abrams in Proceedings of the American Society for Testing Materials, 1918 Part II, shows that the compressive strength of concrete approximately follows a straight line relation with the logarithm of its age. That the data of Mr. Mattimore's Table I also follows this rule fairly closely is apparent from a study of the last two columns of Table A above. This relation may be roughly expressed by the equation

$$S = 1{,}650 \log a + 700.$$

where S is compressive strength in lb. per square inch
a is the age in days.

Prof. Abrams article includes several typical empirical equations derived from published experimental data, among them being

$$F = 1{,}400 \log a - 150$$
and $S = 1{,}900 \log a - 1{,}500$

Since the equation which approximately fits Mr. Mattimore's data is almost the exact mean of these, it seems unnecessary to seek further for an explanation of the difference between the strengths of cored and molded specimens in this particular case.

FRED KELLAM,
Testing Engineer.
Indiana State Highway Dept.

Indianapolis, Ind.
Jan. 14.

NEWS OF THE WEEK

New York, January 26, 1922

Bill Extends Time To Complete Hudson River Bridge

Having been assured by Senator Calder that the financing of the proposed bridge across the Hudson River from New York to New Jersey can be arranged and that the engineering problems involved have been worked out, the Senate has passed the bill introduced by Senator Frelinghuysen, which extends the time for the completion of the bridge until fifteen years from the date of the measure's passage.

Details concerning the proposed bridge were contained in *Engineering News-Record*, May 26, 1921, p. 900.

"Good Roads Show" Needed Four Buildings to House Equipment of 185 Exhibitors

Heavy Material-Handling Machines Vie with Pavers, Trucks, Tractors, Locomotives and Other Transportation Equipment

The greatest aggregation of road-building equipment and materials ever gathered together was on exhibition at the National Good Roads Show held Jan. 16 to 20, inclusive, in Chicago, in conjunction with the nineteenth annual conventional of the American Road Builders Association, the technical features of which are covered in another article on p. 152 of this issue. Indicating the trend of present road-building requirements, heavier, larger and better built machinery was the rule. Material-handling equipment predominated. Rarely have so many locomotive cranes, steam and gas shovels, draglines, heavy graders and hauling equipment in the form of industrial locomotives, motor trucks and tractors, been seen along with concrete mixers, road rollers and asphalt plants. No less than six makes of industrial locomotive vied with motor trucks for their share of the haulage business. Multi-cylinder gas engines were much in evidence for more general use than before.

Of the changes in equipment shown the greatest advances, perhaps, were not spectacular but were confined to a simplification of older models, increased sturdiness, greater size and a more liberal use of cast steel instead of cast iron and cut gears for cast gears. "Not a piece of cast iron in this machine," was the boast of more than one exhibitor.

New Machines

Of the new machines the following are noted: Lakewood brought out a belt distributor for the concrete mixer in its "Master" 28-cu.ft. paver. The 30-in. belt delivers the concrete in 30 sec. over a swinging steel boom, 20 ft. long, at the end of which is a deflector spreading the concrete from the 2-ft. height over a 4-ft. swath. The same company showed an auxiliary hand-operated belt finishing machine with a substantial bridge. The Austin Machinery Corp. exhibited a rotary subgrader about 4 ft. in diameter which carries the earth in adjustable scoops to a transverse belt which, in turn, delivers it beyond the side forms over which the machine travels. A new bucket loader with positive feed and special wheel grips was also shown by Austin. Koehring had on display its recently built heavy-duty locomotive crane. Lee had a new low-hung automatic dump body for a Ford chassis. Numerous truck and body companies showed new arrangements for quick dumping.

Most of the mixer manufacturers, Koehring, Chain Belt, Austin, Foote, Lakewood, Smith, Ransome and Oshkosh, had 21-cu.ft. pavers operating and reported substantial inquiries and some sales during the show.

Attendance at the Coliseum showed a total registration of about 6,000. To give a more comprehensive idea of the show, photographs are shown on another page. A complete list of exhibitors is given below, together with notes of a canvass by staff members of *Engineering News-Record* of the equipment or materials shown in each booth. Four buildings were utilized, the Coli-

Associated General Contractors Hold Annual Convention

Budget of $175,000 for 1922 Approved—Standardization of Equipment and Construction Methods Undertaken

Contracting plans to do its own housecleaning. It will extend its work of standardizing contracts and construction practices. It will continue to strengthen its policy of co-operation in all constructive movements toward stabilizing industry and of co-ordinating organized engineering and organized contracting. These decisions were the outcome of three days' active discussion and committee work by the Associated General Contractors convening at Cleveland, Jan. 17-19. Nearly 200 delegates representing 26 states took part in the proceedings.

Questionable Practices Condemned

A demand upon the association to answer the challenge that contracting had been remiss in not eliminating the vicious conditions disclosed by the investigations of the Lockwood Committee in New York and the Daily Committee in Chicago was made almost at the start of the first general session. Quoting the editorial in *Engineering News-Record*, Jan. 5, 1922, p. 4 it was contended that the perfunctory action of the association indicated a failure to grasp its opportunity to cleanse its own skirts and to appreciate its public duty. It was stated that until the association came forward with a definite program, backed by positive action, it had better eliminate the word "integrity" from its motto. Direct accusation was made that the officers of the association had been delinquent in their duty. This accusation was challenged and the records were presented showing that every positive instruction of the association had been carried out by the officers and that no member of the association had in the two investigations named been cited for indictment or even seriously threatened for complicity in vicious practices. In reply it was asserted that the association virtually failed in its duty when it merely contented itself with the fact that its own members had evaded criminal prosecution. A proper conception of its duties, it was asserted, required positive assistance in punishing the criminals and direct aid in exposing and correcting corrupt practices. As the result of the discussion the resolution was adopted that the

(*Continued on p.* 171)

Mid-West Highway Officials Announce Cement Boycott

Executive officers of the state highway departments of Illinois, Iowa, Kansas, Michigan, Minnesota, Missouri, South Dakota and Wisconsin, members of the Mississippi Valley Association of State Highway Officials at the Chicago Conference Jan. 20 and 21 by resolution pledged themselves "not to make any contracts for highway construction involving the use of cement, except the few contracts for work which cannot possibly be postponed, until the manufacturers have fixed the price of cement so that road construction is not unduly penalized because of its magnitude, its urgency and its popular appeal, which price should be and must be in harmony with the reduced price now in effect for all other basic commodities."

The resolution further recommends immediate investigation, in states where it can be done, of the possibility of erecting and operating state-owned cement mills.

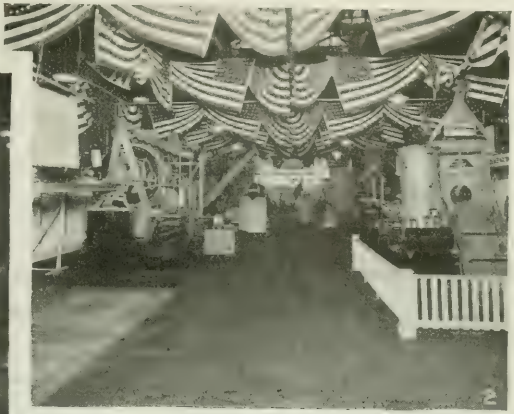
An appropriation of $5,000,000 was made by the last legislature of Illinois for the construction of a cement mill, but so far no definite move has been made.

Low bids of $1.60 per barrel at mills, recently submitted to the Illinois and Wisconsin highway departments, have been rejected.

A resolution calling for a reduction of freight rates on stone and gravel aggregate was adopted.

Heavy Construction Plant, Good Roads Show, Chicago











1. Motor Trucks in Coliseum. 2. Large Size Pavers in Greer Building. 3. Tractor Section in Wilson Building. 4. Material Handling Machinery and Pavers in Coliseum. 5. Motors and Tractors in Coliseum Annex.

seum, the Annex, the Greer and the Wilson Buildings, adjoining. Photographs were taken in each building.

U. S. Bureau of Public Roads, Washington, D. C. — Testing apparatus for determining the effect of impact on bridge members; maps of U. S. showing distribution road-building rock and stone samples on horizontal map; field and laboratory testing apparatus; charts and illuminated colored photographs of road tests; large illuminated map of Illinois roads completed and under way in state system; photographs of Federal aid roads; soil pressure testing apparatus; magnifier of colloid particles, 5,000 4 times; miniature models of various types of roads.

Metal Forms Corp., Milwaukee — Metal form road rails and models of culvert forms.

C. H. & E. Mfg. Co., Milwaukee — Mounted triplex pumping outfits, 1-yd. rear-drive tractor with automatic dump body.

Kelly Culvert Co., Minonk, Ill. — Concrete.

Highway Engineer & Contractor, Chicago — Magazine.

Chicago Stamp Co., Chicago — Chart on prevalence of accidents.

Morgan Concrete Wheel Co., Chicago — Cast concrete wheels for motor trucks.

BUDA CO., Harvey, Ill. — 4-cylinder gasoline engines, jacks, power unit for auxiliary power purposes and steam turbines for headlights.

HASTINGS PAVEMENT CO., New York, and ASPHALT BLOCK PAVEMENT CO., Toledo, Ohio—Asphalt block floors.

SAFETY MUSHROOM LIGHT CO., Milwaukee—Street-intersection lamps.

WILLITE ROAD CONS. CO. OF AMERICA, Chicago—"Willite" road pavement.

LARCO WRENCH & MFG. CO., Chicago —"Speednut" wrench and Cockran pipe wrench.

BUCYRUS CO., South Milwaukee, Wis. —Excavating machinery, steam, electric, gasoline.

THE BURCH PLOW WORKS, Crestline, Ohio—Expansion cast-iron culvert pipe, stone spreaders and distributors, stone unloaders and road plows.

THE CONNEAUT SHOVEL CO., Conneaut, Ohio—Hand shovels, scoops and spades.

SEWELL CUSHION WHEEL CO., Detroit —Cushion wheels for motor trucks.

AUTOMATIC UTILITY CORP., Detroit— The Winsor gravity dump.

BUFF & BUFF CO., Boston—Transits and levels and other surveying equipment.

AMERICAN TAR PRODUCTS CO., Chicago—"Tar-Mac" road tar.

KINNEY MFG. CO., Boston—Road and highway machinery automatic heater and distributor, steam jacketed asphalt pumps, flushers and tar kettles.

ANTHONY CO. INC., Streator, Ill.— Automatic dump bodies.

ERIE STEEL CONST. CO., Erie, Pa. — Multiple batch charging plant for truck haulage.

HANDY SACK BALER CO., Cedar Rapids, Ia.—Sack balers.

THE HIGHLAND BODY MFG. CO., Cincinnati — Wooden dump bodies and truck cabs.

THE AMERICAN CEMENT MACH. CO., Keokuk, Ia.—Mandt automatic dump bodies and Boss mixers.

EASTON CAR & CONSTRUCTION CO., Easton, Pa. — Scoop bodies, industrial railway equipment.

THE WALLIS BOILER CO., Chicago — Boilers for portable use, a tubeless boiler.

AMERICAN GAS ACCUMULATOR CO., Elizabeth, N. J.—Danger signals and road "lighthouses."

INDUSTRIAL WORKS, Bay City, Mich. —Industrial cranes.

CLAY PRODUCTS ASSOCIATION, Chicago —Literature.

ROBERTSON BROS. MFG. CO., Chicago— Steel road strips, spiral lock seam dredging pipe and Burrell railroad signal.

PAUL J. KALMAN, INC., Chicago — Concrete reinforcing bars.

SASGEN DERRICK CO., Chicago—Stiff-legged derricks.

CARBIC MFG. CO., Duluth, Minn. — Carbic lights and Carbic cakes.

KEUFFEL & ESSER CO., Hoboken, N. J. —Full line of engineering instruments.

WYOMING SHOVEL WORKS, Wyoming, Pa.—"Red edge" shovels, scoops, spades and picks.

BALL ENGINE CO., Erie, Pa.—"Erie" steam shovels and cranes.

ELECTRIC WHEEL CO., Quincy, Ill.—E. W. C. power unit and a new E. W. C. traction and mounting equipment.

HYATT ROLLER BEARING CO., New York—Roller bearings.

VAN DORN IRON WORKS CO., Cleveland, Ohio—Truck products, hoists and dump truck bodies.

PAN AMERICAN BRIDGE & CONSTRUCTION CO., LTD., Chicago—"Lee" Simplex bridge and "Lee" road plane.

HELTZEL STEEL FORM & IRON CO., Warren, Ohio—Universal tamper, and forms for concrete road work.

NATIONAL STEEL FABRIC CO., Pittsburgh, Pa.—Steel fabric for reinforced-concrete roads.

AMERICAN REFRACTORIES CO., Pittsburgh, Pa.—Crushed granite from Devils Lake, Wis.

INTERNATIONAL STEEL TIE CO., Cleveland—Roadway paving guards.

PIT AND QUARRY, Chicago — Magazines.

THE JENNISON-WRIGHT CO., Toledo, Ohio—"Kreolite" wood blocks.

AMERICAN STEEL & WIRE CO., Chicago —Wire fabric for concrete road reinforcement.

SERVICE BUREAU, AMERICAN WOOD PRESERVERS' ASSN., Chicago — Literature.

AMERICAN HIGHWAY EDUCATIONAL BUREAU, Washington, D. C.—Literature.

THOMPSON BROS. CO., Chicago—Danger signals.

HIGHWAY HOIST & BODY CO., Edgerton, Wis. — Mechanical hoists and gravity dump bodies for contracting work.

SHUNK MFG. CO., Bucyrus, Ohio — Grader blades.

FOX ROTARY SNOW BROOM, Newark, N. J.—A rotary snow broom attachable to any 5-ton truck.

W. & L. E. GURLEY, Troy, N. Y.— Engineering and surveying instruments, transits, levels, etc.

KENTUCKY ROCK ASPHALT CO., Louisville, Ky.—Kentucky rock asphalt.

CLIMAX ENGINEERING CO., Clinton, Iowa—Industrial engines.

HOUGH MECHANICAL HOIST CO., Chicago—Mechanical standard hoist, high-dump attachment, for road building.

F. D. CUMMER & SON CO., Cleveland —Literature of road asphalt plants.

GALION IRON WORKS & MFG. CO., Galion, Ohio — Giant premier grader, sectional cast-iron pipe, gas and steam road rollers.

AMERICAN PRODUCTION & TRADING CO., Chicago—Rolling dump bodies.

HADFIELD-PENFIELD STEEL CO., Bucyrus, Ohio—4-ton and 7-ton 4-cylinder American gas locomotives.

EAST IRON & MACHINE CO., Lima, Ohio—Miniature of Merriman asphalt plant.

THE BARRETT CO., New York—Miniature of an oil spreader and automatic lantern slide machine, showing use of Tarvia and road oil on highways.

ACME ROAD MACHINE CO., Frankfort, N. Y.—Literature and photographs of steam road rollers.

BEACH MFG. CO., Charlotte, Mich.—A working model of a new dragline bucket of the bottomless type and a new mounted hoist with LeRoi engine.

JENNINGS AUTOMATIC DUMP BODY, ING., Roanoke, Va. — Models of dump bodies.

W. S. TYLER CO., Cleveland, Ohio— "Hummer" electric screens and "Ro-Tap" testing sieve shaker, testing sieves and automatic "Stop-rite" time switch.

SAUERMAN BROS., Chicago—Working models of drag-line cableway and tower. Full-size buckets and accessories. Three types of scrapers in operating models and full size 1-yd. cableway and bucket.

LAKEWOOD ENGINEERING CO., Cleveland, Ohio—New hand-finishing machine shown in operation, finishing machine, sub-grader, a Master 28-cu.yd. concrete mixer with new belt distributor discharge, and a Burton locomotive.

STANDARD OIL CO., (Indiana) Chicago —Working model of oil-pumping outfits and samples of road oil.

ASPHALT ASSOCIATION, New York— Road models, charts, samples and photographs.

BROWN HOISTING MACHINERY CO., Cleveland, Ohio — No. 2 crane with 30-ft. boom; creeper treads.

FATE-ROOT-HEATH CO., Plymouth, Ohio—Plymouth gas locomotive, 3½ to 7 tons.

OSHKOSH MFG. CO., Oshkosh, Wis.— 14-cu.ft. concrete mixer with chute, "tank tread" traction and force feed lubricator.

WARREN BROS. CO., Boston—Samples of bitulithic pavement.

BARBER-GREENE CO., Aurora, Ill. — Bucket loader and belt loader.

PARKER MOTOR TRUCK CO., Milwaukee —Truck with dump body and hydro hoist.

GOOD ROADS, New York—Magazines.

ELGIN SALES CORP., Elgin, Ill.—Literature on motor-driven street cleaning machines.

PIONEER ASPHALT CO., Lawrenceville, Ill. Samples asphalt filler and expansion joints.

AMERICAN CITY, New York—Magazines.

ENGINEERING & CONTRACTING, Chicago—Magazines.

PUBLIC WORKS, New York — Magazines.

SMITH ENGINEERING WORKS, Milwaukee — Model of Telsmith rock breaker.

ENGINEERING NEWS-RECORD, New York—Magazines and books.

EUCLID MOTOR TRUCK CO., Chicago— Truck with Giant gravity dump body.

DUNN ROAD MACHINERY CO., Conneaut, Ohio — Road-finishing machine with auxiliary strike-off.

DUNN WIRE CUT LUG BRICK CO., Conneaut, Ohio—Model of 10-ft. roadway of brick laid with bituminous filler, without filler, and with cement filler.

HOLT MFG. CO., Peoria, Ill.—10-ton standard caterpillar tractor, 5-ton tractor with a bulldozer and snow-plow attachment and a 2-ton model.

LAPLANT-CHOATE MFG. CO., Cedar Rapids, Iowa — 6-cu.yd. bottom dump wagon.

RUSSELL GRADER MFG. CO., Minneapolis—Elevating graders.

J. D. ADAMS & CO., Indianapolis, Ind. — Adams adjustable leaning wheel graders.

BAKER MFG. CO., Springfield, Ill. — "Baker-Maney" self-loading scraper.

AUSTIN-WESTERN ROAD MACHINERY CO., Chicago—Tandem 7-ton gas roller; 10-ton gas roller with scarifier attachment; 10-ton standard steam roller; one Western-Aurora crusher, scarifier, Austin "Rip Snorter," a motor-driven street sweeper, Western No. 20 blade grader, Austin culverts, road-making tools and working models of crushers, graders and screening plants.

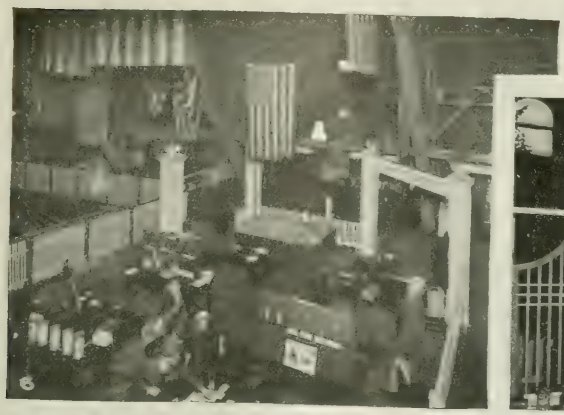
H. P. ANDRESEN & CO., Chicago — Bituminous Road repair outfits.

LITTLEFORD BROS., Cincinnati, Ohio— Tar kettles.

REPUBLIC SALES CORP., Alma, Mich. —Trucks with hand hoist, hydraulic

Manufacturers' Exhibits at Good Roads Show

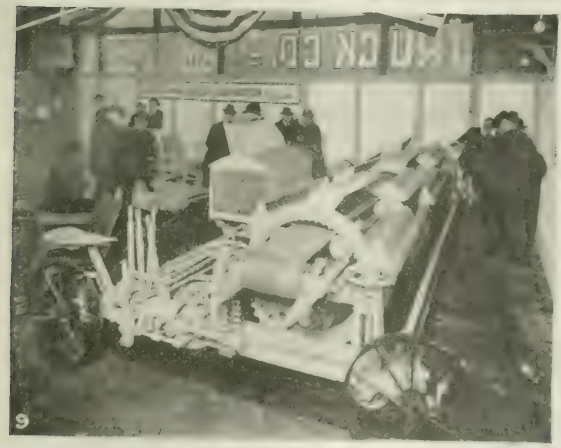
A Few of the Individual Exhibits, Good Roads Show











6. Testing Apparatus and "Rock Map," U. S. Bureau of Public Roads. 7. Educational Booth of The Asphalt Association. 8. Lakewood Paver with Distributor Belt Discharge. 9. Austin Rotary Subgrader. 10. Bucket Loader with Positive Feed Pickup (Austin)

hoist and maintenance truck with Road-spring scraper mounted under chassis.

Wood Hydraulic Hoist & Body Co., Detroit — Trucks with horizontal and vertical hydraulic hoist dump bodies.

Blaw-Knox Co., Pittsburgh, Pa. — Steel storage bin, sectional steel handy house, "Dreadnaught" bucket, steel forms, rotary grader, dump body, and miniature models of clamshell buckets.

Charles Hvass & Co., Inc., New York.—Complete asphalt plant, oil distributor and a 1½-yd. material spreader.

Four Wheel Drive Auto Co., Clintonville, Wis. — Three-ton truck with dump body.

Autocar Co., Ardmore, Pa. — Trucks with dump bodies, 1-, 2-, and 5-ton capacity, and 106¾ lb. crankshaft driven by electric fan 3 ft. away.

Pawling & Harnischfeger Co., Milwaukee—Corduroy 50-hp. gas shovel equipped also with skimmer scoop boom, 50-hp. double drum gas hoist.

Chain Belt Co., Milwaukee — Track-laying type 21-cu.ft. paver, 28-cu.ft. building mixer and 7-cu.ft. Rex paver.

Lee Trailer & Body Co., [illegible] Lee 4 D dump body on Ford chassis, 5-ton trailer and dump bodies.

Novo Engine Co., Lansing, Mich.—Novo engines with hoists, air compressors, diaphragm and force-feed pumps, new 4-cylinder engines, 15 and 35 hp.

Milwaukee Locomotive Co., Milwaukee — Locomotives, gear driven four-speed.

North-West Engineering Works, Green Bay, Wis. — Locomotive crane and tractor.

Ransome Concrete Mach. Co.—Dunellen, N. J. — 21-cu.ft. paver, crawler traction, 4-cu.ft. power mixer and new 1-cu.ft. building mixer.

Locomotive Crane Co. of America, Champaign, Ill.—New model C gasoline locomotive crane.

Keystone Driller Co., Beaver Falls, Pa. — Keystone excavator with new drop-bottom ditcher attachment.

Byers Machine Co., Ravenna, Ohio —Steam revolving crane, crawler traction and auto crane with semi-crawler traction.

George D. Whitcomb Co., Rochelle, Ill.—Six-ton positive gear drive locomotive and cut-away view of clutch and three-speed transmission.

Asphalt Pavement Retreading Co., Chicago—Asphalt pavement retreader.

The T. L. Smith Co., Milwaukee, Wis. — 21-cu.ft. paver and half bag Mixerette.

Foote Co., Inc., Nunda, N. Y.—21- and 14-cu.ft. pavers.

Austin Mach. Corp., Chicago—21-cu.ft. paver, tamper and finisher, new subgrader, cube, and Hex mixers, traction crane with clamshell, new grip-wheel bucket wagon loader and multi-pedal backfiller.

Koppel Industrial Car & Equipment Co., Koppel, Pa.—Industrial cars, track and batch box.

Monarch Tractors, Inc., Watertown, Wis.—Monarch industrial tractor with snowplow attachment.

L. P. Green, Chicago — Power drag scraper.

Equipment Corp., of America, Chicago—Rebuilt machinery.

March-Capron Co., Chicago—21-cu. ft. mixer for central mixing plant.

Baldwin Chain & Mfg. Co., Worcester, Mass. — Steel and malleable chain and Westland friction clutch.

The Owen Bucket Co., Cleveland, Ohio—Grab bucket.

Stroud & Co., Omaha, Neb.—Photographs of elevating graders and dump wagons.

Black & Decker Mfg. Co., Baltimore —Electric drill and loadometer.

Highway Trailer Co., Edgerton, Wis.—Steel trailer and side-dump body.

Fredric Greer, Chicago — Two-wheeled steel trailers.

Thew Shovel Co., Lorain, Ohio — Photographs of various models of shovels.

F. J. Lewis Mfg. Co., Chicago—Asphalt paving and roofing specimens.

The Barnes Mfg. Co., Mansfield, Ohio — The Barnes quadruplex pump, centrifugal and diaphragm pumps.

American Casting Co., Birmingham, Ala. — Cast-iron culvert, drain and sewer pipe.

Martin-Parry Corp., Chicago—Steel dump bodies.

Columbian Steel Tank Co., Kansas City, Mo.—Steel dump body and gas tank.

The Osgood Co., Marion, Ohio—Engine for Model 18 Osgood ¾-yd. revolving steam shovel, swing engine and parts.

Wisconsin Motor Mfg. Co., Milwaukee—Three models complete 4- and 6-cylinder gas motors.

Chris D. Schramm & Son, Inc., West Chester, Pa. — Air compressors and pumps.

David White Co., Milwaukee—Surveying and drawing instruments.

Chicago Steel Tape Co., Chicago—Tapes, rods, engineers' and contractors' instruments.

Truscon Steel Co., Youngstown, Ohio—Truscon highway products, flat sheet reinforcement and hy-rib lath.

Products of 185 Manufacturers Exhibited at Good Roads Show, Chicago

National Paving Brick Mfg. Assn., Cleveland—Literature on paving brick.

R. F. Conway Co., Chicago — Gilsonite asphalt paints, joint fillers and plastic cement.

Municipal & County Engineering, Indianapolis—Magazines.

The Texas Co., New York—Literature Texco asphalt products.

Heil Co., Milwaukee—Steel gravity dump bodies with hydro hoists.

Concrete Steel Co., New York — Full line of Havemeyer reinforcing products, bars, ties, spacers, beam saddles and separators, chairs and curb bars.

Electrical & Specialty Supply Co., Chicago—Mushroom street traffic light.

Domestic Engine & Pump Co., Shippenburg, Pa.—Gasoline pumping outfits, diaphragm pumps, hoists and power units.

Turbine Sewer Machine Co., Milwaukee—Sewer cleaners.

The Maxon Co., Milwaukee — Concrete road finisher.

Titan Truck Co., Milwaukee, Wis.—Subgrade trucks for batch hauling, wet mix, asphalt, gravel or grading.

Waukesha Motor Co., Waukesha, Wis.—Truck and tractor motors.

Reo Motor Car Co., Lansing, Mich. —"Speed Wagon," gravity dump and hoist bodies.

Root Spring Scraper Co., Kalamazoo, Mich. — "Michigan" good roads maintenance scraper.

Atterbury Motor Car Co., Buffalo, N. Y.—Motor trucks, dump bodies and hydro hoists.

Barber Asphalt Paving Co., Philadelphia—Iroquois road roller, samples of Trinidad and Bermudez Lake asphalt.

Le Roi Co., Milwaukee—Truck, tractor and construction equipment engines.

The Philip Carey Co., Lockland, Cincinnati—Elastite expansion joints.

Western Wheeled Scraper Co., Aurora, Ill.—Elevating graders, plows, scrapers, dump wagons, batch bodies and contractors' machinery.

Clark Trucktractor Co., Buchanan, Mich.—Trucks and tractors.

Wiard Plow Co., Batavia, N. Y.—Contractors' plows.

G. A. Schacht Motor Truck Co., Cincinnati—Worm-drive motor trucks.

Manufacturers' Record, Baltimore —Magazines.

The Stoughton Truck Co., Stoughton, Wis.—2½- and 3-ton dump trucks.

General Motors Truck Co., Pontiac, Mich.—Three 5-ton dump trucks.

The Hug Lumber & Construction Co., Highland, Ill.—Truck turrntable and blade-type of subgrader.

Oliver Chilled Plow Co., South Bend, Ind.—Contractors' plows.

Warner Mfg. Co., Beloit, Wis. — Heavy duty trailer reversible bottom and new side dump types.

Rice Equipment Co., Chicago — Fordson tractor, industrial type.

Field Body Corp., Chicago—New 1½-yd. dump body for Ford truck chassis.

Indiana Motor Truck Corp., Marion, Ind. — 2½-ton dump truck equipped with Heil hoist.

Good Roads Mach. Co., Kennett Square, Pa.—Grader and scarifier.

Allis-Chalmers Mfg. Co., Milwaukee — Gasoline tractor, 4-wheel type.

Hadfield-Penfield Steel Co., Bucyrus, Ohio—New crawler traction attachment for rear drive on Fordson truck, Hp. 40 gasoline crawler tractor, new Henneuse design.

Shaw-Enochs Tractor Co., Minneapolis—Gasoline tractor with scarifier attachment.

Rogers Tractor & Trailer Co., Albion, Pa.—The Rogers four-wheel-drive tractor.

Avery Co., Peoria, Ill.—"One Man Road Razer," a new combined tractor and road blade grader.

F. W. Wilson Machinery Co., Chicago—General line of contractors' supplies.

Koehring Co., Milwaukee — New 20-ton locomotive crane, 45-ft. boom, multiplane traction treads, equipped with either drag line or orange peel bucket. Three types of paving mixer, including 21-cu.ft. road building machine with adjustable delivery dump bucket, 7-cu.ft. alley paver and 7-cu.ft. Dandy mixer with batch hopper for sidewalk and building work.

Kissel Motor Co., Hartford, Wis.—Road truck with three-batch compartments. Model of 60-yd. sand and stone storage and loading hopper, with measuring boxes. Turntable with circular track for motor trucks on roadbuilding work.

International Motor Co., New York—Two types of 2½-ton Mack road-building truck, one with a 10-ft. wheelbase designed to turn on a subgrade and the other with a 12-ft. wheelbase for use with a turntable. A 900-gal. capacity Mack-Cressy road sprayer mounted on a Mack chassis.

Portland Cement Association, Chicago—Educational exhibit of photographs, diagrams and model showing operations in the construction of a concrete road. Statistics indicated an equivalent of 18-ft. concrete road constructed in 1921 of 5,864 miles and a total to date of 22,495 miles. Another diagram indicated the effect, this year, of the fall letting of highway contracts. From September to December, 1921, inclusive, more than $3,000,000 worth of work was awarded each month as against between $1,000,000 to $2,000,000 each month during the previous year.

White Co., Cleveland — End-dump 5-ton road-building trucks and 2-ton batch truck with two compartments.

Seibert-Millburn Co., Columbus, O.—Lee concrete road finisher.

Malis Power & Supply Co., Chicago —Surplus army tarpaulins.

General Contractors' Convention

(*Concluded from p. 166.*)

Associated General Contractors of America, (1) Express their sympathy and accord with the purpose of the investigations in progress in New York and Chicago; (2) instruct their committee on ethics to prepare such a "statement of principles governing the relations of contractors with owners, other contractors, workman, manufacturers and dealers that the illegal practices disclosed by the investigations named shall be eliminated."

Building Practices Discussed

Two leading subjects came up for consideration at the sectional meeting of the building contractors: (1) Procedure and practice of members undertaking work within the jurisdiction of a local chapter other than that of which they are a member; and (2), incomplete and partial plans by architects and engineers requiring contractors to complete plans and assume responsibility for design properly the duty of the architect and engineer.

Discussion of the first subject was crystallized in the following rules adopted by the convention in general session:

1. Whenever a member assumes any contractual operations in territory within the jurisdiction of a local chapter other than the one in which he holds membership, it shall be his duty before employing labor in the various crafts, to first ascertain from the local chapter, the prevailing wage scale.

2. That it shall be the duty of such member to offer employment to the various crafts at a rate of remuneration not more than the prevailing local wage scale as ascertained from the local chapter.

3. That in case of difficulty in securing a sufficient force of men due either to the magnitude of the work undertaken, or to a prevailing scarcity of skilled men, the member conducting such operation shall request a special meeting of the members of the local chapter having jurisdiction, and upon such meeting being called, shall lay the matter before it.

4. That it shall be the duty of the local chapter to immediately investigate the difficulties complained of and to attempt in good faith to relieve such difficulties by whatever methods seem best under the circumstances.

5. That it shall be the duty of the contractor from outside the territory to conform to the suggestions of the local chapter in attempting to relieve the conditions complained of, without interrupting the prevailing wage scale.

6. That should the method suggested by the local chapter fail to relieve the situation, the outside member and the local chapter, or either of them, shall place the entire matter before the Executive Board of the Associated General Contractors for its ruling, and such ruling shall be final.

7. That any member who shall refuse to abide by any such ruling of the board, after due notice thereof, in writing, shall be subject to discipline as provided for in Section 7, of Article II of the Rules of Procedure.

No official action was taken with respect to the second subject but individual members cited many examples and condemned the growing practice of architects and engineers of issuing partial plans for the contractor to develop. It was contended that the practice was the outcome of competition and price cutting to secure commissions by shifting the burden of designing details and of guaranteeing safety of design for construction, to the contractor.

Discussion by the roads section related to reduction of surety company premiums, standard materials contracts, and standard methods and equipment for highway construction. It was summarized in a series of resolutions to this effect:

1. That a reduction in the cost of highway construction can be effected through a reduction by the surety companies of the premiums now charged for contract bonds.

2. That a reduction in the cost of highway construction can be effected through the working out of a standard form of material contract which will be more binding upon both parties and that the A.G.C. is requested to appoint a committee to confer with representatives of the various material associations of material producers, looking to the joint formulation and adoption of such a form of contract.

3. That a reduction in highway construction cost can be achieved through the working out of a greater degree of standardization of methods of construction and types of equipment in highway construction. In a recent editorial, the *Engineering News-Record* stated that during three years of intensive activities, highway constructors had made practically no progress in the matter of standardization of equipment and methods of construction. We ask the national body to accept this challenge upon the part of the highway contractors of America and appoint a committee to study the question of standardization of equipment and construction methods.

4. Since recent scientific investigations have disclosed the fact that hardness of coarse aggregates in concrete pavements is not as vital to the construction of durable pavements as was formerly thought. It is the opinion that a reduction in highway construction costs can be secured through a lowering of the present requirements of most highway specifications as to hardness of coarse aggregate, which will permit the opening up of additional sources of supply and it is requested that the A.G.C. take this matter up with the American Association of Highway Officials with the object of lowering the minimum requirements.

Open Shop and Open Markets Advocated

It was brought out in the discussions in all of the sectional meetings that restrictions in the labor and materials markets were placing a heavy burden of unnecessary cost on construction, and as the result of separate actions by the sections the convention in general assembly took formal action as follows:

Since the growth of trade associations has caused the establishments of trade agreements and practices which hinder economic distribution and restrict the right of [illegible] to buy [illegible] in the open market, and encourage the payment of a differential to a local distribution for no economic service rendered.

1. This Association is unqualifiedly in favor of the open market for all materials needed in the construction industry, and is resolutely opposed to all combinations, whether of manufacturers or contractors, whereby power is used or the market or controlled in favor of any particular interest and against the interests of the general public; and

2. This association is equally opposed to any combination whether of labor unions or of contractors, whereby the right to seek or furnish employment is limited to any particular class of persons, members of any association, organization or union.

Program for 1922

Plans for the association activities in 1922 adopted by the management include 45 subjects, of which the following are of particular interest to engineers: (1) Conference of construction cost accountants to develop a standard system of cost accounting; (2) Develop standard estimating forms for builders and highway contractors; (3) Conference on standardization of equipment; (4) Study and begin standardization of construction methods; (5) Complete an equitable rental lease; (6) Formulate and issue a code of ethics for contractors and relations with [illegible] contractors. A budget of $175,000 for the work of the association for the year is voted.

Transportation Chief Topic At Am. Soc. C. E. Meeting

Waterways, Highways, Railways Reviewed, and Recommendations for Their Betterment Made

Transportation by waterway, highway and railway was discussed thoroughly and certain recommendations as to how the various systems of transport could be bettered were made at the sixty-ninth annual meeting of the American Society of Civil Engineers in New York City, Jan. 18-20. Though such discussions formed the technical part of the program, alternative features which included trips to engineering works in and near the city, and social features, including a dinner-dance and a smoker.

Water Transportation—The first session, unfortunately sparsely attended on account of the rival excursion, was devoted to "Water Transportation," which the speakers interpreted to mean ocean transportation. The three addresses by Dr. Emory R. Johnson, R. H. M. Robinson and Winthrop L. Marvin, in effect were pleas for some sort of a shipping subsidy. Samuel O. Dunn, of *Railway Age*, argued in favor of closer relationships of ship and rail haulage, and for such rates as would permit the railways to compete with the Panama Canal in transcontinental carriage.

Railway Transportation—Three of the four major elements that go to make up a railroad system were discussed on the afternoon of Jan. 18. The speaker representing each element gave his review of the situation and recommended specific action to alleviate the general industrial depression in so far as the railroads figure. The first speaker was Howard Elliott, chairman of the Board, Northern Pacific R.R. The second represented the operating employees—William N. Doak, vice-president, Brotherhood of Railway Trainmen, of Washington. The third was Col. F. A. Molitor, chairman of the Board of Economics and Engineering of the National Association of Owners of Railroad Securities. All agreed that the railroads were in a precarious condition and further rate reductions might throw the roads into financial ruin or return them to gov-

ernment ownership, all three of the speakers soundly denouncing such procedure.

Mr. Elliott paid a tribute to the farsighted men who had created such an immense transportation system, but asserted that in the present crisis the public saw only "the penny of failure" in the railroad administration and entirely passed over "the dollar of profit" feature. He asserted that the railroads were indispensable to the great growth that the country had experienced in the last fifty years, but that they had not prospered accordingly. He believed that the utmost care should be exercised in reduction of freight rate charges in order to bring about a further general deflation in prices. A decrease in the wages of railroad operatives, he said, should precede any further decrease in transportation charges.

In the solution of the railroad problem, Mr. Elliott pointed out, the engineer might contribute (1) a lessening in the tractive effort of rolling stock; (2) a decided improvement in terminal facilities; (3) an improvement in water and fuel stations; and (4) a reduction to the minimum of the dead weight of rolling stock. The elimination of waste all through the various transportation branches were also considered a job in which the engineer could co-operate.

For Settling Disputes

Mr. Doak reviewed the various methods by which decisions in railroad disputes had been arrived at and assigned to each class, in his opinion, deficiencies and virtues. The greatest amount of mutual benefit, he said, had been derived from bi-partisan voluntary boards of adjustment. Conciliation, mediation and arbitration had all served their purposes and were efficacious in certain instances, but the voluntary bi-partisan board had so far proven its superior merit.

As suggestions which would materially clear up difficulties usually existing between the transportation employer and employee, he offered the following:

1. That agencies be established for the prompt appointment of mediation, arbitration and conciliation boards.

2. That bi-partisan boards should be established to decide disputes the three foregoing boards were unable to agree upon.

3. That a fair trial be given the railroad Labor Board and that this latter body dispose of cases which the foregoing bodies would be unable to solve.

4. That agencies be established for determining the exact truth regarding transportation conditions and that such truth be disseminated to the general public through reputable publications.

5. That both transportation employees and employers unite in a campaign of education which would reveal the true facts in connection with the railroad situation.

These suggestions, if carried out, he felt would eliminate a great deal of the animus exhibited in newspaper editorials and in private and public conversation—animus that was based on half truths which he characterized as being far worse than whole untruths.

Col. F. A. Molitor, representing the security holders, deplored the present lack of credit of railroad securities asserting that the causes contributing to the decline in their value were in addition to the Adamson law, (1) a refusal to increase rates in 1916; (2) government operation of the railroads with the attendant loss in operating efficiency; (3) the raising of the wages in July, 1920; (4) the proposed abolition of the 6 per cent return provision on net operating income; (5) the extreme deliberation exhibited by Congress and other governmental bodies in the adjustment of railroad claims.

Molitor Offers Remedies

As remedies to the present situation he suggested (1) discontinuation of general freight reductions; (2) adjustment of railroad labor compensation to the level of living costs; (3) the incorporation of the Railroad Labor Board within the Interstate Commerce Commission; (4) the continuance of the 6 per cent return provision as a fair percentage for bond holders of railroad securities; (5) and a strict financial supervision of union organizations and the elimination of radicalism from the ranks of such organizations.

Col. Molitor asserted that not only would the report his committe is about to make declare for certain economies in operation and terminal facilities, but would suggest or provide financial means for their accomplishment.

Sessions on Roads

Highway Transportation—The three sessions devoted to highway engineering, financing and bonding, administration and motor vehicle control developed papers and discussions mostly general in character. Pointing out the extent of expenditure in the last two years in highway construction and the lag of construction behind the use of motor vehicles, T. H. MacDonald, Chief, U. S. Bureau of Public Roads, called for a development of state highway engineering organizations and of courses in engineering schools directed more particularly to the training of highway engineers. With 10,000 engineers now engaged in highway work, the developing program, he stated, called for an accretion of 1,000 to 1,?00 annually to be supplied by the engineering colleges.

The specific organization of a state highway engineering department was presented as represented by the Pennsylvania Highway Department by Col. W. D. Uhler, chief engineer. Education and efficiency of inspectors were laid down as the prime essentials of good construction. In financing highway development, bond issues were deprecated by J. N. Cole, Massachusetts State Department of Public Works, who urged a "pay-as-you-go" construction policy in all states.

E. A. St. John and E. E. Lunt, speaking for liability insurance companies defended high premiums as warranted by the high risks of business. A disclaimer of especial hazard was entered by F. S. Greene former state highway commissioner of New York, who urged legislation proceeding for self-insurance by the state. Motor vehicle taxation, motor vehicle traffic control, and the relations of highway to other transportation systems were discussed.

Akron to Choose New City Manager Soon

Applications for the position of city manager of Akron, Ohio, are being received by a special committee of the City Council consisting of Joe O'Neill, W. R. Palmer and J. P. Frisby. The salary is $7,500 a year in place of the $10,000 received by William J. Laub, who filled the position until the first of the year. Several applications from non-residents have been received, but it is thought unlikely that a non-resident will be appointed if a satisfactory Akron man can be secured.

Extra Meetings To Be Held by Am. Soc. C. E.

Board Direction Holds Quarterly Session—Other Action Taken—Convention Date Unsettled

At the regular quarterly meeting of the Board of Direction of the American Society of Civil Engineers, held in New York City during the annual convention last week, action was taken whereby two more meetings of the society will be held during the year, in addition to the convention and the annual meeting. The first of these is to be held in Dayton on April 5 and 6 and the subject to be discussed will be "Flood Control." The second will be held during October some place on the Pacific Coast, probably San Francisco, and "Water Power Problems" will form the chief topic of discussion. It is probable that these extra meetings will be held in April and October each year and symposia upon the most live engineering topics will be discussed.

The place and date of the society's annual convention have not yet been decided upon, though it is probable that it will be in Maine either late in June or early in July.

The Board also approved a plan whereby there shall be paid to each of the local sections $1 per member per year for the maintenance of such local sections. Such a plan it is believed will greatly stimulate membership campaigns among the local sections.

The acting secretary of the society was instructed to request all local sections to consider the question of the society's becoming a member of the Federated American Engineering Societies, and report the sentiment before the next meeting of the Board of Direction on April 3.

Approval was given the formation of student chapters at the following institutions: Carnegie Institute of Technology, Georgia School of Technology, Lafayette College, Lehigh University, Montana State College, University of Missouri, Ohio State University, and Virginia Polytechnic Institute. Formation of a local section of the society at Toledo, Ohio, was also approved.

The following committees were announced:

Executive Committee.—John R. Freeman, chairman; Robert Ridgway, vice-chairman; A. P. Davis, George H. Pegram, George S. Webster.

Publications Committee.—John R. Freeman, chairman; J. J. Yates, C. W. Hudson, R. L. Humphrey, C. E. Grunsky.

Public Relations Committee.—Baxter L. Brown, chairman; Leonard Metcalf, Onward Bates, G. R. Putnam, A. H. Markwart.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN CONCRETE INSTITUTE. Detroit, Mich.; Annual Convention, Cleveland, Ohio, Feb. 13-16.
AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago; Annual Convention, Chicago, March 14-16.

The Rochester Engineering Society will hold its quarter-centennial dinner on March 18. At the dinner, five prizes, awarded by individual members of the society, will be presented to the winners of the competition for the best papers on engineering topics. The competition is open to all members of the society. Papers should reach the secretary on or before noon of Feb. 20. There will be a first prize of $50, second prize, $25; third prize, $15; fourth prize, $10; fifth prize, $5. Further information regarding the competition may be obtained from the secretary.

PERSONAL NOTES

P. F. CAMPBELL was elected borough engineer of Lilly, Pa., at a recent meeting of the council.

D. A. TOMLINSON, who has been for the past two years connected with the structural bureau of the Portland Cement Association, has been made manager of the newly organized railway bureau. The purpose of the new bureau is the compilation and presentation to railroad officials of authoritative data on railroad uses of concrete.

JOHN P. KENNEDY, civil, mining and mechanical engineer with the Pennsylvania railroad has been appointed a member of the Board of Public Utilities, Los Angeles, Cal.

A. C. WOOD, hydraulic engineer with the Oliver Iron Mining Co., Duluth, Mich., has resigned to accept a similar position with the Chile Exploration Co., Chile, South America.

H. W. COLEMAN has been appointed director of the department of Public Works, of the city of Albany, Ga.

C. E. SHEARER and W. W. WESSELL are the engineer and contractor members respectively, of a commission recently named to revise the building code of Memphis, Tenn.

THE CAHILL-VENSANO CO., contracting engineers of San Francisco, have dissolved partnership. All existing contracts will be completed. John R. Cahill and Edward G. Cahill have formed an engineering firm under the name of Cahill Bros. and H. C. Vensano will engage in the contracting business.

PATRICK H. FITZPATRICK has been appointed superintendent of streets for the city of Bridgeport, Conn., for a term of two years.

JAMES A. MCELROY, city engineer of Bridgeport, Conn., has been reappointed for a term of two years. He will also take over the duties of the superintendent of construction, which office was abolished in December.

HENRY GORDON HINKLE, for four years city manager of Altoona, Pa., has accepted a position of city manager and chief engineer of Columbus, Ga.

L. L. PEARSALL, formerly division engineer for the state highway department Kentucky, has been made chief locating engineer.

HARRY S. RIDDELL, former supervising engineer of the Happy Valley Irrigation District, has been made resident engineer for the Tule Irrigation District and the Baxter Creek Irrigation District.

JOHN S. GALVIN, secretary of the state highway commission of California, has been appointed a member of the state civil service commission.

GEORGE W. BORDEN has been made chief engineer of the department of highways for the state of Nevada. Mr. Borden has been acting chief since the resignation of C. C. Cottrell last September.

JOHN J. COX, engineer manager of the Washtenau county (Michigan) road commission, has resigned and A. R. Bailey of the firm of Bailey and Atwell has been appointed to take his place.

CHARLES WHEATLEY of the Georgia State Highway Department has been made city engineer of Americus, Ga.

EDWIN F. WENDT, consulting engineer, has opened an office in Washington, D. C., for the general practice of engineering in connection with valuation, financing, consolidation and regulation of railroads, telegraphs, water lines and other common carrier properties. He was formerly a member of the engineering board, Bureau of Valuation, Interstate Commerce Commission, in charge of the Eastern District. Mr. Wendt was graduated from Geneva College in 1888 and received the honorary degree of doctor of science in 1913. After graduation he entered the service of the Pittsburgh and Lake Erie R.R. at Pittsburgh, Pa., and was, until he entered government service, engineer in charge, in various capacities, of construction and maintenance work. He was a member of the New York Central Lines engineering committee, 1907-1913; member of the commission to inspect the government railroad in Alaska in 1917; president of the American Railway Engineering Association in 1913; and president of the Washington Society of Engineers in 1918.

OBITUARY

LEWIS S. SADLER, commissioner of the Pennsylvania State Highway Department, died at his home in Carlisle Jan. 20 after a brief illness. Mr. Sadler was born in Carlisle in March, 1874. He was a member of the class of 1895 at Yale and later graduated from the Law School of Dickinson College. He practiced law several years and became interested in political and financial matters in Pennsylvania. During the war he was executive officer of the Pennsylvania Committee of Public Safety and the Council of National Defense, giving his services without salary. He was appointed commissioner of the state highway department in January, 1919. During the three years since he assumed direction of the department, nearly 1,400 miles of main highway have been constructed and nearly $75,000,000 spent on road construction and maintenance. Geo. F. Biles, deputy commissioner, becomes acting commissioner pending the selection of a commissioner by the governor.

EUGENE D. LAFLEUR, chief engineer of the Canadian Department of Public Works, died suddenly at his home in Ottawa. He was in charge of the surveys of the Georgian Bay Canal in 1904-1905 and was appointed to his late position immediately after the completion of the survey.

MICHAEL ANGELO CLARKE, pioneer engineer and contractor died recently in San Francisco at the age of 90. He was born in New York State but most of his work has been done in the west to which he went in 1850 to build the state prison at Folsom, Cal.

William H. Bradley, Gas Engineer

William H. Bradley, chief engineer of the Consolidated Gas Co., of New York, for 36 years, died suddenly of heart failure on January 18, at the age of 84.

Mr. Bradley was born in New Haven, Conn., in 1838 and received his education in the common schools of that city. He served for a time in the mechanical department of a large manufacturing establishment in New Haven, coming from there to the Continental Iron Works, in New York, as construction engineer. That company, which carried out a number of large government contracts, in 1862 built Ericsson's *Monitor*, which subsequently defeated the ironclad *Merrimac*, and Mr. Bradley, who took an active part in the building of the vessel, had the opportunity of contributing to its success by valuable criticisms and suggestions. At the close of the war he went to western Pennsylvania where he had become interested in oil discoveries, but he returned in 1870 to the Continental Iron Works, taking charge of the gas plant and gas holder departments.

One of the first gas plants built under his supervision was that of the Municipal Gas Works, in West 44th St., New York. After the completion of this plant Mr. Bradley became engineer for the Municipal Gas Light Co., at the same time acting as engineer for the Metropolitan Gas Light Co. The Consolidated Gas Co. was incorporated in 1884, and two years later Mr. Bradley became chief engineer of the company, remaining in this position until his death.

After an extended trip to Europe, where he studied gas plants in various countries, Mr. Bradley made a survey of the gas-supply situation of New York, which convinced him that the time would come when gas for the city would have to be manufactured outside of Manhattan Island. This conclusion resulted in the construction of the largest gas plant in the world, at Astoria, Long Island, a plant constructed in every detail according to Mr. Bradley's designs. Only ten days before his death Mr. Bradley had visited the Astoria plant where he saw the newly completed 15,000,000-cu.ft. gas holder put into operation, the second holder of this capacity built under his plans.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Lumber Business Starts Recovery After Holiday Slump

Reports from various mill centers to the American Wholesale Lumber Association indicate a slow recovery in lumber demand for the first week after the usual holiday recession. Production was at 68 per cent of normal, new business at 59 per cent of normal and shipments at 62 per cent. Yellow pine orders exceeded fir orders for the first time since Dec. 3, 1921. On the Pacific Coast both rail and export orders fell off, although moderating weather permitted rail shipments in excess of the last of November, 1921.

Construction Outlook for Spring 60 Per Cent Better Than a Year Ago

Construction Contracted for in Last Quarter of 1921 Probably Totaled $650,000,000

IMMEDIATE prospects for spring construction can best be estimated by examining the figures for contracts awarded in the last quarter of 1921. The total for this period was $300,000,000, as against $267,000,000 in October, November and December of 1920. Placing these two totals on a 1913 purchasing basis (by applying *E. N.-R.'s* Construction Cost Index Number covering the two periods) gives $174,000,000 and $105,000,000, respectively, as the comparative constructive values of contracts let in the last quarter of 1921 and 1920. This means that the *volume* of construction actually in immediate prospect is 66 per cent in excess of last spring's volume.

Table I gives the money value of engineering construction work awarded in the last quarter of 1921 on all classes throughout the country for the six groups of states, according to the regular weekly arrangement in Construction News. The next to the last column gives the totals on each class of construction for the entire country, and these may be compared with the 1920 totals shown in the last column. In this comparison it must be borne in mind that the construction dollar in the last quarter of 1920 was worth only 39 cents, as against 58 cents in the same period of 1921.

It must also be understood that *Engineering News-Record* publishes in Construction News only those projects which exceed specified minimum costs: $150,000 for commercial buildings, $40,000 for industrial works, and $25,000 for public improvements. Furthermore, no account is taken of ordinary residential construction which probably amounts to nearly 50 per cent of total construction.

Table II presents F. W. Dodge's statistics of residential contracts awarded in December, 1921, in the Northeastern quarter of the United States. These figures include prices of all apartments, flats and tenements, all dwellings, barns and farm buildings, dormitories and private garages. The last column gives the ratio of residential construction in each district to the total construction reported for that district.

Accepting $300,000,000 as the value of important engineering contracts awarded in the United States in the last half of 1921, the total value of all construction in the country awarded in this period will aggregate approximately $650,000,000.

TABLE I.—VALUE OF CONTRACTS LET IN THE UNITED STATES IN LAST QUARTER OF 1921 AND 1920

	New England	Middle Atlantic	Southern	Middle West	West of Miss.	Western	Total for Last Three Months 1921	Total for Last Three Months 1920
Water-Works	$40,000	$7,607,909	$168,665	$3,650,159	$4,497,335	$420,399	$16,384,467	$14,370,827
Sewers	34,000	1,803,809	305,662	3,152,888	1,826,222	957,380	8,079,961	15,590,635
Bridges	50,000	516,135	516,945	1,680,452	957,312	919,146	4,639,990	6,098,853
Excav. & Dredging	.....	157,765	217,000	261,431	1,359,143	....	1,995,339	2,335,059
Streets and Roads	2,000,000	20,773,540	11,500,952	12,491,001	13,245,978	6,119,408	66,130,879	36,171,020
Industrial Works	2,890,000	9,670,141	2,263,350	11,630,406	4,106,678	2,032,567	32,593,042	73,421,349
Buildings	15,313,753	44,829,207	13,199,790	58,198,066	20,318,722	2,939,378	154,798,916	83,731,560
Miscellaneous	400,000	3,778,446	554,080	1,768,439	546,834	3,065,865	10,113,664	24,655,879
Federal Gov't	574,749	1,159,684	220,859	1,331,913	151,915	1,098,315	4,537,435	10,835,816
Railways	.....	3,867,138	50,000	50,000			.....	.....
Total	$21,302,502	$94,163,774	$28,997,303	$94,214,755	$47,010,139	$17,552,458		
					Grand Total		$299,273,693	$267,220,998

TABLE II.—RESIDENTIAL CONTRACTS LET IN DECEMBER, 1921

District	Number Projects	Value	Per Cent of Total Construction
Boston	785	$17,358,700	65
New York	1,141	44,071,500	70
Philadelphia	594	12,097,100	36
Pittsburgh	661	8,640,100	38
Chicago	806	16,382,400	35
Minneapolis	249	2,346,900	27
Total	4,236	$100,896,700	50

Labor Trouble Grows More Serious in Chicago

Citizens' Committee Issues Booklet Naming 1,000 Contractors Who Support Landis Award

The resignation of Thomas S. Kearney, president of the Chicago Building Trades Council, and the election in his place of William Curran of the plumbers' union and a leader in opposition to the Landis award is taken as a direct throwing down of the gauntlet to the citizens' committee to enforce the Landis award. Mr. Kearney, while militant, was inclined to live up to the arbitration proceedings. Mr. Curran, whose ascendancy is said to have the backing of "Big Tim" Murphy, a labor leader recently convicted of conspiracy to rob the United States mails, is almost sure to precipitate strikes and cessation on all building work where non-union men are employed. In fact slugging parties have already begun.

The citizens' committee is optimistic and has issued a booklet containing nearly 1,000 names of contractors and sub-contractors who have pledged themselves to work in accordance with the Landis award. The committee has announced that it is prepared to furnish contractors or mechanics in the following trades which have been declared open shop. Carpenters, plumbers, sheet-metal workers, lathers, cement finishers, hoisting engineers, fixture hangers, slate and tile roofers and composition roofers.

Decision in the injunction proceedings brought by the carpenters' union to restrain the work of the citizens' committee is expected this week.

Funds above $1,000,000 in amount, much of it in small amounts by the general public, have been subscribed toward the $3,000,000 figure deemed necessary to finance the committee.

Westinghouse Electric Receives $2,000,000 Japanese Order

The Westinghouse Electric International Co. announces that it has received from its Japanese agent, Takata & Co., an order from the Daido Electric Power Co. of Japan for electrical apparatus for two large hydro-electric plants. The total value of this order is about $2,000,000. These hydro-electric plants are to form a part of a super-power system for the Tokio district, similar to that now under construction for the area between Boston and Washington. The current is to be transmitted at 154,000 volts.

Work has been started at the plant of the Westinghouse Electric & Manufacturing Co., Pittsburgh, Pa., on the largest single order for electrical transformers ever placed, according to an announcement made by officials of that company. The order was received through the company's Japanese agents, and the contract calls for thirty-four transformers averaging 9,400 kva. The transformers are to be installed in a super-power system in the industrial district about Tokio, a super-power zone similar to that now under consideration for the area between Boston and Washington.

Eleven months will be needed to complete the order.

Trend of Business

Bonds — The principal issue was the $30,000,000 Southern Ry. Co. development and general mortgage 6½s, due 1963, at 94½, to yield 6.9 per cent. Municipals firm but inactive. Copper and sugar issues stronger because of higher prices.

Money—General stiffening owing to withdrawal of balances by interior institutions. Call loan rates moved from 3½ per cent to 6 and then to 4½@6, averaging 5. Time funds at 4½, instead of 4 as in preceding week. Easier market expected soon.

Textiles—Generally better tone.

Iron and Steel—Steel Corporation operating at about 40 per cent capacity, independents at about 30 per cent. Prices unchanged for over a month.

Wholesale Prices in December stood at an index 149 for all commodities, the same as for November, according to the Bureau of Labor Statistics.

Lower Prices in 1921 than in 1920 reduced the gross sales of Sears-Roebuck & Co. from $254,595,059 in 1920 to $[illegible]014,981 for 1921. The net loss is $16,435,469, as against a net profit of $11,746,670 ($10.65 per share) in 1920.

Industrial Expansion and Building in Baltimore

Active industrial growth took place in Baltimore during 1921, despite the severe business depression. The city had almost $11,000,000 of capital added for new industries and expansion of existing plants. Moreover, there is at present a demand for structures of various kinds, resulting from an accumulative shortage and an influx of labor to man the new industries, of which some will be ready for operation in the early part of 1922. These conditions forecast a building program of even larger proportions in the next few years.

Among the new plants already announced for erection in 1922 are Lyon, Conklin & Co., American Oil Co., Patuxent Clay Products Co., National Cooperage Co., Cyl-Lap Products Co., Adamantex Brick Co., Hampden Laundry & Ice Manufacturing Co., and the Rasin-Monumental Fertilizer Co. at Curtis Bay. The building program of the Standard Oil Co. will be continued, as will also that of the Prudential Oil Corp. and the Red "C" Oil Co., Sherwood Brothers Co., and the U. S. Asphalt Refining Co. The directors of the Bethlehem Steel Corp. have added another $65,000,000 to that company's expansion program at Sparrows Point.

Among hospital buildings are to be counted that of the woman's clinic of Johns Hopkins Hospital, an 8-story service building for the Church Home and Infirmary, the Union Memorial Hospital, a continuation of the large University of Maryland Hospital program and the Municipal Hospital for Contagious Diseases. Five large apartment houses are planned, a 5-story garage and at least one office building. The Public Improvement Commission will continue its program of municipal improvement during 1922, $25,000,000 to $30,000,000 being available for its various activities.

Wages Down 16.1 Per Cent Since the Peak

Study of Key Industries — Building Trades Workers Cut 17 per Cent— Materials Men, 18

A tabulation of average wage reductions during 1921, with the approximate numbers of workers and establishments affected has been compiled by the J. L. Jacobs Co., Chicago, and is reproduced here. The digest summarizes reports from 1,026 establishments and industrial groups, and shows average wage cuts of 16.1 per cent for over 5,000,000 workers. Since the start of deflation in 1920 the cost of living, as calculated by the United States Bureau of Labor Statistics and other agencies, has declined about 20 per cent.

In the building trades of 183 cities where building trades workers received cuts 8.2 per cent of the total reduced wages less than 10 per cent; 41.5 per cent of the total reduced wages between 10 and 14 per cent; 12 per cent made reductions between 15 and 19 per cent; 26.3 per cent reported cuts of from 20 to 24 per cent and 12 per cent reduced wages over 25 per cent.

The more important instances in which building trades wages have been reduced since the peak include those of from 12½ to 20 per cent in Seattle; 25 in Fall River and in Danbury, Conn.; 24 in Philadelphia; 10 to 20 in Newark, N. J., Omaha, Neb., Fort Wayne, Ind., and Lynn, Mass.; 10 to 15 in San Diego, Cal.; 14 in Warren, Pa.; 15 to 20 in Des Moines, Iowa; 20 in Worcester, Mass., in Minneapolis and St. Paul, Minn., in Saginaw and Bay City, Mich., and in Memphis, Tenn.; 10 to 16⅔ in Boston, Mass.; 10 to 35 in Pittsburgh, Pa.; 20 to 25 in Milwaukee, Wis., and in Toledo, Ohio; 7½ [illegible] San Francisco, Cal.; from 10 to 36 in Chicago, Ill., through the present decision of Federal Judge Landis; 12½ to 20 in New Orleans and in Dayton; 17 in Cleveland; approximately 20 in Detroit; the California metal trades, including some 25,000 workers were reduced 10 per cent; and 35,000 sheet and tin plate workers between Pittsburgh and St. Louis received a like reduction of 10 per cent. The County building trades of Westchester County, arbitrated the wage adjustment and some 10,000 workers received a reduction of 11 per cent.

Iron and steel workers, both of the United States Steel Corporation and the independents, have in most cases received three reductions and the wages have been brought down to the level of May, 1917, the reductions being approximately from 30 to 40 per cent from the peak.

Among the public utilities, wage reductions reported show that of 161 organizations, 35 reduced wages 5 to 9 per cent; 57 reported reductions of from 10 to 14; 31 from 15 to 19; 26 from 20 to 24; and 12 over 25 per cent. Some of the larger street railways reporting reductions include those in the cities of New York, Philadelphia, Brooklyn, Boston, San Francisco, Detroit, Cleveland, Pittsburgh, Denver, Los Angeles, Seattle, Albany, Indianapolis, Buffalo, Milwaukee, Omaha, Topeka, Council Bluffs, Salt Lake City, Mobile, Ala., Fort Wayne, Syracuse, N. Y., Newark, N. J., and other metropolitan New Jersey cities.

A number of municipalities and state organizations made wage reductions from 5 to 20 per cent, affecting particularly highway and street employees, firemen, policemen and some officials. The outstanding reduction was that in the Federal government in which a reduction of from 10 to 20 per cent was made for the 68,000 civilian workers of the United States Navy Department.

By deducting the 1,879,000 railroad and express employees who received an average wage reduction of 12½ per cent, the average reduction for the other 1,024 groups and establishments is approximately 18.1 per cent.

WAGE REDUCTIONS IN 1921 BY INDUSTRIES
Compiled by the J. L. Jacobs Company, Chicago.

Industry	Number Establishments and Groups Reporting	Estimated Number Employes Affected	Average Per Cent Wage Reduction
Meat Packing	18*	200,000	25.5
Cotton Manufacturing	27*	217,000	24.9
Hosiery & Underwear Mfg	8	7,000	24.3
Leather Manufacturing	8	15,500	22.0
Woolen Manufacturing	26	100,200	20.0
Car Bldg. and Repairing	12	15,600	19.6
Mining	26	137,000	19.5
Iron and Steel	101*	433,800	19.2
Building Materials Mfg	16	6,800	18.3
Electrical Manufacturing	6	75,500	18.2
Rubber Goods Mfg	13	12,500	17.9
Boot and Shoe Mfg	39	78,500	17.5
Building Trades (Cities)	183*	490,000	17.0
Men's Clothing Mfg	7*	100,000	16.7
Paper Manufacturing	22	24,000	16.6
Public Employment	58	111,500	16.5
Silk Manufacturing	25	31,500	16.2
Public Utilities	161	144,350	14.8
Shipbuilding	20	109,300	14.8
Express Employes (R. R.)	1*	50,000	12.5
Railroad Employes	1*	1,829,000	12.5
Miscellaneous	248	866,300	16.4
Totals and Average	1,026	5,055,350	16.1

*Entire Group or Industry Included.

Grand Trunk Places Rail Order

The Grand Trunk R.R. has placed an order covering its rail requirements for 1922, closing recently orders with the Dominion Iron & Steel Co., and with the Algoma Steel Corporation, orders aggregating 29,000 tons. The Dominion Iron & Steel received an order for 15,000 tons for production at its Sydney plant. The Grand Trunk rail orders added to the Canadian National Railway's recent placing of 40,000 tons in equal shares with the Dominion and Algoma Companies brings the total for the two systems to 69,000 tons.

Bids Desired on Big Jobs

Among the projects on which bids are either asked or will soon be called in Construction News, pp. 31@39, are the following:

A hotel for Los Angeles, $10,000,000.

A 20-story bank and office building for Cleveland, $10,000,000.

A library for Philadelphia, $3,000,000.

A hospital for St. Louis, $1,000,000.

A waterworks project for Newport Beach, Cal., $250,000.

A dam for Columbus, Ohio, $3,000,000.

Large Contracts Let

Among this week's announcements of contracts awarded in Construction News, pp. 31@39, are the following large projects: A 5-story hotel in Los Angeles, Cal., to Milwaukee Bldg. Co., Wright & Callender Bldg., $1,250,000; a street and road development for Tallahassee, Fla., $1,[illegible]; a 15-[illegible] apartment in New York City, under supervision of R. Candela, New York, $1,500,000.

Urges Amnesty for Trusts

In a recent speech before the Building Trades Employers' Association and the General Contractors' Association of Massachusetts in Boston, Samuel Untermyer, counsel to the Lockwood legislative committee on housing, which is investigating New York building conditions, urged amnesty for violators of the Sherman anti-trust law who make full disclosure of existing illegal agreements and prosecution of those who do not meet the amnesty conditions.

Mr. Untermyer doubted the possibility of the suppression of such trade conspiracies, but he asserted an endeavor should be made to do so before resort was had to compromise methods. The qualification which he placed upon such an agreement would be that amnesty should not be granted in any case where there had been ruinous competition, coercion or other form of oppression of competitors, or where the combination had involved the commission of a criminal offense other than that of violating the anti-trust law.

Twenty-One in Soil Pipe Trade Are Indicted

An indictment charging ten individuals and eleven corporations, members of the Eastern Soil Pipe Manufacturers Association, with price fixing and violation of the Sherman anti-trust law, was made public recently by the United States attorney for the Southern District of New York. The allegation is made that the defendants conspired to restrain trade through an agreement to control the sale of soil pipe.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of January 5; the next, on February 2.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$2.63	$3.50	$4.00	—$2.63	$2.91	$3.50	$3.10	—$3.60	$4.00
Structural rivets, 100 lb	3.50	5.00	5.50	3.43	3.90	4.25	4.50	4.00	6.50
Reinforcing bars, ¾ in. and larger, 100 lb	2.53	3.20	3.50	2.68	2.81	+3.42½	2.75	3.75	2.75
Steel pipe, black, 2½ to 6 in. lap, discount	61%	57.65%	45%	57%	61.9–5%	44%	53.7%	+53%	35.10
Cast-iron pipe, 6in. and over, ton	47.30@48.30	45.00	48.30	44.10	47.80	52.00	50.00	—44.00	60.00
Concreting Material:									
Cement without bags, bbl	2.30	2.55	2.55	1.97	2.24	2.90	2.84	2.94	3.10
Gravel, ¾ in., cu.yd	1.75	1.85	2.00	2.00	1.50	2.50	2.25	1.50	1.50
Sand, cu.yd	1.00	1.25	2.00	2.00	.50	1.10	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd	1.75@1.85	2.00	2.93	1.60	2.25	3.50	2.25	3.00	2.10
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	49.00	35.00	34.00	+44.00	38.00	50.00	32.00	19.00	.....
Lime, finishing, hydrated, ton	16.99	19.00	25.00	18.00	29.00	30.00	22.00	27.00	+26.00
Lime common, lump, per bbl	3.00@3.49	1.50	2.75	1.40	1.40	2.95	1.75	2.75	11.00
Common brick, delivered, 1,000	18.40	9.00	12.65	11.00	15.00	14.00	15.50	14.00	16.00
Hollow building tile, 4x12x12, block	Not used	.0675	.13	.0821	.0752	.08	.12½	.10	.08
Hollow partition tile 4x12x12, block	.11120	.0675	.13	.0657	....	.10	.14½	.11	.....
Linseed oil, raw, 5 bbl. lots, gal	+.75	+.80	.93	+.79	.84	+.93	.83	+.86	—.82
Common Labor:									
Common labor, union, hour	.75	.35	.....	.72½	.40	.50@.55	.62½	.50@.60	.....
Common labor, non-union, hour	.....	.20	.35@.45	.35@.40	.40	.35@.40	.56¼	.50	.20@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations are delivered except tiles, which are "on trucks." Common lump lime per 280-lb. net; both lump and hydrated quoted f.o.b. cars New York. Sand gravel and crushed stone are quoted alongside dock. Cement and steel pipe delivered to contractors on job. Gravel ready mixed $2 per cu.yd.

Chicago quotes hydrated lime in 50-lb. bags; common lump line per 180-lb. net.

Minneapolis quotes on fir instead of pine. Brick and hollow tile delivered. Cement on cars. Gravel, sand and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized.

Denver quotes cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5¾ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to contractors in yards at San Francisco. Lumber price is for No. 1 fir, common.

Seattle quotes on Douglas fir instead of pine. Common lump lime per 180-lb. net.

Montreal quotes sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 95 cents). Bag change is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net.

Changes Since Last Week

Pittsburgh mill price of $1.50 per 100 lb. on structural steel continues in effect. Steel shapes are quoted in the Chicago warehouses at $2.63 as against $2.88 and in Seattle at $3.60 as compared with $3.85, one week ago. Steel prices, generally, seem steadier now than at any time during the last year.

Long leaf yellow pine is quoted in Chicago at $44 as against $43 and in Denver at $50 as compared with $45 per M. ft. b.m., last week.

The Interstate Commerce Commission has ordered a reduction in freight rates on hardwood lumber. This schedule will become effective not later than Mar. 6, 1922, and will reduce the scale to 7@11c. per 100 lb. above the rates prevalent in 1920, before the general increases went into effect. The various yellow-pine lumber associations are appearing before the Interstate Commerce Commission this month to present their case for lower rates on yellow pine. No rate reduction on this type of lumber is anticipated for the next two months. Leading lumber manufacturers anticipate higher prices by Mar. 1, 1922.

Good demand for paint materials, for the approaching spring season, has prompted an advance of 2c. per gal. in raw linseed oil (5 bbl. lots) in New York and Denver; 3c. in Chicago and 7c. in Seattle.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, President

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. Mehren
Editor

Volume 88 — NEW YORK, FEBRUARY 2, 1922 — Number 5

Sound Engineering

IF LAST week's editorial comment on the failure of the Palm Beach bridge has led any one into a too pessimistic view of current concrete bridge engineering, the article on the Chemung River bridge in this issue is offered as an antidote. This bridge is not especially large or complicated and its design and construction offered no extraordinary problems, but those responsible for it showed the soundest engineering and constructing sense in its study and execution. There was a most careful balancing of alternatives in design and a definite plan and purpose in construction operations, which plan was properly supervised by the engineer as the one finally responsible to the owner. The bridge exemplifies the best sort of technical precision and of professional obligation.

House Shortage and Death Rates

OUR HOUSING SHORTAGE is doubtless a menace to health, as was urged at the American Society of Civil Engineers meeting reported in our news section of Jan. 12, but the record-breaking low general death rates for 1921 in our three largest cities indicate nothing of the kind. New York came first with a tentative figure of 11.17 per 1,000. Chicago plays safe by reporting an even "eleven" and claiming that it heads the list of large cities. Philadelphia is satisfied to characterize its 1921 death rate of 12.55 as the "lowest in the history of the city." These are records to be proud of, housing shortage or not. They do not prove that the housing shortage is not a menace to health. The decline in the general death rate, despite the housing shortage, may be due to a continuation of declines in other causes that more than offset the evil effects of the housing shortage; and it may be that the shortage will suddenly cause an excess of deaths through outbreaks of communicable disease. Study of the details of the 1921 deaths by causes may disclose what the total deaths fail to show, but it seems more likely that our health bookkeeping on the one hand and our meager housing data on the other are utterly inadequate to measure the housing shortage menace to public health in terms of vital statistics.

Spring and Fall Meetings

THERE should be a favorable reception of the proposal of the Board of Direction of the American Society of Civil Engineers to hold spring and fall meetings of two days each in different parts of the country. Under this plan the society would be taken to the members three times a year instead of once. There should, as a result, be a greater interest and loyalty. One of the handicaps that a national society must endeavor to overcome is its detachment from its members. Two additional large meetings will help to overcome the difficulty. The places selected for the first experiments—Dayton, in the spring, and San Francisco, in the fall—are excellent for the purpose. Both are now the centers of much engineering interest. The practice of holding large spring and fall meetings has been tried by other national engineering societies with success, and there is no reason why it should not be equally satisfactory for the civil engineers. It will be recalled that one such interim meeting was held some years ago—at New Orleans—and was successful. The new plan aims to make these interim meetings — if well received — a regular feature of the society's activities.

Activity on Highway Standards

CRITICISM of contracting for its failure to make progress in establishing standard practices in constructing paved roads, emphasizes the equal culpability of engineering as disclosed by the committee on standards of the American Association of State Highway Officials. Only two states, it appears, have attempted to develop a "rational design" for road foundations or for monolithic road slabs. Not more than six states have given the problem serious thought. Hardly two states, it is reported, widen curves the same amount or use the same methods of widening. Such more complicated procedure as superelevation of curves or of grade compensation for curvature are utterly without uniformity in practice. There is not general agreement even on elemental factors like width and thickness, or on amount of crown or permissible grades for various surfaces. In brief, there are no standard practices in road engineering as there are none in road contracting, and road building is the greatest task of engineering construction which the United States has ever undertaken. These facts carry no tribute to either road engineers or road contractors and it is high time that the work toward standardization, ordered by the American Association of State Highway Officials in convention last month and by the Associated General Contractors in convention two weeks ago, was undertaken. Neither association has an interest of greater importance than road construction nor committees which should be driven harder in their tasks for 1922 than the Methods Committee of the general contractors and the Standards Committee of the state highway officials.

Better Convention Facilities Needed

IT IS unfortunate that the facilities offered for presenting the papers and discussions forming the technical program of the Chicago convention of the American Road Builders' Association last month were of a type which would have been a reflection on less competent men. The high character of the papers and the well balanced selection of subjects deserved a far better setting than was accorded by the auditorium in the Coliseum annex. It is not so much to the point that the hall was a dreary, ill-lighted, depressing place, for engineers are not fussy individuals and do not demand a Louis XV salon for their deliberations. They do ask, however, for an opportunity of hearing what is being said at their gatherings, particularly when the talk is

very much to the point. This was rendered impossible, most of the time, by an almost continuous rumbling of machinery in operation on the floor below. Speakers had a hard time competing with the machine-gun-like vibrations of screening devices, the grinding of rotating concrete mixers, and the clanking of dump buckets. It should be well known by this time that engineers like to "say it with diagrams." Any attendant at engineering conventions knows that fully half of the papers are generally accompanied by charts and photographs. At Chicago, however, no adequate provision for operating a stereopticon machine in the auditorium had been made, and it was necessary, in several cases, to delay the proceedings and scurry about for a man who could show the illustrations which formed an essential part of certain addresses. For a time it looked as if an important contribution on the research work of the U. S. Bureau of Public Roads, dependent in large measure upon lantern slides, was to end in a fiasco due to the lack of a stereopticon operator and a failure of electric current. It is doubtful whether any convention or road builders has listened to a better program of engineering subjects offered under such miserable conditions. The technical food was excellent, but the service was bad.

Road Building Costs

IN A falling market there is always a tendency to postpone purchases with the hope of getting in, not at a reasonably low level, but at the bottom. Prospective buyers often fail to recognize the valleys in price curves, and, by holding off too long, are forced to buy after the turn.

In some localities state highway officials have been holding back construction in the belief that lower prices could be secured by waiting. This subject was much discussed at last month's convention of the American Road Builders' Association and it is worth while repeating the advice of Thomas H. MacDonald, chief of the U. S. Bureau of Public Roads, to the effect that, with the considerable cut in labor costs during recent months, highway authorities need not hesitate, on account of costs, to let contracts for grading, excavation, and similar work. On such work labor forms the outstanding element of cost. This view was generally concurred in by the convention's delegates, but it was emphasized that reductions in labor costs had been much greater in rural work than within city limits. Grading contracts, as was pointed out in these columns, have recently been let at 1914 prices.

As to surfacing costs it was emphasized that the materials item makes an important difference. This was believed to be still too high, especially when compared with the lowered price of labor. Here high freight rates are an important element. The point to remember, however, is that on kinds of work involving chiefly labor, costs are down to pre-war levels.

For Constructive Thought on Transportation

AT NEXT week's meeting of the National Council of the U. S. Chamber of Commerce there will be discussion of a proposal that Congress create the position of "Commissioner General of Transportation." The duties of the office would be to take a constructive attitude toward the conservation and development of the transportation facilities of the country, and to see that the public's rights get adequate consideration in all transportation matters. At present the railroads receive government attention only through regulatory bodies—the Interstate Commerce Commission and the Railroad Labor Board. There is no agency which constructively considers the country's transportation agencies. Waterways and highways, in this respect, are in a more favorable position. The Corps of Engineers has a fostering care of waterways. (So has, we might venture to say, the log-rolling politician.) The Bureau of Public Roads is doing a great constructive work for highway development

Obviously the railways need to have the same fostering care of the government. Their future is as vital to the prosperity of the country as are industry, agriculture, mining and other branches of our national economy to which great government departments and bureaus are devoted. That such care is not likely to come from bodies that are essentially regulatory in spirit is evident.

The proposal of the Chamber, therefore, rests on solid ground. There will be disagreement in detail. For example, this journal does not favor the erection of new independent establishments; the new office, as we see it, should be in the Department of Commerce. Again there will be points that will need long study; should the new office take away some of the constructive functions of the Corps of Engineers on waterways, and of the Bureau of Public Roads on highways?

Undoubtedly there will be classification of many points at next week's discussion. The basic idea, though, is sound.

Federal Influence on Motor-Vehicle Laws

A MEANS of putting teeth in motor-vehicle laws and bringing about uniformity in vehicle legislation has been suggested by a highway engineer of the Middle West who has experienced difficulty in securing adherence to the weight restrictions of his state. He proposes that the federal government require definite vehicle laws to be enforced on federal-aid roads.

In the recently enacted federal-aid highway law definite obligations are placed upon the states to supply adequate funds for maintenance of federal-aid roads. It is now suggested that the federal highway Act might go further and authorize the expenditure of federal-aid funds only when the states agree to enforce regulations limiting truck weights and speeds. In other words, weight regulation would rank with maintenance as a reason for withholding federal-aid in case of failure to live up to agreement. If a state were made to realize that future federal aid were contingent not only on adequate maintenance but on strict vehicle-law enforcement, it is probable that the present laxness in the latter respect would disappear.

Aside from the effect in forcing the states to administer properly their motor-truck laws there are other arguments favoring the suggestion. We know of many roads ruined by excessive loads and high truck speeds. If vehicle-law enforcement is vital in order to get reasonable life from surfacing, why is not such enforcement as legitimate a subject for contract agreement as maintenance? Both factors bear on the service which the people are to get from the federal expenditure.

Another attractive feature of the proposal is that it would tend to bring about a uniform motor-vehicle law in all states or, at least, in large sections of the country.

Obviously, there are objections. Without doubt some

will cry that it invades the police power of the states. Others will protest that if maintenance be adequate the federal government has no interest in what causes the maintenance costs. Still others will resent greater federal interference, and others will claim that a uniform law is impossible.

The suggestion, though, has merit and reason. We should like to see its advantages and disadvantages fully discussed.

Responsibility and Pay

IN THE court inquiry into the collapse of a theater in New York, described in our issue of Dec. 8, 1921, p. 954, it developed that the plan examiner of the Building Department who approved the design for the theater is paid $1,944 a year. The magistrate was shocked. "Your approval of the plans was final? There was no one else to check or question your conclusions?" he asked the examiner. Evidently he thought that technical knowledge worth less than $2,000 a year is not of high quality or dependable. To the extent that the design for the structure played a part in bringing about the collapse and causing the death of seven workmen, the examination and approval of the plans obviously connected itself in the magistrate's mind with the fatal outcome. A much more serious duty and responsibility rested upon this examiner than his salary of $1,944 indicated, as the magistrate expressed in the remark: "A man carrying your responsibility and exercising it properly," said the magistrate, "should receive at least $10,000 a year."

Such is the opinion of a judicially minded layman on technical responsibility and adequate compensation therefor. Engineers themselves have urged this view time and again, and have pointed out that placing heavy responsibility on men for grossly inadequate pay leads very surely to deterioration and debasement of the work. But public authorities are deaf to this argument, and so are many private employers, unfortunately. Engineers in river and harbor work, the technical men of the Bureau of Standards, and the Patent Office experts are as pertinent examples as this particular building-plan examiner. Their fight to prevent destruction of the service by inadequate compensation has generally been in vain. And so, in another field, has the classical case of the bank teller always remained in *statu quo*, in spite of case upon case of the unhappy results.

It will not do to depend upon the wisdom of the employing authority to fix adequate compensation, and engineers will make no progress in their fight unless they continue the course initiated some years ago and stand in concerted action against inadequate compensation within the profession.

The foregoing paragraphs were written before the shocking collapse of the Knickerbocker Theatre at Washington. At this moment we do not know much about that accident or the design of the roof that failed, but we do note a general disposition to blame the building department of the city for laxity. "Responsibility for the dreadful catastrophe," says the New York *World*, "comes home at last to the government of the District of Columbia and its building laws and their enforcement."

And yet the head of that building department receives less than a dapper, responsibility-free bond salesman, and the wages of the man who passed on the Knickerbocker design or repairs, if there were any, would be despised by many a skilled laborer with only himself to care for.

When hundreds lie dead, the people—and their newspapers—see clearly the importance of their building departments. When budgets are being made, short-sighted tax-payers loom large in the legislator's mind. What was it Kipling said, before the great war, of the British public and its soldiers—

> "Oh, it's Tommy this and it's Tommy that, and it's Tommy, damn your soul!
> "But it's 'the thin red line of 'eroes' when the drums begin to roll."

After-Thoughts on the Hardwood Lumber Decision

IN THE month since the decision on the Hardwood Lumber case was announced, there has been a maturing of views. The panicky impression of the first few days has disappeared. In its stead has come a settled conviction that the decision is of limited application, that it was predicated on the showing that the association had used statistics as a basis for advice on future action, and that a favorable decision may be expected when there comes before the court an association which has confined its activities to the collection and distribution of data regarding closed transactions. This, by the way, was the view expressed editorially in *Engineering News-Record*, Dec. 29. This view, however, is not universally held. Naturally, some associations feel on unsafe ground. Six of them (we do not happen to know the nature of their work) have been abandoned, so the U. S. Chamber of Commerce reports.

While the less alarming interpretation has been gaining ground there has also been developing the conviction that safety in statistical activities lies in the direction of publicity. But this thought, too, is not without opposition. Some manufacturers fear that the statistics will be misinterpreted by consumers, and that the misinterpretations will lead to unintelligent buying, unsettled markets, and to unwarranted pressures put on producers.

We, ourselves, are not fearful of dire results. Unsettlement there may be in the beginning, but it will be the precursor of a more stabilized business. The consumers will soon learn to interpret the figures intelligently. Then will come buying in the light of fact. More important, though, will be the confidence with which the manufacturer will be regarded. Now he is looked on as having leagued with his fellows for the exchange of data to be used against the buyer.

We should think that the study of the operation of open exchanges would tend to quiet the fears of those who oppose publicity for statistics gathered by associations. In the food-supply field, for example, we have a long chain of published facts, beginning with government crop reports, down through shipments and sales and prices. We believe that it is generally agreed that this publicity is a gain to the entire industry and conserves, as well, the interests of the public.

Publication of association figures is in harmony with the spirit of open exchanges and would remove the basis of criticism which not only has prompted the government suits but may result in legislative action. The public, it is apparent, is distrustful of associations which gather figures for their members' private use.

Open-Well Piers and Subdivided Warren Trusses of Bismarck-Mandan Bridge

Foundations on Clay at Depths Up to 70 Feet—Tilted Pier Righted by Help of Blasting—Riveted Simple Spans With New Web Type—Disadvantages of Continuous and Pin-Connected Construction

By C. A. P. Turner
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THROUGH North Dakota the transcontinental highway from the east to the Yellowstone National Park is known as the Red Trail. The crossing of the Missouri River at Bismarck by ferry—hitherto the only means of crossing in summer—is impracticable, however, in high wind or at time of flood. During winter the river is passable on the ice, but it is impassable during the time of ice formation and breaking up. Due to the fact that the river varies anywhere from 1,500 to 3,000 ft. in width, presenting a bluff on one side and from one to three miles of river bottom on the other, bridge crossings are infrequent and expensive. These conditions controlled the construction of the Bismarck-Mandan bridge, now nearly completed.

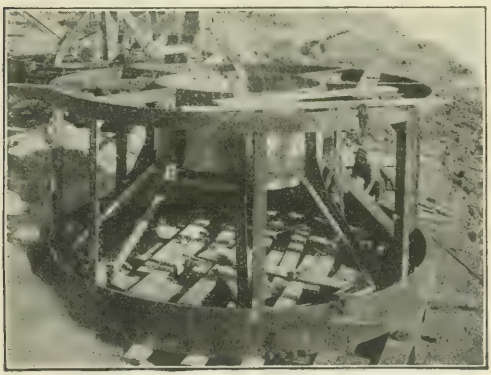


FIG. 1. PLACING BASE FORMS ON SHORE-PIER CYLINDER

The river bed is formed of silt, shifted at each succeeding flood period and deposited at the subsidence of the high water. As the river rises it commences to dig out its bed so that the depth of the water is increased downward as much or more than in an upward direction. It is limited in its capacity for channeling by a stratum of shale clay which extends for many miles up and down the river, at an elevation varying from 30 to 90 ft. below low water. Bridge foundations must be carried down into this clay if they are to remain permanent and unaffected by the scour at flood periods.

A location about a mile below the Northern Pacific R.R. bridge at Bismarck was adopted for the new crossing. It lies in the most direct line from Bismarck to Mandan, is far enough below the Northern Pacific bridge to meet the requirements of navigation, and avoids the slip of the clay bank which is causing the Northern Pacific R.R. trouble with its east pier. The depth of clay is somewhat greater than found at the upper site. The bridge proper consists of three main spans, 476 ft. center to center, with concrete approaches on curve, about 400 ft. on the east and 600 ft. on the west end. The deck provides a roadway 27½ ft. wide and two 6-ft. walks.

Foundations.—Because there are relatively few logs and boulders in the bed of the stream above the clay stratum, the open-dredging method of sinking piers was adopted. A somewhat novel design was employed: The bases of the river piers, 23 x 60 ft., by 14½ ft. deep, are framed with a steel skeleton built up on the cutting edge, the latter made up of a 24 x ½-in. plate outside, a 24 x ⅜-in. plate inside bent 40 deg. from the vertical, and a 3 x ¾-in. bar between. Forms were attached to the frame and the whole filled with concrete stiffened by reinforcement. Three dredge pockets were left in the base. Above the base, the pier was narrowed down to 16 ft. width and above low-water line, where ice action commences, to 12 ft., and still higher to 10 ft. in the form of two cylindrical columns.

Twin cylinders having a base 20 ft. in diameter by 10 ft. deep with dredging pocket 9 ft. in diameter constitute the shore piers. Sinking the piers progressed at the rate of 1 and 3 ft. a day until clay was reached, when some little delay and difficulty was experienced in sealing the piers, as the clay was too compact to dredge with a clam. Without at least 10 to 15-in. penetration of the cutting edge into the clay, the dredging pockets could not be sealed against the inflow of silt through irregularities in the surface of the clay. Pier 3, at depth of 70 ft., gave additional trouble; the clay stratum was inclined and the pier tilted about 30 in. The clay on the high side of the pier was loosened by driving points consisting of old boiler tubes closed by a blacksmith into the clay near the cutting edge, lowering dynamite cartridges into the holes so made, and shooting several at a time. After the piers were sealed and pumped out, they were carried to the desired depth in the clay by chopping out the clay with mattocks.

The pier shells had been reinforced for air should it become desirable to employ it in sealing. All piers were sunk in the open, and air was used in sealing only the west shore piers in the dry, as insisted upon by the U. S. Bureau of Public Roads.

Fig. 2 shows the steel framing for one of the twin cylinders of Pier 1. The frames for Piers 2 and 3, rectangular boxes, were made up in the same manner. After the base sections were concreted, the piers were sunk by progressively building up and dredging out. (Figs. 3 and 4). Fig. 3 shows one stage of sinking of Pier 1; here the north (near) pier has been sunk only a few feet, the top of the base still showing above water, while the south pier has progressed farther and the upper section of the shaft has been built up from the base. In Fig. 5, Pier 2 is seen complete. The two shafts, which are heavily hooped and reinforced, are of enormously greater strength than the ordinary masonry pier, while costing far less because of their lesser bulk.

Clearance for Navigation.—Following the Missouri

River Commission report of forty years ago, the practice of the War Department has been to approve plans only as they provide for at least 50 ft. clearance above June high water. With railroad and truck competition, steamboat transportation on the upper Missouri river is found today to be feasible only with the internal combustion engine, so that the 50-ft. clearance required for the smokestack of the old-fashioned coal-burning steamer is today unnecessary. Through the active interest taken in the structure by Capt. I. P. Baker, principal owner of the Benton Packet Co., of Bismarck, the only company now commercially engaged in the transportation of freight on the upper Missouri by boat, this old requirement for headroom was reduced by the War Department to 38 ft., although navigation interests maintain that 25 ft. is ample for any commercially feasible craft navigating the river today. It may be expected that further reductions in the excessive clearance required for bridging the Missouri will be permitted in the near future, as it is an item of material importance in reducing the high cost of railroad and highway structures across this stream, now necessary to give the prescribed clearance at a reasonable grade.

Superstructure.—The superstructure of the approaches presents little that is novel; the spans are uniformly about 34 ft. center to center of columns, and the pedestals in general rest upon piles cut off at the permanent water line. The main spans, however, are decidedly interesting.

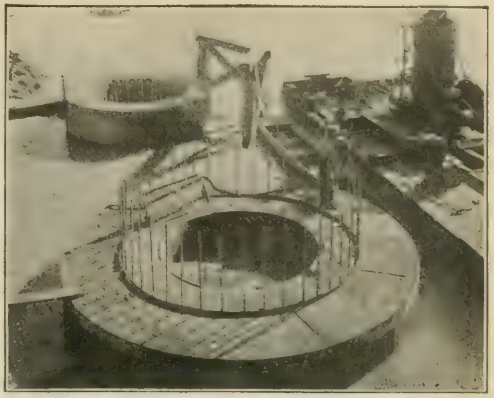
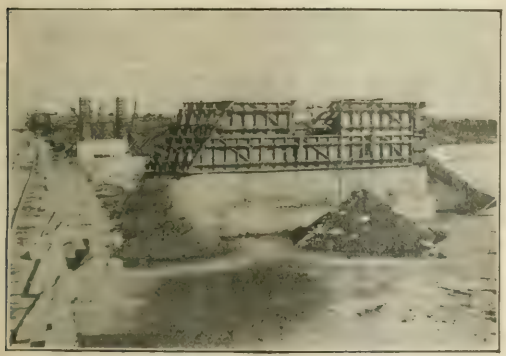


FIG. 2. TWIN CYLINDERS OF SHORE PIER AT TWO STAGES OF SINKING





FIGS. 3 AND 4. A RIVER PIER; FORMS OF A LOWER SECTION, AND COMPLETED PIER

Two primary questions of bridge economics presented themselves: simple spans or continuous construction, and riveted or pin joints.

Simple or Continuous.—Reduction in expense of erection for the center span was the main argument favoring continuous spans. Offsetting this would be the additional cost of shop work and additional weight of metal, estimated at about 30 per cent over that required for simple spans.

The so-called renaissance of continuous bridge construction appears to the author to be based on misconception of the elements of relative economy in a comparison of the two types. In the simple span, maximum moment occurs where the shear is least; accordingly, relatively great depth may be utilized in resisting moment, and heaviest chord members occur where the weight of the web members approaches a minimum. In the continuous type the heaviest and longest web members are required at the support, where the moment is numerically greatest. Hence the continuous structure labors under the disadvantage of a much heavier web than the simple span, and the economic depth for the simple span is therefore greater than that for the continuous span.

The estimated difference between the two types, designing each as economically as possible, was approximately 30 per cent of the simple-span design, the continuous design being the heavier by that amount and more expensive by at least 20 per cent.

Riveted or Pin-Connected.—Some 25 years ago there was considerable controversy between American and continental engineers regarding the relative economy of pin-connected structures as against riveted structures, the latter being used almost exclusively in Europe and pin-connected structures being generally adopted in America.

It is submitted that the riveted design adopted for the Bismarck-Mandan bridge is more economical from the standpoint of weight of metal involved than a pin-connected design, notwithstanding the fact that riveted bridges as designed by European engineers are in general heavier than typical American pin-connected bridges. For the same skeleton the weight of details depends in a large measure on economy in splicing the

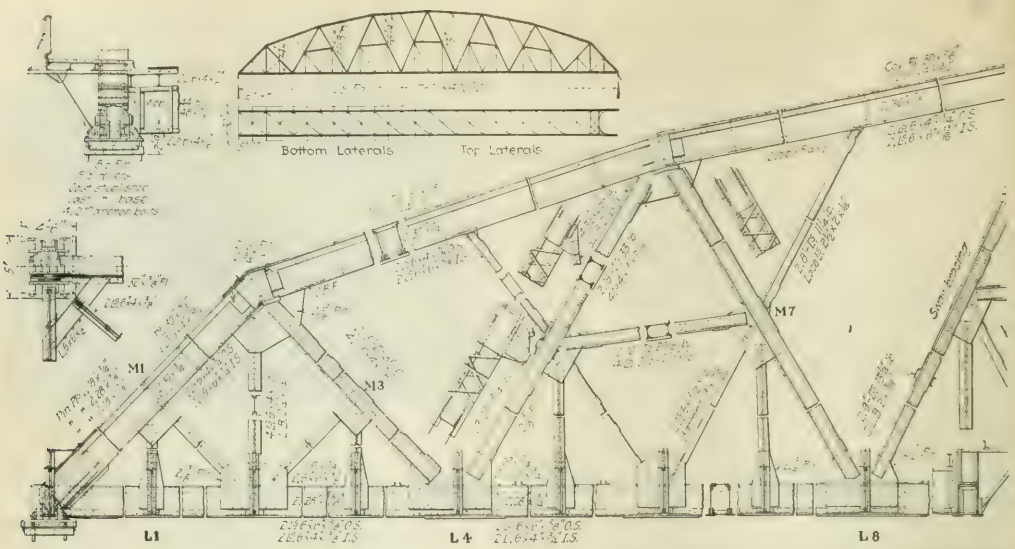


FIG. 5. SUBDIVIDED TRIANGULAR TRUSSES

main sections and the complexity of the details involved. In the pin-connected bridge, when a first-class lateral system acting in the plane of the bottom chord is designed, complicated details of the floor-beam connections are involved. With the riveted design the floor beams are made of full cross-section with square ends, requiring no bent-up flanges or cutting to clear pin nuts and to fit eyebar heads.

In the design adopted the cross-section of the compression chord varies little from end to end. There is but little variation in the bottom chord, the end section being somewhat lighter than the others. The lengths of uniform section are four panels, by virtue of the subdivision adopted. This spaces the splices of the main sections 68 ft. apart, and in the total length of the bridge there are but six splices in the bottom chord and seven in the top chord. Thus the number of joints in the bottom chord is no more than in a 140-ft. span with seven 20-ft. panels, and because of the reduction in the number of these joints the percentage of details is relatively lower than in the pin-connected type.

The make-up of the truss is completely shown in the general detail drawing of the truss submitted herewith. It differs in some minor respects from common practice in presenting balanced sections in the compression members, which are well designed to resist both torsion and flexure by virtue of broad and liberal flanges and cross diaphragms inserted at suitable intervals. The lacing itself presents a large amount of torsional rigidity, since angles rather than flat lacing bars are used and these in turn are riveted in a manner far more substantial than has been followed in other designs of heavy bridge structures. Double shear on the rivets of the connections of all main joints is secured by forked ends of the members.

The type of truss is one originated by the writer to eliminate the multiplicity of nominal members, i.e., those that do no work except to break up the length of compression members, to be found in the Baltimore type; to render the triangulation a closer approach to that of the equilateral triangle; to reduce the secondary stresses to the minimum amount; to simplify and facilitate field erection by the reduction of the number of joints to the practical minimum limit.

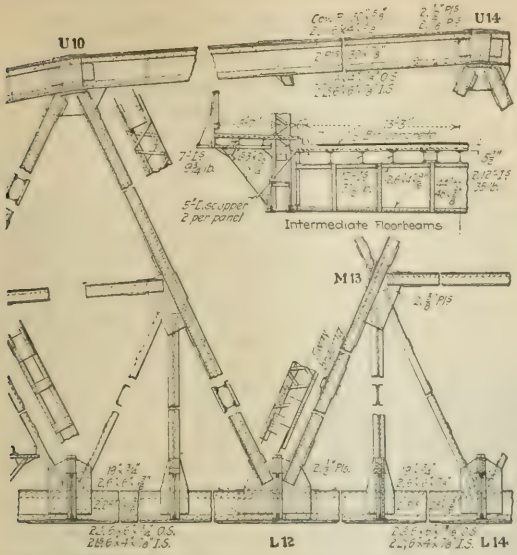
Field Advantages.—In erection this form of truss proved fully as advantageous as in its design effect. At the very first, the erection men, being not used to the work, "cussed" the design; but very quickly they got the hang of putting the work together, making phenomenal speed even on the first span. The long members and few joints brought rapid progress.

Erection started in July, after driving of the pile falsework for the first span on the Bismarck side—this work having been interrupted a number of times





FIGS. 6 AND 7. SUPERSTRUCTURE ERECTION. LEFT, MAIN TRAVELER STARTING SECOND SPAN; RIGHT, TWO SPANS COMPLETED



WITH TOP-CHORD BRACES

by ice and high-water damage. The first span was completed late in September. In the meantime falsework had been driven for the second span and work started immediately there. Steel was placed by an outside traveler, which may be seen in one or two of the photographs. Between four and five days were required to place the shoes of the second span and grout them, set the floor system on the blocking, and lay down the bottom chords. Then only 3⅝ days were required to erect and couple up the rest of the span (above the floor).

The general opinion of the erecting men seemed to be that the triangular type of truss could be erected 1½ times as rapidly as an ordinary pin-connected span, and with far greater safety to the men putting it up.

A small traveling derrick frame running on the falsework was used ahead of the main traveler to place the floor and bottom chords. All erection above the floor was handled by the outside gantry traveler, the hoisting engines for which were located on the smaller traveler. Yard handling of material, from the ground alongside the approach to cars on the bridge floor, was done by locomotive cranes.

The work is being executed under the direction of the Highway Commission of North Dakota, Gov. Lynn Frazier chairman, W. H. Robinson secretary and chief engineer. The writer's firm, the C. A. P. Turner Co., of Minneapolis, acted as consulting and designing engineer. The Foundation Co. carried out the foundation work and the American Bridge Co. the fabrication and erection of the superstructure. The work was financed with federal aid, administered by the Bureau of Public Roads, E. O. Hathaway district engineer and Thos. H. McDonald director. The Government contributes half and North Dakota one-third of the cost; the counties of Burleigh and Morton each contribute half of the remaining amount. E. G. Patterson is chairman of the Burleigh County board, and C. P. O'Rourke chairman of the Morton County board.

A noteworthy feature of the enterprise is that the land occupied by the concrete approaches and the roadway from the approach to the city of Mandan was donated by Capt. I. P. Baker of Bismarck, who has been an enthusiastic supporter and promoter of the project throughout, although it might seem that his interest in river navigation would be incompatible with promoting the best connection between the property lying on the east and west side of the river. His view is a broad one—that with better communication there will be more business for the packet company.

Compact Sewage-Works for Annexed District of Rochester

By John F. Skinner
Principal Assistant City Engineer, Rochester, N. Y.

DUPLICATE grit chambers, fine racks, measuring weirs, an air-lift pump well, an Imhoff tank and sludge drying beds arranged concentrically with the tank, all on a lot 132 x 275 ft., comprise the sewage-works for the former village of Charlotte, which was annexed to the city of Rochester, N. Y., a few years ago. The plant is designed to treat from 30 to 180 cu.ft. per minute from sanitary sewers serving ultimately a habitable area of about 800 acres. The present winter population is about 3,000 and the permanent summer population about 4,000. During the summer season there is a large transient summer population brought in by railway and trolley, automobiles, and by boats on Lake Ontario, Charlotte being a summer pleasure resort at the junction of the Genesee River with the lake named. Trolley lines alone have brought as many as 12,000 people to the beach in a single afternoon. The sewers now carry roof and street surface water, but the intention is to exclude the storm water.

The sewage arrives at the works at a level about 12 ft. below the ground surface. It then passes through one of two parallel 4 x 40-ft. grit chambers, at the lower end of each of which there is a cast-iron rack with bars spaced ⅓-in. apart, set 3 horizontal to 4 vertical. The sewage then passes over a 12-in. Cippoletti weir to an air-lift well 20 ft. deep from which it is raised to the Imhoff tank, the water surface of which is about at the ground level.

A neat operating house, 18 x 30 ft., inside, constructed of tapestry brick lined with sand lime brick and roofed with red concrete tile, houses the machinery, gauges, etc., and serves as an office.

Air is provided for the air lift by three No. 1 Nashhytor compressors direct connected to 10-hp. constant speed motors and feeding into a common header. No air drier or air receiver is provided. A 6- and a 7-in. air-lift furnish the necessary variation in capacity.

The Imhoff tank is circular, 38 ft. inside diameter, 35½ ft. deep over all, with a total water depth of 30½ ft., a free board of 2 ft. at the periphery and 3 ft. at the central gas well, in which the water surface has a diameter of 9½ ft. The gas well area is 6¾ per cent of that of the settling chamber. The flow is semicircumferential. The volume of settling chamber at low-water flow is 10,284 cu.ft. The sludge capacity below the slots is 11,531 cu.ft., which, for 10,000 population, gives 1.153 cu.ft. per capita.

The sludge will be lifted by air through a vertical 8-in. pipe in the center of the tank. Gates at the top divert the sludge, which only has to be raised against a 2-ft. head, to either side of the tank to two annular

sludge beds 10 ft. wide, concentric with the tank, having a total area of 3,333 sq.ft., or ⅓ sq.ft. per capita for a population of 10,000.

The effluent is discharged directly to the Genesee River, one mile from its mouth, through a 12-in. submerged outlet pipe. The river at this points has a channel 24 ft. deep and is the outlet of 2,200 sq.mi. of territory. In the last seven miles it has falls amounting to 260 ft. so that it is naturally well saturated with oxygen.

The plant was put into operation in October, 1921, being seeded from the Irondequoit plant of the City of Rochester the following month.



GENERAL VIEW OF CHARLOTTE SEWAGE WORKS, ROCHESTER, N. Y.
Effluent is collected in an open drain, located between the two sludge beds, the latter being arranged concentrically to the Imhoff tank.

The plant was designed by the writer and constructed by N. A. Brown, special assistant engineer, under the general supervision of C. A. Poole, city engineer. The general contract was executed by Whitmore, Rauber & Vicinus of Rochester, N. Y.

Tentative Thoroughfare Plan for Cleveland

A map showing a tentative thoroughfare plan for the city of Cleveland, Ohio, bearing date of Dec. 1, has been printed for distribution. It is on a scale of 1 in. to the mile and shows existing thoroughfares, proposed widenings, and proposed extensions. In general the thoroughfare plan is a combination of radial and rectangular street systems, the radial streets centering in the public square at the civic center which has been under development for some years past. There are also some minor radial street systems centering in various quarters of the city. The normal widths for the three main courses of thoroughfares are 66, 86, and 120 ft., these figures including in each case two sidewalks which are respectively 13, 15, and 22 ft. wide each. Put differently, these may be stated by roadway widths as follows: 40 ft., providing for four lines of traffic, all moving; 56 ft., providing for six lines of traffic, four moving and two standing; 76 ft., providing for eight lines of traffic; six moving and two standing. Robert H. Whitten is city plan adviser and C. E. Conley is engineer to the City Plan Commission.

Alternate Plans For Proposed Colorado River Dam

Rock-Fill Made By Blowing Down Canyon Sides From Tunnels or Thin Concrete Arch For Boulder Canyon Dam

By Arthur P. Davis
Director, U. S. Reclamation Service, Washington, D. C.

STUDY of the Colorado River Basin from the standpoint of its use in irrigation and otherwise may be said to have begun by the establishment of stations for the measurement of stream discharge in various parts of the basin in 1894 and 1895 by the U. S. Geological Survey. One of these stations was established at Yuma, Ariz., to intercept and measure the discharge of the entire stream, there being no tributaries below this point. It was found that gage height readings had been kept for a considerable period by the Southern Pacific R.R. at Yuma and these were utilized so far as possible, but the shifting nature of the channel made their use of doubtful value, and also to a considerable extent vitiated the records kept at Yuma by the U. S. Geological Survey for the first few years.

After the passage of the Reclamation Act in 1902 the Reclamation Service took up the systematic study of the lower river, provided for more frequent and systematic gagings at Yuma and other points, and made a topographic survey of the lower valleys of the Colorado River from Bull's Head to the Mexican boundary. The investigations above were continued, particularly as regards stream measurements and the survey of reservoir sites and borings at the necessary dams. In the stream measurement work substantial co-operation was extended by the Geological Survey and the results were assembled in the publications of that bureau from time to time.

A more intensive study of the entire basin was inaugurated in 1914 by a special allotment of $50,000 for this purpose, supplemented by annual allotments in subsequent years, and this work was finally assembled in three large volumes of manuscript by John T. Whistler. It included a reconnaissance of practically all of the proposed reservoir sites and irrigation projects in the basin above the Arizona line and the compliation of all existing data including the water filings and water rights throughout the basin. The study did not stop with the rendition of Mr. Whistler's report, but was transferred to the lower basin where the topographic survey of the basin was continued up the river from Bull's Head and a detailed survey made of the proposed reservoir site at and above Boulder Canyon, in the northwest corner of Arizona and below the Grand Canyon.

Borings made in 1903 and 1904 on the lower river

showed that at Bull's Head, Williams Fork, Picacho, and other points tested, the subterranean channel of the river had been eroded to a great depth, so that the foundation of dams at any of these points on bedrock was considered infeasible. In view of this fact and of the silt problem, some engineers were led to conclude that storage at any point in the lower basin of the Colorado River was not feasible. Further consideration, however, led to the evolution of a plan for building at Boulder Canyon a high dam without excavating the river to bedrock, which owing to the peculiar topography of the site seemed to be at least worthy of consideration. At this point the canyon is about 300 ft. wide at the river level, and cliffs of massive granite reach upward nearly vertical to a height of over 2,000 ft. above the river. Plans were evolved for a loose rock dam at this point constructed by the following method:

Loose Rock Dam Details

It was proposed to pierce the cliffs with large tunnels on each side of the dam site a short distance just above the level of the river at medium stages in order that the river might be diverted through these tunnels at moderate stages if desired. These tunnels were to be equipped with controlling works. For a dam say 600 ft. above the river level it was proposed to provide slopes for a rock fill dam of slopes of 1 on 3 on each side when counted from bedrock to summit, with a top width of 30 ft. This would mean that the thickness of the dam upstream and downstream at the river bed would be 3,630 ft., or nearly three-quarters of a mile. The cliffs were to be pierced with small tunnels parallel to the river at numerous points well above and outside the lines of the dam in order later to be filled with powder and exploded to blow the rock from these cliffs into the river for forming a loose rock dam. At a point just above where the upstream slope of the dam would intersect bedrock a tunnel on each side of the river was to be filled with powder and exploded, throwing the rock into the river bed in such manner as to form a cofferdam and divert the river into the diversion tunnels. This cofferdam was to be faced with smaller rock in order to serve its purpose and then the river turned over the cofferdam, which it would proceed to destroy by scouring the bed of the river at the lower toe and rolling the rocks of the dam into the cavity thus formed.

After such action had proceeded to a point of comparative quiescence another blast from higher tunnels on both sides of the river would blow additional quantities into the river just below the cofferdam and the river required to work upon this mass for a short time. With the high head thus formed the scouring effect of the water upon the toe of the rock fill would be very powerful and would carry away all the finer material, but the large blocks of granite that would thus be provided could not be carried by the river but being undermined would be settled deeper and deeper into the river bed.

This process would be repeated in such manner as to secure the largest possible action of the water in scouring out the foundation and settling the large rock from the cliffs as low as possible into the foundation. This proceeding from upstream to downstream would pave the foundation progressively with large rock as deeply embedded as possible. The process of blowing rock from the cliffs above by means of tunnels parallel to the river and packed with black powder would be repeated at such points that the required rock fill would be built as nearly as practicable to the height desired on the required slopes, the river being used to the maximum extent in settling the rock into the foundation and all surplus waters drawn off through the tunnels. It is obvious that masses of granite could be secured in this way very much larger than could be feasibly moved by ordinary mechanism.

During the early stages of construction when the mass is of moderate height it would be necessary to take the flood waters of the river over the structure, and this action would be used to the greatest possible extent in paving the foundation with the heaviest rock obtainable.

As the structure increased in height the storage above it would increase in volume rapidly, and at moderate heights the storage capacity and the tunnel capacity combined would be adequate to prevent the overflow of the dam in times of high water after such overflow became undesirable.

When this structure had reached the designed height and slopes, the entire upstream face would be brought to an even slope by depositing smaller rock until the surface was smooth enough to be paved with concrete. A concrete pavement would then be provided of considerable thickness and reinforced with steel. This would cover the entire face of the dam from the river bed to the top and would be securely sealed to the cliffs on either side to prevent percolation through the dam so far as practicable.

Other Considerations

Prior to placing the cofferdam or any of the rock fill, it is proposed to drive a row of steel sheet piling as deeply as practicable across the upstream toe of the dam to be later connected and sealed firmly to the toe of the concrete pavement on the water face of the dam.

The placing of the rock fill should be completed a year or more before beginning the construction of the concrete pavement. This time would be occupied in sloping up the water face preparatory to placing the pavement. The construction of the pavement would be so planned that the sealing of the pavement to the rock of the abutments would be the last finishing touch of the dam so as to give the mass the maximum time for settlement before making this junction.

The control of the river during construction and immediately after would form a pond of varying magnitude just above the dam, filled with the muddy waters of the Colorado and these would deposit their sediment on the river bed and upper toe of the dam in such manner as to form something of a seal and tend to prevent water entering the foundation at any considerable velocity.

This plan of construction was discussed with Secretary Lane in obtaining authority for the extensive investigations of the Colorado River in 1914. It had previously, and has since, been discussed by the author with many engineers in order to bring out, if possible, any weak points connected with the plan, and some of the details of this plan have been modified as the result of such discussions. They are of course subject to further modification by further thought, and especially by the experience obtained during construction. The plans were worked out in more detail and estimates made on the basis of such a structure as compared with a dam built of concrete under the direction of the chief engineer of the Reclamation Service by John L. Savage and his assistants.

cially by the experience obtained during construction. The plans were worked out in more detail and estimates made on the basis of such a structure as compared with a dam built of concrete under the direction of the chief engineer of the Reclamation Service by John L. Savage and his assistants.

These studies seemed to indicate that no material saving could be made by adopting such a plan as compared with a concrete structure carried to bedrock providing the latter proved feasible at all. A depth of 135 ft. to bedrock while presenting serious difficulties in foundation work, is believed to be entirely feasible if proper preparations are made and proper plans are followed.

It is not believed that within reasonable cost it is either feasible or necessary to divert the entire flood flow of the Colorado River, which may at times reach 200,000 sec.ft. The alternative plan is to design a thin arch of such radius and dimensions as to be safe with its base upon the foundation rock and its summit about 40 ft. above the low-water level of the river. Within this limit the canyon is quite narrow, being at all points less than 350 ft. in width, and therefore a structure of short radius and light section would be safe. After the construction of a cofferdam and of diversion tunnels of sufficient capacity to carry the ordinary flow and moderate floods of the river, excavation would be undertaken of only sufficient width to secure foundation for this thin arch, and this would be completed and the arch poured during the nine months or so in which it would be possible to unwater the foundation by means of the tunnels and cofferdam.

This thin arch would serve as a subsequent cofferdam and also for the heel of the masonry structure to be built. If this were overtopped by floods, they would fill the pit with water only, which could be quickly pumped out when the flood had passed and the excavation of the additional foundation and placing of foundation concrete could proceed at all times when the river flow is below the capacity of the tunnels; this would be possible without serious or expensive interruptions except in the brief high water season of May and June.

The method just described for meeting foundation conditions in Boulder Canyon has been successfully carried out in placing the foundations for the Shoshone and the Arrowrock dams, the highest yet built by the Reclamation Service. The depth to foundation at Arrowrock was about 100 ft., and on the Shoshone about 90 ft. At Boulder Canyon the depth is greater and the quantities are larger, but it is practicable to assemble a much larger construction outfit and to make more strenuous speed than was found necessary at either of the two locations mentioned. These experiences have led those familiar with them to conclude that the placing of the foundation in Boulder Canyon for a concrete dam by the above method is feasible and not unduly expensive.

If this is true, the plan of blowing the cliffs into place for a rock-fill dam is not necessary to solve the problem. It may, however, have advantages of economy, but this is difficult to predict on account of the unprecedented character of the operations.

A structure necessary to solve the problem of the Colorado River by a dam in Boulder Canyon is so high and so far beyond the precedents that it seems advisable with due care for engineering safety and economy, to avoid going outside of such precedents so far as possible. For this reason it seems to be desirable to build the structure of concrete in accordance with well established theory confirmed by numerous and varied precedents. A rock-fill structure might be cheaper but our experience is so limited that we can not be sure that this will be the case. If some unforeseen difficulties such as blow-outs under the rock fill should be encountered, its expense might even be greater than that of a concrete structure, and we cannot be sure that it would be entirely safe.

Electric Control and Operation of Water Valves at Buffalo

By George C. Andrews
Water Commissioner, Buffalo, N. Y.

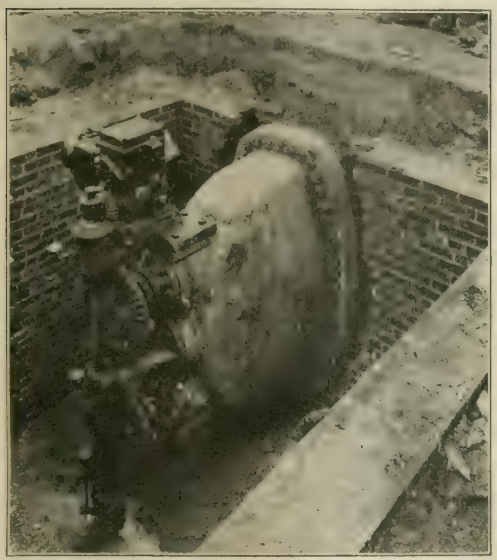
THE Bureau of Water of the City of Buffalo has just equipped 15 of the 36-, 42- and 48-in. valves in its distribution system with electrical operation and control apparatus. Ten of these valves are on the discharge mains leading from the pumps at the Massachusetts Ave. pumping station and five on the boundary line separating the high and low service on the 60-in. discharge main running up Jersey St. from the new Col. Francis G. Ward pumping station. The valves at the Massachusetts Ave. station were so equipped to allow quick and immediate opening or closing to simplify the changing from high or low service, which under former conditions required many men for several hours, and for emergency use in case of breaks in the pumps or their discharge mains. The valves on the Jersey St. line are to be operated daily to allow the main to be used on either the high or low service as occasion may demand. All these valves are in manholes underground and from ten to forty years old.

The present Massachusetts Ave. pumping station is situated on the site of the original station on the east bank of the Black Rock Ship Canal, with the Niagara Falls Branch of the New York Central Railroad directly east of it. The pumps are approximately 40 ft. below the street level. The discharge mains pass under the railroad tracks and then ascend the grade on a slope of 45 deg. This station has six 30-m.g.d. pumps, each provided with its own discharge main. None of the discharge mains are equipped with a check valve in the station because of lack of room, so that it is necessary to close the street valves when a pump is not running, or else depend upon the pump valves to hold the pressure. Since the original station was built several series of pumps have been installed, each with its independent discharge main, and the side hill and adjacent streets contain a maze of mains and valves which were very confusing to operate by hand. Over thirty large valves are located in one block and while a model of the installation is kept for the information of the employees few were able to operate the correct valves for each pump or service without more or less trial. By careful study ten valves were found which control all pumps and allow either high or low service and these valves have been equipped with electrical operating and control apparatus. These valves are located in one block, in and on each side of the street, and are controlled from one switchboard, located in the gate house at the top of the stairs leading down to the station. The other valves are left permanently open or closed.

Each valve has been equipped with a Dean control unit, which consists of a high torque, totally enclosed

watertight motor, reduction gear and limit mechanism in one cast-iron watertight case. There are five different styles of mountings, allowing the unit to be mounted directly on a new valve yoke, or on an attachment to an old yoke or on a channel iron set into the manhole walls. Driving connection is made by either bevel or spur gears between the Dean unit shaft and valve stem, the ratio in all cases being such as to close the gates at about 3 in. per minute, allowing for emergency closing.

The method of control on the Massachusetts Ave. section is from stations mounted on the main switchboard in the gate house. This board contains ten control stations, ammeter, volt meter, switches and fuses, and indicating lights. The indicating lights show by red and green lenses whether the valves are open or closed.



GENERAL VIEW OF DEAN ELECTRICAL VALVE OPERATING AND CONTROL DEVICE

The control device was attached to the old valve by welding the bearing pad to the old yoke.

Current is conveyed from units to control stations by steel taped, lead covered Park cable laid directly in trenches in the ground about 12 in. deep. The connections are made to the Dean units so as to be absolutely watertight. For supplying this section, current is furnished at 220-volt 25 cycles, single phase, and transformers are installed of sufficient capacity to operate two valves under their maximum operating condition at one time, or four at one time under normal operation.

The motors are so wound as to start closing the valve at a speed of approximately 6 in. per minute, and to complete the closing at a speed of about 3 in. per minute, or less, according to the velocity of the water through the gate.

Each valve is equipped with an entirely new and novel form of Dean mechanical valve position indicator, attached directly to the valve stem, showing at a glance the actual turns that the valve is open. Stenciled on the Dean unit and on the manhole frame in large figures is the number of turns required to completely open the valve, so that by reference to the indicator the exact position of gate is known. The control units are provided for hand operation in case of failure of current.

At the Jersey St. section four of the five valves are controlled from two points: One in the central station in the Lakeview Ave. storehouse, and the other is mounted in a cast-iron street pedestal adjacent to the curb. This pedestal contains the control station and relay panel, together with indicating lights. On the switchboard in the Lakeview Ave. storehouse is mounted the necessary remote control stations, indicating lights, switches, etc. The current used for the operation of the Jersey St. valves is taken from the generating equipment at the Col. Ward Pumping station, and is 220-volt single-phase, 25 cycles.

No. 1 Valve is equipped with a Dean electrical position indicator, mounted on the switchboard, the needle of which shows the movement of the gate from open to close, so that its exact position can be noted from the board, although the valve cannot be seen from that point. This is highly desirable as the valve may be used to bleed from high to low service. Special manhole covers marked "electrically controlled valve" have been provided for the manholes.

The complete installation was recently tested under operating conditions when the average speed for opening and closing was eleven minutes.

A complete operating schedule has been laid out whereby every valve is completely open and closed once a week, thereby insuring their being in perfect operating condition. A full report of this test is made on a card and sent to the engineer in charge of mains. At each switchboard is posted the valve layout with legends fully explaining what each valve controls and operating directions, so that, in case of emergency, a valve can be operated by any person of average intelligence. All valve controls on the switchboard are provided with locks and keys, kept at the storehouse. In case of emergency, by breaking a glass on the control, the lock can be opened without a key.

The great advantage of the installation is that it gives complete and immediate control of the mains at the Massachusetts Ave. station, and it has also eliminated the objection which the National Board of Fire Underwriters has had to the discharge system there, without the construction of a new discharge system and valve house which they have long recommended. The equipment of the Jersey St. line allows the daily utilization of two discharge mains on high pressure from the Ward station, thereby lessening the risk of interruption of water service when the Massachusetts Ave. station is shut down entirely.

The complete contract was undertaken by Payne Dean, Limited, of New York City, the work all being under the supervision of the writer.

1921 Maintenance of Indiana Roads Cost $4,000,000

All of the Indiana state-maintained roads with the exception of a few miles of earth road are in the best of condition, according to the report of A. H. Hinkle, chief of the maintenance department of the state highway commission to Governor McCray. The report, recently issued, covers the fiscal year from Oct. 1, 1920, to Sept. 30, 1921. More than $4,000,000 was spent by the maintenance department during the last fiscal year. Approximately $1,000,000 of this amount was spent on bills contracted during the previous year.



Some Features of the Chemung River Concrete Bridge

Careful Balancing of Design Alternatives and Definite Purpose in Construction Planning—Reinforcement Interlocking, Waterproofing Details and Flood Protection of Plant

PILE foundation design and the problems of expansion and construction joints, drainage and waterproofing, were given especial attention in constructing the seven-arch, reinforced concrete bridge at Corning, N. Y. Incidentally all parts of the bridge are reinforced concrete poured in place even to the foundation piles and the lamp posts on the parapets. The reinforcement is, consequently, interlocked from the piles up through footings, pier shafts, arch rings, spandrel walls and sidewalks to the hand railing and lamp posts. Architecturally, simple, pleasing lines and masses were sought.

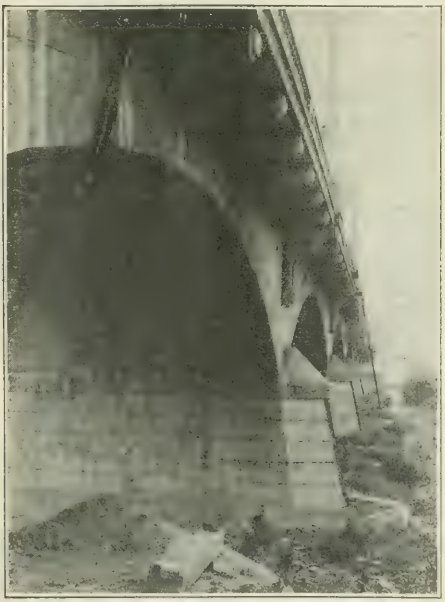


FIG. 1. LOOKING ALONG THE SEVEN SPAN MEMORIAL BRIDGE AT CORNING, N. Y.

The structure is 752 ft. long and is composed of seven three-centered segmental barrel skew arches 92-ft. 3-in. span and 11-ft. 3-in. rise. The arches are 41 ft. in width face to face of parapet walls and support a 36-ft. roadway on earth back fill, and two sidewalks 6 ft. in the clear which cantilever 5 ft. beyond the face of the parapet walls. The total width of structure face to face of coping beams is 51 ft. The depth from the crown of the road to the crown of the arch is 1 ft. 8 in., a minimum requirement in placing a 10-in. water main in an earth cushion under a concrete pavement.

Three streams, draining about 4,200 square miles, come together near Corning to form the Chemung River, which is crossed by the bridge. These streams are flashy, and floods come quickly and subside almost as quickly. In the maximum recorded flood of March 14, 1918, the river rose 19 ft. The rate of rise has, at times, been 1 ft. an hour. In computing waterway, the length of the bridge 752 ft. was set as the distance between the dikes, which have contained past floods, and the roadway was set at an elevation which gave an aggregate waterway between piers below springing lines sufficient for the record flood, leaving the arch spaces above springing lines as a factor of safety in case of greater floods.

With the foundation conditions, 2 to 6 ft. of gravel and clay, then stiff clay down to 16 ft., and then hardpan, the first problem was to choose between shallow footings on piles and deep foundations protected by coffer-dams. Because of the flood conditions and the favorable bottom, the advantage was in favor of piles. With piles adopted, the alternatives were wood and concrete and, in case of concrete, they were precast and cast-in-place construction.

The ground was so compact that it was thought that it would be impossible, or at least impracticable, to attempt to drive wood or precast concrete piles. In fact, the piles adopted required 8 blows for a 1-in. penetration under a No. 1 Vulcan Steam hammer, and in some cases this was raised to as many as 12.

While the unit cost of concrete piles was higher than that of wood piles, about half as many were required,

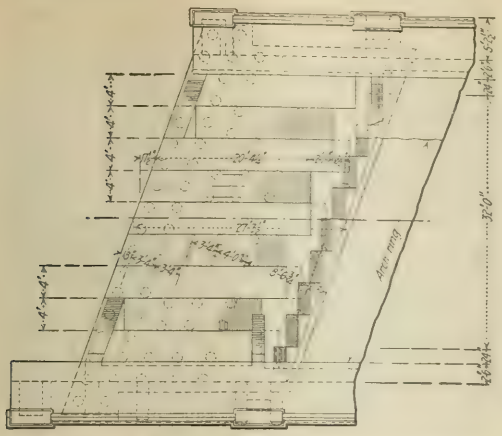


FIG. 2. PLAN OF ABUTMENT SHOWING PILE GROUPING

assuming a bearing power of 35 tons for concrete and of 18 tons for wood. Using fewer piles reduced the area of the pier footing; this saved excavation and also concrete and reinforcement, since the smaller footing could be plain concrete but the large footing, required by the wood piles, must be heavily reinforced. Wood piles would also have necessitated a deeper foundation at some of the piers. The great superiority of the concrete pile appeared, however, in the design of the abutments.

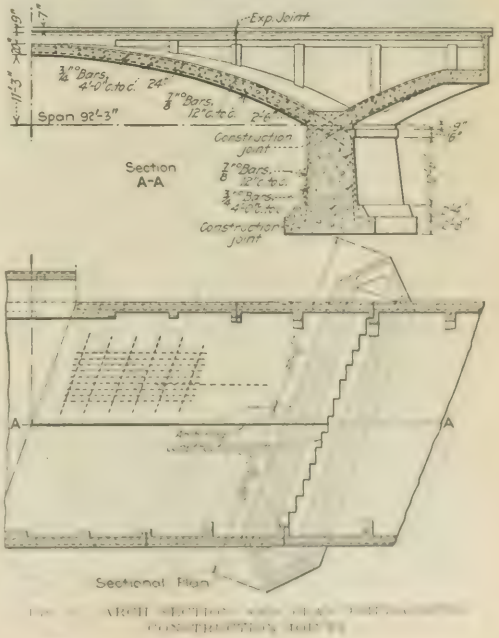
With concrete piles selected, the cast-in-place type had advantages over the precast type as follows: (1) No time was required for curing and the work of driving could be started immediately after the excavation for the first abutment was completed. (2) Reinforcing rods could be inserted immediately after the piles were poured, to bond the footing course to the piles. Additional stubs placed in the footing course lapped the vertical bars in the pier shaft and also in the face walls of the abutments. This arrangement was effective in resisting eccentric thrusts in constructing the arch ring.

The advantage of the concrete piles in the design of the abutments was signal. Here any reduction in length saved a similar length of foundation excavation to a depth of 19 ft., since the abutments were set back into the dikes. The thrust of the arch against the abutments was fixed in amount and direction and to get the vertical load of abutment and fill necessary to resist the arch thrust required a width of abutment of approximately 28 ft. With the amount of eccentric pressure on the outer toe of the abutment, it was impossible to place enough wood piles within the pressure area of the 28 ft. width, without greatly exceeding the safe loading on the piles of the outer row.

In designing the abutment, concrete piles were so spaced under the varying pressure area of the 28 ft. width that each pile was loaded uniformly to carrying capacity. The center of gravity of the cluster of pile under each 4-ft. buttress, Fig. 2, was made to coincide with the resultant pressure of the external loads. It is remarked here that the outer face, of the abutment, was made to act as an abutment buttress in addition to its function as a retaining wall and a support for the sidewalk. The resultant pressure of the abutment and arch thrust is outside of the middle third of the abutment base in the contracted area of the concrete pile plan. Therefore the six piles in a row along the inner face of the abutment adjacent to the arch, theoretically are not taking any vertical load, but these six piles tied to the abutment footing by projecting bars offer a factor of safety against overturning and satisfy a possible discrepancy between the actual and theoretical action. Three 1-in. square reinforcing bars were placed on the side of every pile facing the arch to reinforce the pile in shear and these bars also projected into the footing course. The ends of the buttresses, due to their shallow section in the area of maximum pressure, were reinforced in shear by $\frac{3}{4}$-in. stirrups spaced 12 in. apart.

Two features of the arch design stand out. One is the provision for subsequently interlocking the walks and balustrades to the arch ring and spandrels, and one is the provision for expansion, drainage and waterproofing. In general, the bridge was designed to carry 150 lb. per square foot over the roadway. The sidewalks were designed to carry 100 lb. per square foot. The maximum stress in the concrete was set at 650 lb. per square inch and in the steel at 16,000 lb. per square inch.

The arch ring, Fig. 3, 1 ft. 8 in. at the crown and 2 ft. 6 in. at the haunch, was made three centered to conform to the pressure curve of the load. The parapet wall, Fig. 4, 1 ft. 6 in. in thickness supporting the sidewalk and balustrade, is of the buttress type and is reinforced in the longitudinal direction. The reinforcement of the buttress, which is anchored to the arch ring, is carried through the upper plane of the sidewalk beams in line with the buttresses and furnishes the necessary reinforcement for these beams. The depths of these beams, to satisfy architectural considerations, gave a very low shearing stress and no additional reinforcement was necessary. The outer 1 ft. 6 in. lamina of the arch ring, upon which the spandrel wall and sidewalk sit, was made 8 in. deeper than the arch



ring proper at the crown, and 12 in. deeper at the haunch to carry this extra loading. Poured simultaneously with the half width of the arch ring, it formed a suitable construction joint from which the spandrel wall could be run in a separate operation. Also by raising the construction joint above the extrados, a curb was formed that precludes seepage to the face of the wall, if the waterproofing membrane fails. The wall was carried up to the underside of the sidewalk, with recesses to receive the sidewalk beams.

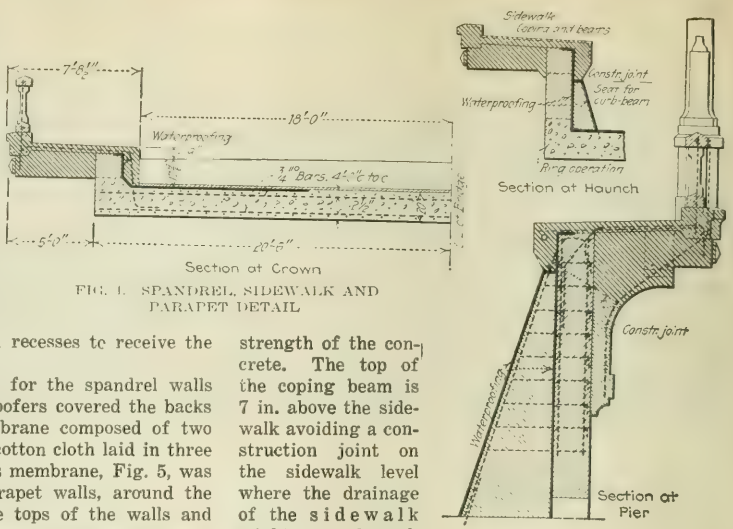


FIG. 1. SPANDREL, SIDEWALK AND PARAPET DETAIL

Immediately after the forms for the spandrel walls had been removed, the waterproofers covered the backs of the arch rings with a membrane composed of two plies of an asphaltic saturated cotton cloth laid in three swabbings of hot asphalt. This membrane, Fig. 5, was carried up the back of the parapet walls, around the buttresses and flashed over the tops of the walls and

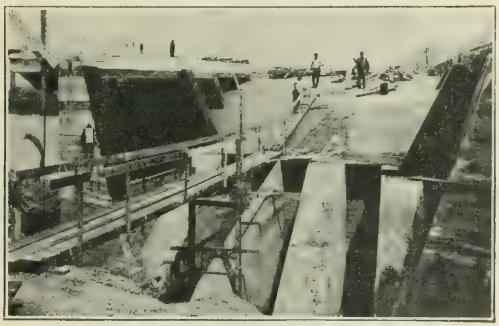


FIG. 5. SOUTH ABUTMENT BUTTRESSES AND WATERPROOFING

into the sidewalk beam recesses. This operation was followed immediately by a protective layer of 1:3 sand mortar 1½ in. thick over the backs of the arches to protect the membrane from being punctured in subsequent construction operations and in back filling.

The next concreting operation was the simultaneous pouring of the curb beam supported on the 6-in. ledge top of the wall counterfort, the sidewalk and the fascia coping beam. With this concrete operation, the waterproofing is positively secured and flashed, with no danger of being pulled away from the wall by settlement of the back fill or of water working behind the membrane, since it is completely protected by the curb beam. The heavy curb beam built with the sidewalk also gives a certain balance to the sidewalk overhang and furnishes a sort of lock giving added strength by the tensile strength of the concrete. The top of the coping beam is 7 in. above the sidewalk avoiding a construction joint on the sidewalk level where the drainage of the sidewalk might seep through to the face of the coping. The coping is reinforced to act as a beam carrying the balustrade and half the sidewalk load to the sidewalk cantilever beams. The sidewalk slab, therefore, is reinforced by light triangular mesh in the transverse direction extending to the edge of the curb. Vertical rods were embedded in the coping beam and projected the full height of the balustrade to hold the latter substantially to the coping.

Expansion joints were placed at the quarter points of each span, approximately at the point of contraflexure in the arch ring. To avoid the uncertain action of a sliding joint of any description, the superstructure at this point was cut clearly in two by a bulkhead. The sidewalk beam and counterfort, therefore, are built in two separate units and reinforced to take the separate end reactions. The joint was built up by multiple layers of tar paper. A steel plate covers it through the sidewalk and it is further protected from seepage by copper flashing embedded in the concrete.

In planning the equipment, the frequency of the floods suggested mobility and retreat and the high ground on the north bank of the river, with the protection afforded by the dike, offered the haven of safety.

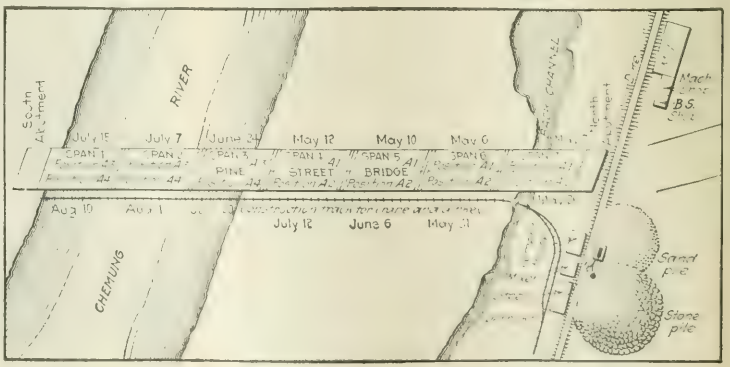


FIG. 6. PLANT LAYOUT AND PROGRESS SCHEDULE



FIG. 8. CENTERS AND ARCH RING FORMS IN PLACE

Therefore the construction of the bridge was planned around a locomotive crane, with a 60-ft. boom, and a construction plant as indicated by Fig. 6. A derrick, having a 75-ft. mast and 70-ft. boom was placed within reach of the stock piles, the cement and steel store houses and the concrete mixing plant. The wooden forms were built near by so that they could also be handled by the derrick. These forms were built in heavy units, Fig. 7, so that they could be reused.

Work started on Oct. 5, 1920, excavating for the south abutment. Building and grading a ramp from the top of the bank the crane worked its way down to the river's edge, and thence across on tracks laid in the bed of river during low water, driving the sheeting and making the excavations for the river piers as it proceeded. Immediately after the excavation was completed the pile-driving equipment was lowered into the hole and the driving of the piles commenced. It was estimated that 15 piles could be driven in a working day and this progress was made in driving 633 piles in 42 working days. About two days were required to move the driver from pier to pier. The driving schedule was interrupted for a short period in the early part of November due to an unprecedented flood for this particular month. The specifications required eight blows of a No. 1 Vulcan steam hammer to 1 in. penetration and where driving was especially difficult twelve blows were given to secure depth. The average driven length of the piles was 12 ft.

Work on the piers followed the pile driving. The foundations for the river piers were poured before floods of any consequence occurred, but the pier shafts were completed between floods, with a very narrow margin of time in each operation. Work on the piers was advanced so that the superstructure could be started from the north end and be completed on the high ground during spring months to the river's edge before the June flood. Fortunately, due to the unusual drought this flood did not materialize but the work was developed accordingly to the predetermined plan which contemplated that high water would cause delay but would not cause serious damage to the work or plant.

Fig. 8 shows the structural steel centering. One unit, forming a half-width arch barrel, was composed of two ribs made up of four separate Pratt truss sections, with parallel top and bottom chords. These sections were made to conform to the approximate curve of arch by wedge-shaped diaphragms at the crown and quarter points of the truss. The true curve for the lagging was formed by wood shims of variable height, which raised to the proper level and inclination the 6 x 12-in. purlins set parallel with the skew axis of the arch. Over these purlins 4 x 10-in. longitudinal riders, 3 ft. 3 in. center to center, were warped to the true curve of the intrados and to them the 2 x 6-in. lagging, laid parallel to the skew axis, was nailed. The weight of one rib assembled was 9.2 tons which was easily handled by the crane, Fig. 9, to its position on the timber bent bolted to the piers.

This supporting bent was capped by a 10- x 10-in.



FIG. 7. BALUSTRADE FORM UNITS [illegible]

timber. Between the cap and another 10 x 10-in. timber under the shoe of the truss, two 10 x 10-in. x 4-ft. oak wedges were placed as the means of raising or lowering the centering. A heavy oak thrust block, cut to the



FIG. 9. DERRICK SETTING STEEL RIB FOR ARCH CENTER

skew angle of the bridge, was set back of the truss shoe to transfer the horizontal thrust to the piers. Rollers were placed between the two 10 x 10-in. timbers before the wedges were struck, on which the entire unit, truss, lagging and all, was jacked and rolled over to the second half of the arch ring.

The sequence of arch construction is shown in Fig. 6. The rings were poured in the order named and each one is a continuous operation, pouring alternately from either end. Including a 9-in. lift over the half area of the pier, there were 160 cu.yd. in each operation poured in eight hours with a one-yard mixer. The short time between arch ring operations was employed without reduction of force in the construction of the parapet walls, sidewalk and balustrade. When the last half of the arch ring was poured Aug. 10, the parapet walls were almost completed on all the spans and much of the sidewalk and railing was completed. In this manner operations were distributed over the entire work so that a maximum force could be economically employed up to the last three weeks. Remarkably fast work was done with the centers erection and concrete placing in the arches. Within one month after the arrival of the centers four halves of arches had been poured.

The bridge was planned and supervised by A. B. Cohen, consulting engineer, New York City. J. I. Bingham was resident engineer in field charge. The improvement was carried on through the office of W. O. Drake, Superintendent of Public Works, Corning, N. Y. Bush, Roberts & Schaefer Co., of New York, were the general contractors with J. E. Jones superintendent of construction. The piles were driven under separate contract by MacArthur Concrete Pile & Foundation Co. and the centers furnished by the Blaw-Knox Co.

Columns and Walls Lifted By Swelling Clay Under Floor

New Texas Church Built in Dry Year Damaged When Clay Enclosed by Foundation Walls Became Saturated

By F. E. Giesecke
Professor of Architectural Engineering, University of Texas, Austin

SHORTLY after construction of the University Baptist church in Austin, Tex., a change in the moisture content of a 6-ft. layer of clay under the building produced a vertical expansion of about 4 in. and thereby lifted and broke the concrete floor slab, lifted iron and wooden columns, with their superimposed loads, off the concrete piers originally supporting these columns, and lifted a brick wall together with a portion of its concrete foundation wall, after having overcome the tensile strength of the concrete foundation wall. The clay is decomposed Eagleford shale.

The building was erected in two installments; the first portion, which included the Sunday school department and the basement of the main building, was erected by Johnson & Chambers, of Austin, from April 1918, to January, 1919; the second portion, which completed the building, was erected by Hedrick Construction Co., of Houston, from August, 1920, to October, 1921. The architect was Albert Kelsey of Philadelphia;

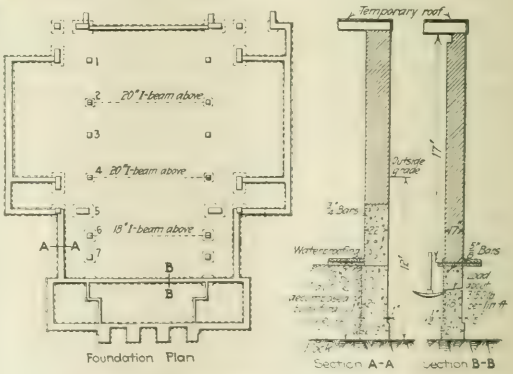


FIG. 1. PLAN OF DAMAGED CHURCH

the supervising architect of construction was Roy Thomas of Austin.

In Fig. 1, a plan of the basement of the main building, several walls are lettered for reference in the following description of the effect of the expansion of the clay. Fig. 3 shows the rainfall in Austin for 1917, 1918, and 1919; the first construction period of the building and the date when the failure of the concrete floor slab became noticeable are marked. As appears from this figure, the erection of the building followed a very dry year, the concrete floor slab was poured in July, when the ground was very dry, and the failure of the con-

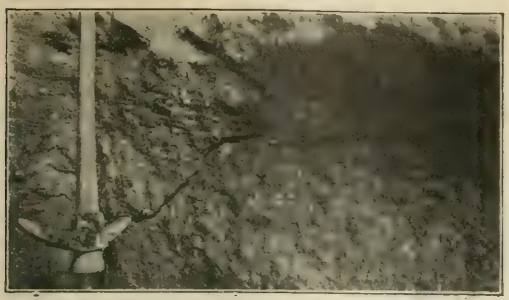


FIG. 2. CRACKED WALL FOUNDATION

crete floor slab became noticeable in June of the following year after a long period of heavy rains.

The foundations of the building were designed, under the direction of the writer, to rest on rock and to exert a pressure of 40 lb. per sq.in. thereon. For this condition the walls A and B (Fig. 1) needed practically no projecting footings, and the contractors excavated the trenches for these walls accurately and poured the concrete into the trenches without the use of other forms. To provide the entire building with a waterproofing membrane, 3½-in. of concrete was laid over the entire floor, across the concrete footings for the columns and across the concrete foundation for the wall B.

After the concrete floor slab had been poured, a wet season set in. The clay under and around the building became as wet as it could possibly be, the elevation of the groundwater at the building was above the level of the basement floor, and the 6-ft. layer of clay, under the basement floor expanded vertically about 4 in. Horizontally it did not expand at all, because it was confined by the four exterior concrete walls, which did not crack. The result of the expansion of the clay was the bending and lifting of the concrete floor slab, and with it (since the lower portion of the concrete floor slab extended under the columns) the columns and the brick wall B.

All the columns and the entire area of the floor were lifted. At the exterior walls the floor sloped down, so that it was evident that either the foundations of all the walls and (to lesser extent) the column foundations were settling, or that the floor together with wall B and (to lesser extent) the columns were being raised up. The levels of the columns seemed to bear some relation to the loads on the columns, the most heavily loaded columns being lowest. Assuming the action to be one of lifting, the condition may be described by the statement that the most lightly loaded columns had lifted about 4 in., and the most heavily loaded columns about 1 in., the differences in lift being represented by bending and warping of the floor slab near the columns.

It took several months of investigation to prove definitely that the floor had been lifted up and that the foundations had not settled.

Column 1, a 6 x 6-in. wooden column, was lifted off its concrete pier several inches. The lifting of this column bulged the roof over it very noticeably. The foundation of wall B was cracked as Fig. 2 shows. This wall, weighing 3,150 lb. per linear foot, was lifted about ½ in. After the concrete slab had been cut on both sides, the wall settled back to its original position and closed the crack. Fig. 4 shows the concrete pier under column 7, which developed a crack about 2 in. wide just below the floor, apparently at a construction joint.

An effort to determine accurately the degree of contact between the wall footings and the foundation rock failed because the excavations made for that purpose without and within the building could not be cleared of water. However, it was possible to drive a ½-in. rod 24 in. long between the foundation rock and the footing of wall A and it was possible to push a trowel up to its handle between the foundation rock and the footing of wall B. The question arises whether the wall footings were never in contact with the foundation rock or whether the clay in expanding gripped the two walls and lifted them.

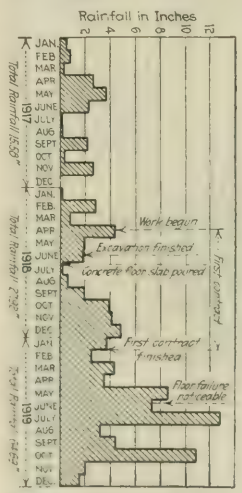


FIG. 3. LOW RAINFALL PRECEDING AND HIGH RAINFALL FOLLOWING CONSTRUCTION OF THE CHURCH

In this connection an experiment was made by filling a three-gang, 2-in. cube brass mold with compacted pulverized clay and allowing the clay to absorb water while the mold rested on a glass plate. The clay expanded vertically a little more than ¾ in. and horizontally to such an extent that the friction against the smooth brass mold was sufficient to lift the mold 0.049 in. off the glass plate. The clay in the mold was then dried, the middle mold emptied, and the space around the clay blocks in the outer molds filled with dry pulverized clay. When the clay was again allowed to absorb water, a similar expansion resulted as in the first experiment, and the brass mold was lifted 0.04 in. off the plate glass. By similar action the clay in contact with wall A could have lifted that wall slightly, and it seems, therefore, entirely possible that the wall A is no longer resting on the foundation rock, but that it is supported by the bond to the clay.

When funds had been secured to continue the erection of the building, the contractor, under the direction of the supervising architect, cut the concrete slab around the columns and on both sides of the wall B and allowed the columns and the wall to settle back to their original supports before proceeding with the erection of the superstructure.

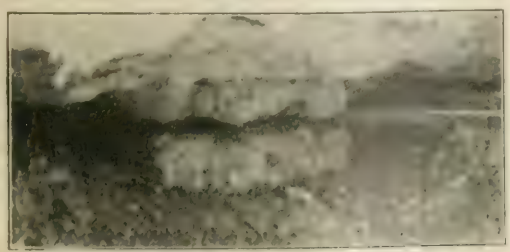


FIG. 4. COLUMN PIER UNDER WHICH THE FLOOR

Uses of Aerial Photographs in Map Making

Work Must Be Co-ordinated with Ground Surveys—Will Aid Completion of Topographic Map of U. S.

By Glenn S. Smith
Acting Chief Topographic Engineer, Topographic Branch, U. S. Geological Survey, Washington, D. C.

TWO articles have appeared in *Engineering News-Record* within the past few months on the use of aerial photographs in connection with mapping. The article appearing Oct. 13, 1921, p. 596, prepared from data supplied by Frederick E. Jones, of the American Air Service Corp., was very optimistic in tone as to the



PHOTOGRAPHS COMBINED TO FORM MOSAIC WITH TOPOGRAPHIC FEATURES INKED FOR TRANSFER TO FIELD SHEET

extent to which these photographs could be utilized, based apparently on theory rather than on any practical tests to which they had been subjected. On the other hand, the letter signed by P. J. Barry, Dominion Water Power Branch, Department Interior, Canada, in the issue of Nov. 17, 1921, p. 828, was very pessimistic and did not concede that there are any practical values to be obtained from aerial photographs. A more conservative position is taken by the U. S. Geological Survey in reference to the use of air photographs, based on the results obtained from their use in connection with several field surveys covering large areas.

It is unfortunate that the word "mosaic-map" has been applied to a combination of photographic prints, as this is a misnomer and a better name would have been a "mosaic photograph" of the area. A map is the delineation of some portion of the earth's surface on which the geographical position of certain features is shown in the correct relative position. The so-called "mosaic map" is not a map in this sense, as the features shown on the combined prints are in no case in their correct relative position to all others shown on the mosaic.

Air photographs taken with the latest type camera by experienced airplane photographers contain valuable data which can be used to great advantage in the compilation of base maps when such data are properly controlled by means of ground surveys, such as triangulation or primary traverse. The use of air photographs in connection with the general mapping of the country is confined at present to maps not larger than 1:10,000, and wherever photographs are used in connection with engineering problems they are for the purpose of facilitating the study of these problems as a whole, and only in exceptional cases can they be used for working plans. It has been demonstrated that the data obtained from air photographs, when handled by experienced engineers or cartographic draftsmen familiar with the adjustments of ground survey data, are far more complete, and in most cases more accurate, than are obtained by means of the present methods employed in ground surveys. The wealth of information shown on the photographs and the availability of this information for frequent reference, when necessary, makes this method of securing survey data superior to the ground methods.

Errors in Ground and Air Work

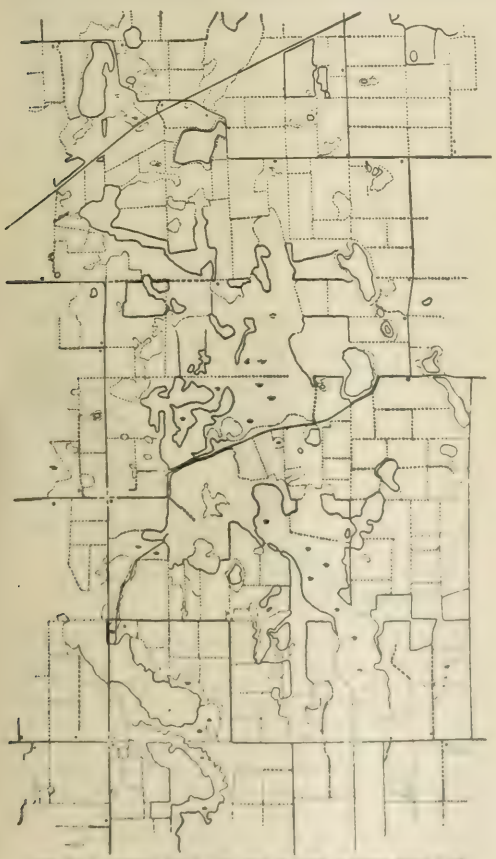
Any method employed in making ground surveys is subject to errors which may be caused by a gross error at one or more points, or may be an accumulation of several errors due to errors in the field or in computing or plotting the field notes in the office. All such errors must be corrected either by a resurvey or by arbitrary adjustments in the office, either being far from satisfactory. On the other hand, the errors in the air photographs due to distortion caused by the tilting of the ship (which can now be accurately determined by means of various devices), poor lenses, or by expansion or contraction of the paper used in making the prints, are all errors which can be located and can be adjusted in the office with a greater degree of accuracy than errors in ground surveys.

In considering the use of air photographs for supplying data for the compilation of maps, the question of the scale of the map to be compiled is of the first importance in considering to what extent the data on the photographs can be used in such compilations without introducing a source of error. If the standard map of the United States, on scale of 1 in. to the mile, is to be prepared, the errors appearing in the photographs due to distortions caused by poor lenses or the failure of the pilot to fly his ship on an even keel can be easily eliminated by means of ground control lines covering the area to be surveyed at intervals not to exceed 5 miles.

The amount of control necessary to adjust accurately the data shown on the air photographs will depend on the scale and the character of the country to be mapped,

and, as a rule, such control can be better planned after the country has been photographed and an examination of the resulting photographs made to determine which photographs or series of photographs in any flights are subject to adjustment. Control lines can then be run through such areas as are needed to meet the requirements for adjustments. In country of average relief, control lines or points, when plotted on the base or projection sheet, should not be farther apart than 5 in. *on the paper*, regardless of the scale of the map. In country other than average relief, control must be placed to meet the conditions that exist in the area under survey.

The methods of taking air photographs and the results obtained have not reached a point where they can be used for all classes of maps, but the practical demonstations which have been made within the past year by the Topographic Branch of the U. S. Geological Survey, have proved beyond doubt that this source of



IN BLEACHED MOSAIC ONLY INK LINES REMAIN

information will be extensively used in connection with the topographic mapping of the United States on a scale of 1 in. to 1 mile. This is especially true in connection with the survey of swamp areas lying on the coastal plain and in sections of the United States where there is little or no relief.

Within the last year the Topographic Branch in cooperation with the Air Service of the U. S. Army, has used the photographic data in connection with the survey of two large areas, one located in the vicinity of Schoolcraft, Mich., covering an area of 225 sq. miles, and the other of Bibb County, Ga., covering approximately 275 sq. miles. The Schoolcraft area is located in a Land Office-surveyed state, and there were available the Land Office survey land lines which could be used for the control of the data contained on the photographic prints.

In order to transfer the data supplied by the photographs to the field sheets, the land lines were laid down on the field sheets and were tied to primary control points which had also been previously established. Three or four photographs, such as the specimen shown, were joined together by overlap. On this small mosaic those features which it was desired to transfer to the field sheet were then inked in. The mosaic was then bleached to clear off all other details of the photographs. The resulting bleached photograph was then reduced by photography to the proper scale of the map, as given by the land lines. One of these reduced copies is shown. The wealth of detail carried by these field sheets is evident at a glance.

The photographic prints clearly showed the location of a large percentage of these land lines, which appeared on the prints either as fence lines or the limits of timber tracts or cultivated land, which enabled the engineer easily to locate on the photographs the land lines plotted on the base sheet. The data taken from the photographs, which consist of roads, houses, streams, timber line, etc., were transferred to the corresponding section on the base map. Any error in the photographs due to distortion was adjusted within and confined to each square mile. As these photographs were taken on a scale of approximately 4 in. to the mile, and the data reduced to 1 in. to 1 mile, any slight distortion or error that appeared in the photographs was eliminated by this great reduction.

In the case of Bibb County, Ga., it was necessary to run a network of ground control lines of primary traverse, by means of which the intersection of cross-roads, railway crossings, railway lines and other prominent ground features which appeared on the photographic prints were computed to obtain their geographic position and were then plotted on a base sheet as control points to which the data taken from the photographic prints were adjusted. In this map, the control points were in no case farther apart than 5 miles, and it was found that with the photographic prints on a scale of approximately 4 in. to 1 mile, when placed together by means of approximately 60 per cent overlap and reduced to 1 in. to the mile, the area to be adjusted between any two control points was well within the degree of accuracy required for a map on a scale of 1 in. to 1 mile. In every case the data taken from the photographs were used in the same manner as the same data would have been used if secured by means of plane-table traverse. Wherever an error was found it was adjusted between the control points. The amount of control necessary for the control of the data shown on the photographic prints depends entirely on the character of the terrain of the area under survey. If the relief is great the control lines or control points must be very much closer together than in a country of low relief.

Mr. Barry cites in his letter an example of distortion which could take place, but no experienced flier or photographer would bank his machine at such an angle

as to make it possible to secure a photograph distorted as shown by the diagram submitted by him.

Various devices are used to determine the position of the airships at the time each photograph is taken, and should the records for any photograph show that it was taken when the airship was in position similar to that described by Mr. Barry, that photograph would be discarded as one unfit for use and new photographs taken of the area, or ground methods substituted to secure the data required.

The value of aerial photographs in connection with various engineering activities is being appreciated more and more by engineers who recognize the proper method of using them to obtain the greatest amount of information. For example: The Reclamation Service of the Canadian Government is reported to have photographed approximately one million acres of land on the Carrot River between Manitoba and Saskatchewan, which is inaccessible on account of floods.

The engineers state that this photographic work does not supersede the ground surveys, but is used mainly for reconnaissance purposes, which indicates that they thoroughly understand the value of air photographs.

Too many fliers and photographers who are totally ignorant of the fundamental principles of accurate map making have made enthusiastic claims that air photographs will completely do away with the necessity of ground surveys. The public has been led to believe that the complete mapping of the United States could be executed in an amazingly short period and at a cost insignificant as compared to that which would be involved in preparing a map of the United States by ground surveys. The result is that the necessary mapping activities which are essential for the proper use of air photographs are being curtailed under the impression that the "mosaic" will replace the ground surveys. Air photographs are destined to play an important part in all mapping activities, and to a limited extent in the solving of certain engineering problems, but for general use, other than that of government map making, there must be greater facility for securing the use of privately owned airships manned by specially trained personnel in order to obtain photographs at a cost not to exceed that of obtaining the same data by ground methods before any practical value can result from them.

The development of airplane photography is in its infancy, but there is every indication that it will eventually become an important factor in connection with mapping activities and replace many of the ground methods now employed in securing map information, but before this can be accomplished there must be an immense amount of experimental work done with a view of perfecting the present methods of photographing from the air and also to reduce the cost of such work.

Cost of Burying Garbage of Baltimore

During the three months, September, October, and November, 1921, pending the disposal of the garbage of Baltimore, Md., under contract by the Sanitary Reduction Co., a total of 18,315 cu.yd. of garbage were buried at the old piggery farm. The cost was $1.225 per yard, including unloading and burial only, and about $1.68 taking into account the cost of equipment, and other factors. The methods employed were described in *Engineering News-Record*, Oct. 27, 1921, p. 694. The work was done under the direction of A. E. Christhilf, highways engineer of Baltimore.

Cold Weather Concreting Methods and Equipment

Plant for Heating Materials—Methods of Placing Canvas Housing—Location of Salamanders—Fire Protection

PROTECTION of concrete building work from frost is completely secured by heating the materials before mixing, covering the green concrete tightly with canvas and placing salamanders so as to cause a circulation of heat around the concrete. No other resorts are necessary for safe concrete construction in winter. The procedure is not difficult nor complex but it has to be conducted with attention to detail The details as they have been worked out by the Turner Construction Co., New York, on many concrete building operations are given in this article.

Warm concrete is the first essential for safety from freezing in winter construction. The most satisfactory

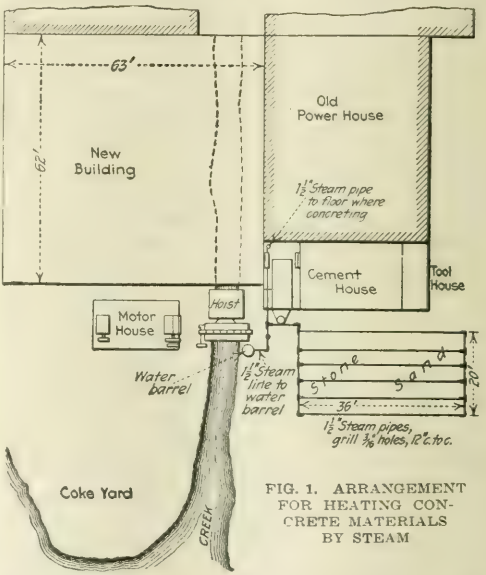


FIG. 1. ARRANGEMENT FOR HEATING CONCRETE MATERIALS BY STEAM

method of heating sand and pebbles is by a 1½-in. steam line run from the boiler to the stock piles where a grill of 1½-in. pipes covers an area slightly smaller than the area required for storage. These pipes should be 4 ft. on centers and should be perforated by ⅜-in. or ½-in. holes staggered on 1-ft. 6-in. centers, or, where trouble is experienced from large grains of sand blocking up round holes, by cutting notches in the pipe with a hack saw at intervals of 1 or 1½ ft. If the sand and gravel are stored in bins, a grill of steam pipes should be placed in the bottom of the bins.

In case the stock pile will not be constant enough to warrant a grill on the ground, insert in the steam main three connections controlled by valves and attach to each a length of steam hose on the end of which is fastened 6 ft. of perforated pipe, with one end closed and drawn to a point. Two of these pipes should be driven into the gravel pile and one into the sand pile at places where the carts or barrows are loaded.

A 1½-in. steam line controlled by a valve conveniently

placed at the mixer, should be run from the boiler to the water barrel with the pipe extending down into the barrel to about 2 in. from the bottom in order to force live steam into the water. Also a 1½-in. line should be run up on the concrete hoist and a suitable valve and connection supplied at each floor level to provide for the attachment of steam hose for cleansing ice and snow from the forms and reinforcement.

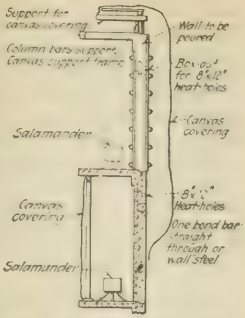


FIG. 2. HOUSING AND HEATING COLUMNS AND FLOORS

For a large operation, a 50-hp. boiler carrying from 50 to 60 lb. of steam is required to furnish heat and if steam is used for cleaning snow and ice from the forms in addition to heating aggregates and water, a 50-hp. boiler is the smallest practicable size for even a comparatively small job. On jobs of not more than 5,000 sq.ft. area on one floor, an 18 to 25-hp. boiler will give good results.

Housing and Keeping Placed Concrete Warm

Support the canvas on wooden frames resting on the column reinforcement about 18 in. above the floor and hang curtains from the exterior columns. The curtains should be carefully lashed to the underside of the floor below, care being taken to have the canvas some distance from the exterior forms so as to provide a circulation of heat (Fig. 2). Then a curtain hung across the width of the building under the forms will shut off the section to be concreted.

Enough salamanders should be provided to maintain a temperature of from 60 deg. to 80 deg. F. in this section. This will usually require one salamander to every 300 sq.ft. of floor area. The side curtains should be in place and the fires started in the salamanders as soon as, or before, concreting is started, and in extremely cold weather the curtains should be in place and the fires burning for several hours before beginning to deposit concrete. As soon as one bay of the slab is concreted it should be covered and in general the entire work should be closely followed with the protection.

Where the bays are not over 20 ft. square, provide one heat-hole about 8 x 12 in. through the slab so that circulation of heat may be maintained over the slab. In larger bays, provide a heat-hole for each 300 ft. of floor area. These heat-holes should have bevelled sides so as to make the filling plug of concrete perfectly secure (Fig. 3). When the canvas is removed the heat-hole should be covered with boards.

It is the best practice in winter work to concrete the columns at the same time as the floor and in this case great care should be taken to tamp the columns to prevent shrinkage cracks between the slab and the column head. Tamping sticks should be left in the head of the column and for several hours after the floor is concreted tamping of the columns should be continued. If the columns are concreted the day previous to the floor slab the side protection should be in place, floor forms made tight and the tops of the columns covered to prevent the column heads from freezing.

The most difficult places to protect from frost are the bases of exterior columns. It is frequently found that with a temperature of 80 deg. F. near the under side of the slab, a temperature below freezing will be found near the bases of the exterior columns. Hence, in extremely cold weather it is necessary to place a salamander on two sides of every exterior column. The bottoms of the columns may be further protected by packing the forms with marsh hay, or other suitable material. When unusual speed is required, or in extremely cold weather, it will be necessary to curtain the floor below and place salamanders around the bases of exterior columns.

This method of protection is also necessary when monolithic walls are carried up with the building as it is practically impossible to protect them from the cold unless heat is supplied from the story below. If the walls are blank it will be necessary to provide openings in the forms to allow circulation of heat to the outside of the exterior walls. These openings should be about

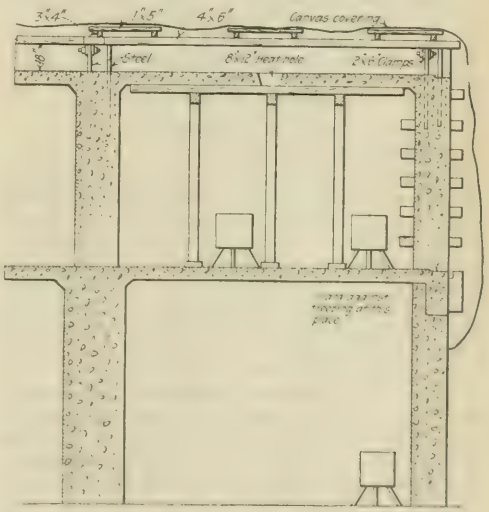


FIG. 3. HOUSING AND HEATING EXTERIOR WALLS

8 x 12 in. and should be bevelled down and upward so as to prevent water from entering the building when the holes are plugged (Fig. 3). There should be two such heat openings in each panel between columns.

It is important that the man tending the salamanders be carefully instructed as to the proper method of firing and as to the precautions necessary to prevent the canvas and forms from catching fire. Best results in firing will be accomplished if a small amount of fuel is applied frequently thus obtaining a maximum of heat with a minimum of smoke. The average laborer has a tendency to apply a large quantity of fuel at infrequent intervals as this tends to lighten his work.

As a protection against fire, several barrels of water should always be standing on each floor where salamanders are burning. They should be inspected frequently to see that the water has not leaked out or frozen. Care must be used to see that the canvas is securely fastened in order to prevent it from blowing

against the salamanders as experience has shown that this is a source of danger from fire.

During the entire time that protection of concrete is in progress a detailed temperature record should be kept in permanent form showing the date and hour, outside temperature, temperature at the bottoms of columns, temperature at the under sides of the slab, under the canvas over the slab, and the temperature of the concrete as it is placed in the forms. Temperatures should be taken at the bottoms of a number of exterior columns and especially at those columns on the windward side of the building.

The superintendent in charge of winter construction work should make a personal inspection of the job before leaving at night in order to see that all the precautions are being carried out. He should also make occasional visits to the work in the course of the night in order to see that all the men are carrying out their various duties.

Special Cast-Iron Pipe Used for Whittier Water-Works

Higher Tensile Strength and Lighter Pipe Saves $13,000 in Cost at Foundry and $20,000 in Freight on 305 Tons

By E. A. Rowe

Engineering Offices of J. B. Lippincott, Los Angeles, Cal.

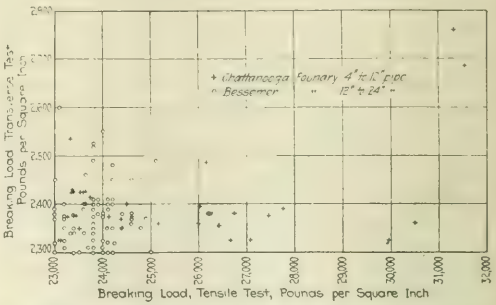
THE city of Whittier, Cal., has recently completed the construction of improvements to its domestic water system involving the expenditure of approximately $400,000. The work involved the driving of wells, installation of additional pumping equipment, construction of a 7,000,000-gal. reservoir and the replacement and enlargement of the pipe distribution system. These works were constructed with money received from a bond issue, based on engineers' estimates, made in June and July of 1919, shortly after the signing of the armistice. There had been a slight drop in the price of water-works materials immediately following the armistice and further reductions were expected. The estimates were based on the prevailing market quotations at the time they were made. However, between the time the engineer's estimates were made and the time when the bonds were voted, sold, and the money made available for construction work, there was a heavy advance in most of the materials entering into this work. Cast-iron pipe which prior to the war was laid down in Los Angeles for $28 per ton rose to $95.

About 50 per cent of the cost was for the pipe to be used in the distribution system. The price of this material advanced approximately $18 a ton between the time the estimates were made and the bids were opened. Meanwhile freight charges had also advanced. The advance in pipe cost alone increased the estimated total cost approximately $50,000. It was, therefore, apparent that if the work was to be done as outlined and within the limits of the bond issue, great economy would have to be exercised. The largest saving accomplished was in the cast-iron pipe.

The original specifications for the cast-iron pipe were those adopted by the American Water Works Association. When the bids were opened it was found that two large manufacturers had not only bid on the specifications submitted but also on a special pipe to be made of cast iron having a higher tensile strength than the ordinary standard metal, resulting in a pipe lighter in dimensions and weight. The engineers, after careful inquiry of the experience of water-works superintendents and engineers of cities where such pipe had been used, decided to purchase the high tensile pipe for this order, provided it would be manufactured under the city's specifications. In submitting their bid for the high tensile pipe the manufacturers stated that this higher strength would be secured by the use of higher grade ores in the manufacture of the iron. In preparing the specifications the Fanning formula was used,

$$t = \frac{(p + 100)\, d}{0.4s.} + 0.333 \left(1 = \frac{d}{100}\right),$$

in which t equals the thickness in inches; d equals the diameter in inches; s equals the ultimate tensile strength of the cast iron; p equals the working pressure in pounds per square inch; $(p + 100)$ equals the working pressure + 100 lb. per square inch for water hammer. When this allowance is made for water hammer the factor of safety equals 5. Using this formula it was found that pipe of the dimensions of Class A (American



BREAKING LOADS UNDER TENSILE AND TRANSVERSE TESTS OF 200 SPECIMENS OF CAST-IRON PIPE

Water Works Association) would serve for Class B service when s in the above formula was 23,000 lb. per square inch. The American Water Works Association specifications called for an ultimate tensile strength of 20,000 lb. per square inch. It was decided to specify an ultimate tensile strength of 23,000 lb. per square inch and use the dimensions specified for Class A pipe for pipes to be subjected to Class B pressure and to use Class B pipe dimensions for pipe to be subjected to Class C pressures. By so doing it would not be necessary for the foundry to change its patterns and moulds.

Cast iron can be made to have a tensile strength of 23,000 lb. per square inch from the same pig used when making pipe in conformity with the American Water Works Association specifications of 20,000 lb. per square inch by a more rapid cooling of the finished pipe. However, by so doing the resulting pipe is hard, dense and brittle. In order to protect the city against such practice it was decided to change the specifications for the transverse loading and deflection to agree with the new tensile strength.

The standards of the American Water Works Association provide that the transverse test shall be made on bars 26 in. long, by 2 in. wide and 1 in. thick, which when placed flatwise upon supports 24 in. apart and loaded in the center shall support a load of 2,000 lb. and show a deflection of not less than 0.30 in. before break-

ing. Careful search of engineering literature was made to find some relation between the tensile strength of tensile bar specimens and the load supported by bars under the transverse test. Little definite information on the subject could be found. The two large water-works associations have committees appointed to revise the specifications for cast-iron pipe and they are now engaged in research to settle just this point. At the time our specifications were drawn these committees had no data available for our guidance. Authorities seem to agree that the size of the test bar used in transverse tests has an effect upon the results. In the absence of definite information on the subject it was decided to specify that the breaking load on a transverse bar specimen should be 2,300 lb.—10 per cent of the ultimate tensile strength of the metal. This is in line with the standards of the American Water Works Association which require transverse breaking load of 2,000 lb. and an ultimate tensile strength of 20,000 lb.

Specifications Adopted

The deflection specified was computed in accordance with the tentative specifications prepared by the joint committee of the New England and American Water Works Associations. These specifications, while published, have not yet been adopted by the societies. They read as follows:

> The bars when placed flatwise upon supports 24 in. apart and loaded in the center, shall support a load of 2,000 lb. and show a deflection of not less than 0.32 in. before breaking, and an increase in deflection of not less than 0.03 in. for each 200 lb. of ultimate breaking load in excess of 2,000 pounds.

Computed on this basis, transverse bars supporting a load of 2,300 lb. should show a deflection of not less than 0.36 in. The specifications when finally prepared were identical with those of the American Water Works Association with the exception that the dimensions and weights for Class B service corresponded to their standards for Class A service. Paragraph 9 of the standard specifications of the American Water Works Association was changed to read as follows:

> Specimen bars of the metal used, each being 26 in. long by 2 in. wide and 1 in. thick, shall be made without charge as often as the engineer may direct, and in default of definite instructions, the contractor shall make and test at least one bar from each heat or run of metal. The bars when placed flatwise upon supports 24 in. apart, and loaded in the center, shall support a load of 2,300 lb and show a deflection of not less than 0.36 in. before breaking, and if desired, tensile bars shall be made which will show a breaking point of not less than 23,000 lb. per square inch.

When the specifications were finally prepared the contract was submitted to the local representative of the successful bidder who signed the contract for the manufacturer. When they were forwarded to the home office of the manufacturer, their engineers took exception to the specifications in regard to the deflection specified, it being their contention that there was no engineering authority available for such a specification, and that in order to meet the deflection requirements it would be necessary to run the tensile strength to points higher than 23,000 lb., which they claimed would result in a hard pipe, difficult to tap. It was presumed that they would accomplish this by a more rapid cooling of the pipe. The specifications as prepared were probably defective in that they did not specify an increase in the transverse breaking load with an increase in the ultimate tensile strength. However, the city was protected against hard pipe by paragraph 8 of the American Water Works standards which contain the following clause: "The metal of the casting shall be strong, tough, and of open grain and soft enough to satisfactorily admit of drilling and cutting."

The pipe as delivered to the city was found to be as soft and as easy to work as standard pipe. In order to determine if possible whether or not there was any relation between the strength of the bars under transverse loading and the ultimate tensile strength, the city employed the Pittsburgh Testing Laboratories as their inspectors at the foundry, and had some 200 tensile and transverse tests made for each run of the metal. The results of these tests are shown by the accompanying diagram. It is apparent that there is no relation between the transverse and the tensile tests as shown by these reports. The foundries had considerable difficulty in making pipe to meet these specifications. Inspection reports showed that about 38½ per cent of the pipe was rejected at the foundry. No doubt a large part of this trouble was due to the unsatisfactory labor obtainable at the foundries at that time.

The pipe was shipped by rail from the Birmingham district to Mobile and thence by water to the docks at San Pedro, from which point it was trucked directly to the streets in which it was to be laid. Inspection at the San Pedro flocks showed that a large quantity of the pipe had fine hair cracks at the spigot end. However, pipe manufactured in accordance with the American Water Works Association standard and shipped on the same boat showed the same cracking. It is believed that these cracks were caused by rough handling at the docks. The city and the pipe manufacturers had no control over the handling by the ship company. They seemed to prefer paying for damaged pipe rather than take a little more time in loading and unloading.

Economies Effected

The pipe has all been laid. It was necessary to remove several joints when put under pressure but inspection showed that in every case the defect was evidently due to an old crack which had escaped the inspector before laying. No evidence of breaking has developed which is directly chargeable to a weakness in the metal.

The difference in weight between standard pipe and the special pipe for the entire order amounted to approximately 305 tons. The saving in the cost of the pipe itself at the foundry amounted to $13,000 and in freight about $20,000. The rail freight rate from the Birmingham district to Whittier was $30 a ton. The regular line steamship company's rate, including rail rate from Birmingham to Mobile, was approximately $24 a ton. The city's engineers, however, by pooling orders for other cities in California with the Whittier pipe, to make an entire ship load, were successful in securing a rate of $18.50 from Birmingham to San Pedro. The entire work was accomplished without additional bond issues at a cost of some $30,000, over the engineer's estimate, which was met by a slight increase in the water rates. The plans, estimates and specifications were prepared by the engineering offices of J. B. Lippincott, Los Angeles, who also supervised the construction work. The pipe was manufactured by the United States Cast Iron Pipe & Foundry Company.

Why the Joint Commission Favors The St. Lawrence Waterway

Summary of Conclusions of the Report Discusses Navigation Possibilities, Economics and Engineering Features

ON JAN. 6, 1922, the International Joint Commission submitted to the Secretary of State its report on the proposed navigation and power development of the St. Lawrence River, a matter referred to the commission by the governments of the United States and Canada, Jan. 21, 1920. That report was transmitted by the President to Congress, Jan. 16, and was referred by the Senate to the Committee on Foreign Relations and by the House to the Committee on Interstate and Foreign Relations and, in regard to bond issues, to the Committee on Ways and Means. The report in full is being printed as Senate Document No. 114, and will make with maps and appendices several volumes. The final recommendations of the Commission were given in *Engineering News-Record*, Jan. 19, 1922, p. 128. The summary of conclusions on which these recommendations were based is as follows:

Navigation Possibilities

To sum up as briefly as possible its conclusions in the matter of the proposed improvement of the St. Lawrence River between Lake Ontario and Montreal, the commission finds nothing in the evidence to warrant the belief that ocean-going vessels of suitable draft could not safely navigate the waters in question as well as the entire waterway from the Gulf of St. Lawrence to the head of the Great Lakes, or that such vessels would hesitate to do so if cargoes were available.

It finds that of the various alternative routes mentioned from the interior to the seaboard, none offers advantages comparable with those of the natural route by way of the St. Lawrence.

As to the economic practicability of the waterway, the commission finds that, without considering the probability of new traffic created by the opening of a water route to the seaboard, there exists to-day, between the region economically tributary to the Great Lakes and overseas points as well as between the same region and the Atlantic and Pacific seaboards, a volume of outbound and inbound trade that might reasonably be expected to seek this route sufficient to justify the expense involved in its improvement.

It finds that, as between the American and Canadian sides of the tributary area, the former contributes very much the larger share of this foreign and coastwise trade, and in all probability will continue to do so for many years to come. The benefits to be derived from the opening of a water route to the sea will therefore accrue in much larger measure to American than to Canadian interests, though it is reasonable to assume that eventually the advantages may be more evenly distributed.

It finds that the existing means of transportation between the tributary area in the United States and the seaboard are altogether inadequate, that the railroads have not kept pace with the needs of the country, but that this does not apply to the Canadian side of the area, where railway development is still in advance of population and production.

While the commission is conscious of the fact that war conditions had something to do with the dislocation of railway traffic on the United States side of the boundary, and that various other factors must be taken into account, such as the congestion of traffic at certain critical points between the West and the Atlantic seaboard commonly referred to as "bottle-necks," and the abnormal demand for cars at certain times of the year to carry the peak load of the harvest, it is convinced that the fundamental difficulty lies rather in the phenomenal growth of population and industry throughout the middle western and western States, a growth which the railroads have failed to keep pace with.

The solution of the problem, in the opinion of the commission, lies in the utilization of every practicable means of communication, and particularly of the wonderful natural waterway extending from the Atlantic into the very heart of the continent, together with the development of such a system of co-operation between railways and waterways as would at one and the same time bring the load the railways have to carry within practicable limits, and give the West an additional route for its foreign and coastwise trade.

The conclusion is obvious that, if countries that had for the most part to import their raw materials from abroad were able to build up a great foreign trade because of their ready access to the sea, the region economically tributary to the Great Lakes, with its limitless resources, its raw materials within easy reach, its facilities for industrial expansion, can hardly fail to become an even greater factor in the world's markets than it is to-day, if given a practicable and efficient water route to the sea.

Of scarcely less importance is the linking up of land and water routes. Here also the experience of Europe is illuminating. Belgium and England are the most densely populated portions of Europe, and both are pre-eminently industrial nations. Each possesses a network of railways reaching into every corner of the country, yet each is today, despite its very short rail haul to tidewater, finding it necessary, in order to give adequate service to congested areas, to link up the railways and the highways with the inland waterways. Despite the difference in area between these countries and the rigion tributary to the Great Lakes, transportation conditions are not altogether dissimilar, particularly in the more congested areas of the Middle West. One finds in such a district as that around the south shore of Lake Michigan much the same conditions of a rapidly increasing concentration of population and industry, with a corresponding concentration of rail lines, that is so noticeable in England and Belgium. And similar conditions are quite evidently developing in the territory immediately tributary to Detroit, Cleveland, and other middle-western cities. When these cities and their tributary territory are given access to the sea, they will find it necessary, in order to secure the maximum benefits from the new route, to co-ordinate their railways and highways with the great waterway that will be common to them all. The advantages of co-operation will be found as real in this case as in Europe, although the remedy may be somewhat different in character.

An example on this continent of the effective co-ordination of rail and water services is found in the Canadian Pacific Ry., which, in conjunction with its rail system extending from ocean to ocean, maintains lines of steamers not only on the Atlantic and the Pacific but also on the Great Lakes and the inland waters of British Columbia.

Distribution of Cost

The whole question of the distribution of cost has given the commission some concern. If the area to be benefited were all in one country the problem of financing the improvement would be a comparatively simple one, but as the matter stands the situation is complicated not merely by the fact that two neighboring countries are joining in the project, but that these countries are unequal in population, unequal in wealth, unequal in their ability to make effective use of the waterway. That is the situation today, but it does not necessarily follow that it will always be the situation. As the years go by the relative position of the two countries will doubtless change, and the disproportion between their population, wealth, and commerce may gradually diminish. In the meantime the fair and reasonable plan appears to be to divide the cost in proportion to the benefits each receives.

Objection may be made that the proposed principle of dividing the cost in proportion to the benefits each country derives from the improvement could hardly be put into effect until the works had been completed and in operation for a sufficient period to secure reliable data on the subject. For the intervening period, however, the commission believes that there are already available authoritative statistics on

which to base a tentative decision as to the interest each country is likely to have in the waterway.

Another factor in the situation that should not be lost sight of is the peculiar relationship to the proposed improvement of the New Welland Ship Canal, a portion of which is now under construction. As pointed out in an earlier part of this report, the completion of the Welland Ship Canal and the adoption and completion of the St. Lawrence improvement would remove the only barrier to the creation of a deep-water route from the head of the lakes to the sea. This would give at least 25 ft. navigation from the sea up to the Detroit River, with a present minimum of about 20 ft. above Lake Erie. Although entirely outside the strict terms of the reference submitted to it by the two governments, the commission has been impressed by the fact that the New Welland Ship Canal is such an integral part of the waterway, and is so inseparably interwoven with the project under immediate consideration, that it should properly be considered as a part of the whole scheme and the expense of its construction should be apportioned between the two governments upon the same basis as the works recommended for the upper St. Lawrence.

In other words, each country should be debited with its share of the entire cost of all works necessary for navigation, including the cost of the Welland Ship Canal, based upon the proportion the cargo tonnage carried to and from its own ports by way of the St. Lawrence bears to the entire tonnage by the same route. The ratio to be charged to each obviously would require to be readjusted periodically.

Water Power

In regard to the water-power side of the question, by the language of the treaty as well as the obvious intention of the reference, water power must be regarded as subsidiary to navigation. Statements were repeatedly made during the hearings to the effect that while the movement for improving the St. Lawrence was nominally in the interests of navigation, it was really being engineered by water-power interests to serve their own ends. The commission is confident that there is no justification whatever for these assertions. As a matter of fact, as already stated, very little testimony of any kind was offered at the hearings upon the power side of the question, public attention being apparently centered on the economic practicability of the undertaking as a navigation route.

For the purposes of the conclusions, recommendations, and answers to questions, "navigation works" shall be deemed to mean and include all works of every kind and description required for the proposed improvement of the St. Lawrence between Montreal and Lake Ontario other than and except superstructures, machinery, plant, and equipment for the development and utilization of power in connection with such improvement; and "power works" shall be deemed to mean and include all superstructures and all machinery, plant, and equipment required for the development and utilization of power in connection with the said improvement.

In apportioning between the two countries the water power capable of development in the international section of the St. Lawrence, each country should be charged with such quantities of power as are set apart to meet the requirements of existing plants.

In regard to the distribution between the two countries of the cost of power works, the commission is of the opinion that as each country will be entitled to half the available power in the international section of the river, the cost of the works necessary solely for the development of that power should be borne equally by each country. It is further of the opinion that the cost of navigation works required for the combined use of navigation and power over and above the cost of works necessary for navigation alone should be apportioned equally between the two countries.

As elsewhere noted, it was repeatedly stated by those who appeared before the commission that the water power developed on the St. Lawrence would be sufficiently valuable to carry a considerable proportion, if not the whole, of the cost of the undertaking both for navigation and power. The commission desires to emphasize the point that if this prediction should prove well founded, nothing in the commission's conclusions and recommendations as embodied in this report need conflict with the charging to water power by either country of any proportion of its share of the entire cost that may eventually be found desirable.

In regard to the method of control, the commission is conscious of the fact that the peculiar character of the St. Lawrence, partly international and partly national, creates an unusual situation, and it believes that, in order to combine the fullest possible liberty of action on the part of each country in its own territory, with the efficient co-ordination of the several parts of the completed improvement, all navigation works lying wholly within one country and capable of economic and efficient administration as complete and independent units, should be maintained and operated by the country in which they are located; that navigation works not lying wholly within one country and not capable of economic and efficient administration as complete and independent units, should be maintained and operated by an international board on which each country would have equal representation; and that this board should also have the right of inspection of navigation works lying wholly within one country, for the purpose of insuring economy and efficiency. The commission is further of the opinion that all power works should be built, maintained, and operated by the country in which they are located.

An important result of the proposed improvement, if carried out, will be the extent of damage resulting from flowage due to the higher levels maintained in the St. Lawrence. This damage is estimated by the engineering board at about $6,000,000. The commission is of the opinion that there should be an exhaustive investigation of the extent and character of the damage as soon as the plan of development has been finally accepted.

Finally, the commission is strongly of the opinion that the subject matter of this investigation is one of such extraordinary importance to the people of the two countries, and involves engineering problems of such magnitude and diversity, that no effort should be spared to secure a plan which will beyond all reasonable doubt obtain from the upper St. Lawrence its maximum efficiency in navigation and power. To this end the commission believes that, before any particular scheme is finally adopted, all the available engineering data, including the report and plans of the engineering board and all comments thereon or alternative plans, should be referred to a special technical board for careful consideration and report.

Distinguishing Long-Leaf Pine From Short-Leaf by the Pith

LONG-LEAF pine has a large pith, usually over 0.1 in. in diameter, while short-leaf has a pith usually the size of the lead in a lead pencil. Occasionally a vigorous first year's growth may unduly increase the size of the short-leaf and loblolly pine, in which case positive identification may be made by measurement of the pith diameter and comparing it with the second annual ring. The Forest Products Laboratory has formulated a diagram on which these two diameters may be plotted. If the point falls above the diagonal line the specimen is long-leaf; if below it is short-leaf, loblolly or some other of the minor southern pines. The vigor of a tree at the time the pith is formed is indicated by the diameter of the second annual ring. Therefore, where the pith in loblolly is over 0.1 in. in diameter, the diameter of the second annual ring is comparatively large.

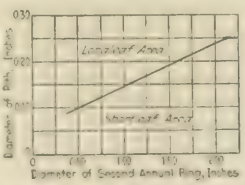


CHART TO DISTINGUISH LONG-LEAF FROM SHORT-LEAF BY RELATION OF PITH DIAMETER TO THAT OF SECOND ANNUAL RING

Road Builders' Problems Discussed at Convention

Abstracts of Some of the Papers Presented at the Nineteenth Annual Meeting of the American Road Builders' Association, Chicago, Jan. 16-20, 1921

North Carolina's Sub-Grade Roads

By Charles M. Upham
State Highway Engineer of North Carolina

NORTH CAROLINA now has a bond issue of $50,000,000 provided for the "purchase" of roads. It is the business of the State Highway Commission to purchase for the taxpayers of the state, road improvements which will serve the most people of the state and do the greatest economic good. For some time, many of the Southern states have been constructing sand-clay and top-soil highways, which, in reality, are sub-grades which at some later period will be covered by a roadway of a higher type. The roads of this type have been found satisfactory for many seasons of the year, and, in a degree, solve the construction of a large road mileage at a moderate cost.

Roads of this type are called "progressive type" roads. They are roads for which grading has been done in the ordinary manner, satisfactory drainage structures constructed and a subgrade of selected material built. This sand-clay or top-soil road or selected sub-grade, can be maintained at a moderate cost, and with moderate traffic is satisfactory for the greater period of the year. This is a progressive road because its construction can be added to, and advantage taken of all the previous steps, and a hard surface pavement constructed without loss of any of the previous steps in construction.

This sub-grade highway may be still further improved by constructing into the earth roads a single layer of stone which, after receiving a bituminous treatment, becomes an integral part of the earth road, and also affords for the bituminous material, a stone surface which will not dust up and allow the bituminous mat to peel from the surface. Upon this reinforced or armored subgrade highway can be constructed practically any hard surface type which may at some future time be required. In the meantime, a roadway capable of carrying moderate traffic at a reasonable maintenance cost is provided. It is doubtful if this treatment of subgrade highways would be satisfactory in the northern states, where there is excessive frost.

Notes on Brick Paving Practice

By W. W. Horner
Chief Engineer, Sewers and Paving, St. Louis, Mo.

FOLLOWING the recent reduction in paving brick varieties from 66 to 11 there remain as accepted standards three depths of brick—3, 3½ and 4 in.—and two widths—4 and 3½ in. The 4-in. depth is suitable for the heaviest traffic; the 3½-in. depth for moderate traffic; while the justification of the 3-in. depth, in spite of a slight saving in first cost, is questioned.

Repressed brick were eliminated from the St. Louis, (Mo.,) specifications in 1914, and side wire-cut lug brick have been used exclusively since that date.

Of the three types of bedding—plain sand, sand-cement and wet concrete (monolithic)—the writer considers the sand-cement mixture the most valuable in brick paving, regardless of the kind of filler used. Opinion seems to be about equally divided in the choice of filler as between cement grout, bituminous, or bituminous mastic. Where the brick is laid on a strong concrete foundation supported by a well-drained soil, the writer invariably prefers the cement grout as giving to the wearing surface a slab strength over small areas which is of value. If on flexible foundations or on clay soil subject to frost and heaving, a bituminous type of filler is probably a safer choice. When properly handled it is somewhat easier to secure good penetration with a bituminous filler than with cement grout. It has been argued that this ease of penetration with bituminous fillers justifies the omission of lugs, but an examination of recent pavements around the country and reports from engineers in the technical press do not bear out this contention.

The writer believes that the lugs heretofore used on both wire-cut and repressed brick are somewhat larger than necessary for this purpose, and that in the case of the bituminous filler a ⅜-in. lug will be satisfactory.

It seems advisable to raise the question whether efforts to reduce the cost of brick pavement in some cases are not carrying us into a design that is economically unsound, and whether the ultimate waste in pavement failures on this account may not be far greater than the waste we have been attempting to eliminate in the standardization of brick. The writer believes that the consumer, in this case the engineering profession, should seriously consider whether conservative specifications such as those of the American Society for Municipal Improvements, should not be more strictly adhered to even where the cost involved would be somewhat greater than the first cost of certain of our pavements. If these specifications were adopted quite generally by the profession there would not only be eliminated this possibility of waste, but there would be further elimination in the styles of brick in that the plain wire-cut lugless brick in both 3 and 3½-in. depths could be dropped. It might utimately be wise to drop, also, the other styles of 3-in. brick.

Bituminous Foundations for Street and Road Pavements

By Hugh W. Skidmore
Chicago Paving Laboratory

TWO essentially different schools of thought, as applied to pavement foundations, have been evolved. One seeks to overcome the destructive effect of the traffic loading, which at any instant may be converted into impact equivalent to several times the dead load, by means of a rigid slab possessing strength superior to the possible force of impact. The other adopts the principle of dissipating the blow by absorbing a considerable portion of it through a flexible structure, which is always in actual contact with the subgrade, thereby insuring greater uniformity of load distribution and functioning as a distributing medium or foundation and not as a deflector.

Flexible foundations include gravel, broken stone, water-bound macadam, bituminous macadam, and hot-mix bituminous concrete. They are usually classified as to value in a pavement structure in reverse of the order named with bituminous concrete as the highest type. It is estimated that there are 15,000,000 sq.yd. of "black base" giving satisfactory service in this country. The bituminous foundation structure, although possessing considerable beam strength, functions primarily as a shock reducer, that is, it *gives* slightly under the blow of impact in transmitting the load to the subgrade. Therefore, the design of this type places considerable reliance in the load-supporting power of the subgrade. Its use, then, is dependent upon a knowledge of the ability of the subgrade to support loads equal to the probable force of impact reduced by the slab strength residing in the bituminous structure; whereas the rigid type, regardless of the bearing power of the soil, must be built to sustain the entire force of impact. For this reason a much thicker rigid foundation is required under given traffic and subgrade conditions, as has been demonstrated by impact tests.

Even where soils are of questionable value as a subgrade,

bituminous foundations may still be employed economically, if an artificial subgrade of broken stone, gravel, boulders, or even cheaper materials, is first constructed. Where old macadam or gravel roads already exist, an excellent artificial subgrade is offered at almost negligible cost. If widening is necessary, this can usually be accomplished, as in the case of the Kingston Pike at Knoxville, Tenn. where "black base" was laid about 4 in. thick over the old macadam and 7 in. thick at the edges of the widened pavement.

Black-Base Practice

In the West, where the most extensive yardage of bituminous foundation has been laid, the general practice seems to be, in taking alternate bids, to specify 5 in. total depth for black-base pavement and 7 in. for portland cement concrete pavement of 1:2:3 mix. The general opinion appears to be that the black-base type is giving superior service. Almost universally bids for black-base pavements have been less than for either portland cement concrete pavement or asphalt wearing surface on portland cement concrete base. The saving has varied from 20 to 60c. per square yard.

Contractors are willing to guarantee black base as readily as portland cement concrete. The experience of contractors generally has been decidedly lower maintenance expense and lower first cost except in a very few instances where freight rates proved to be an extraordinary item. Assuming equal depth of foundation, the use of the same aggregate materials in both types, and portland cement concrete not to exceed 1:2:5 in richness of mixture, 90 per cent of contractors queried by the writer estimated a difference in initial cost of from nothing to 50c. per square yard loss for black base; 75 per cent estimated black base at from 25 to 50c. per square yard less than portland cement concrete. Since it is true that under similar traffic and subgrade conditions, less depth of black base is required, it will be seen that rigid foundations will usually cost substantially more than the highest type of flexible base.

The only objection raised by contractors to black-base construction is the possibility of idle equipment in the event of a protracted rainy season.

Cost Keeping on Highway Construction

A. R. Losh
Assistant Chief of Construction, U. S. Bureau of Public Roads

THE proper basis for a cost system is the four principal elements of cost allocated to the units of production: (a) Labor; (b) material; (c) equipment, and (d) administration or general. The products or highway construction to which these cost elements are assignable are: (a) right of way; (b) roadside, shoulders, and grade; (c) traveled way or roadway proper; (d) drainage channels or ditches and drains; (e) drainage structures or bridges and culverts, and (f) supplementary structures of miscellaneous road parts, such as guard rails, retaining walls, guide posts, etc.

Thus, there are six major products on each of which there may be four elements of expense or cost; consequently there are 24 cost divisions. Since general expense is not ordinarily ascertained directly on production but is prorated to the various operations the actual cost divisions with which the cost keeper is directly concerned are reduced to 18. It is believed that this is the minimum number of cost divisions which will provide a satisfactory highway cost keeping system. These cost divisions are susceptible of much further analysis by breaking them up into various operations. For example, a square yard of concrete roadway is one of the unit products. The cost divisions for this are, labor, materials, and equipment. To these three may be added the pro-rated general expense. For further analysis, this square yard of roadway may be subdivided into subgrade finishing, placing forms, hauling materials, mixing concrete, placing concrete, curing concrete, etc. This illustrates how the system may be extended to meet the requirements of any desired analysis.

In placing the cost items against the appropriate construction items the greatest difficulty appears to be with "equipment costs" and "administration costs."

The handling of equipment costs has been greatly simplified by the use of a rental factor computed to cover fixed charges, depreciation, overhauling, lost time, storage, and supervision. In the case of its own plant the bureau has prepared rental schedules for all units of equipment having a useful life of more than one working season and costing more than $25. Small tools and those which are usually worn out on one job are handled the same as materials. If greater accuracy is desirable for fiscal purposes, an annual appraisal of the equipment may be made and the depreciation, repair, storage and other charges pro-rated to the projects which have used the equipment.

Two suggestions are offered for the handling of general expense. First, it will be found advantageous to divide general expense into two parts, one of which includes those costs which are assignable directly to the project and the other the general administration costs of the organization which must be pro-rated to all its various projects. This latter part need not be considered in current cost reports as it does not in any way affect the efficiency of the construction organization on the project. This part of the general expense may be apportioned to the project upon its completion. The second suggestion is that the amount of general expense (project) taken up and pro-rated on current reports be a percentage of the total probable general expense, not greater than the percentage of the project completed. For example, if the project is only 10 per cent complete, pro-rate to completed work not more than 10 per cent of the total probable general expense. On projects where the cost of "moving in," "camp installation," "organizing," and "disorganizing" is of a considerable amount the unit construction costs are liable to be materially affected if this entire cost is distributed before the work is well under way.

Problems of Highway Contracting Which Affect Costs

By Henry H. Wilson
Managing Partner, Winston & Co., New York

BEARING in mind the present necessity and demand for lowered costs in every line of industry, particular attention should be directed to those contracting problems, a solution of which will result in decreased costs for highway building.

Internal Relationship.—It is good business for contractors to educate their competitors; it is good business and eliminates waste both to the contractor and owner, to seek out together the best means consistent with first class work and to assist in the standardization of methods and equipmen along those lines:

Risks.—The greatest reduction which could be brought about in contract prices would result if certain risks now assumed by the contractor were assumed by the state. A contractor can figure closely on work in direct proportion as elements of risk and uncertainty are eliminated. In many states the assumption of these elements of risk and uncertainty are required by the organic law and can only be escaped by access to public opinion as expressed through legislative action. To bring about a change in these laws will facilitate a more balanced and equitable form of contract.

It is also the problem of the higway contractor to use his influence to create a public sentiment which will countenance better paid and better qualified engineers and inspectors. One of the greatest problems confronting highway commissions and chief engineers is a salary scale which will permit them to employ men more competent and experienced. Contractors invariably find engineers and inspectors satisfactory in direct proportion as the latter possess integrity, intelligence and experience.

Specifications.—The problem of the contractor here is to co-operate in pointing out those requirements of specifications which entail increased costs without any commensurate advantage and those requirements which can be waived in the interests of economy without sacrificing quality. Under present laws, the difficulty with commissioners and engineers [illegible] contractors are asking [illegible]

recognize the just principle to apply as in finding a means to apply it practically.

Labor.—More uniform wages and working conditions for the various classes of skilled labor employed upon highways are believed to be a problem from whose solution benefit can be derived. If it were possible to develop some co-ordinated industry in the northern and border states, whereby highway labor might be retained the year around upon some productive work, contractors would be able to secure great economy and added efficiency from their organizations. Co-operation between concerns working in the same locality, in the matter of labor, will go far towards stabilizing conditions and creating greater efficiency.

Other Problems

Materials.—One problem here relates to the working out of a form of contract with material producers which will be a standard for the industry and more binding upon both contracting parties. Another problem is responsibility for rejected material. Some producers refuse to accept reponsibility for material condemned after unloading, while some engineers refuse to make final inspection until the material is unloaded. Uniformity of practice and understanding will remove an element of anxiety and loss to many contractors and will reflect itself in lower contract prices.

Transportation.—Our chief problem, in this connection, is to assist the railroads and indirectly the public, in the elimination of waste and expense, by so designing work and unloading facilities as to provide for prompt release of cars.

Standardization. — Standardization of equipment holds great possibilities for efficiency and economy and organized construction is already moving in this direction. Here again the working out of standard specifications for the country at large will do much to facilitate matters as it frequently happens that equipment suitable for construction in one state it not suitable in another.

Surety Bonds.—Much demoralization has been caused by the bonding of irresponsible concerns. With the past ten years, there has been an increase of approximately 100 per cent, in bond premiums and, within the past thirty years, the increase has been comparatively greater.

Minnesota's Highway Financing

By C. M. Babcock
State Highway Commissioner of Minnesota

THE state constitution of Minnesota was amended at the last session of the legislature to provide for a state trunk highway system, 7,000 miles in extent out of a total of 100,000 miles in the state, the funds for its improvement and maintenance to be raised by a tax upon motor vehicles. The law prescribes that 40 per cent of the funds shall be used for maintenance and minor betterments.

The detail of levying the motor vehicle tax was wisely left indefinite in the constitution, but the legislature putting it into effect used 2 per cent of the value of motor vehicles as the basis of taxation, which should not be the only factor; it is expected that, in addition to valuation, there will also be a levy made either upon the weight of the vehicles or upon the gasoline consumption. Under the present system the current revenues from motor vehicles amount to approximately $6,000,000 per year derived from the registration of about 330,000 vehicles and averaging less than $20 per car, with a minimum of $12 on passenger cars and $15 on trucks.

The constitutional amendment also allowed the legislature to issue bonds of the State in an amount not exceeding $10,000,000 per year, with a maximum limitation of $75,000,000 outstanding at any one time, but it was not deemed necessary to issue any bonds for the first biennium, for the constitution allowed counties to issue their bonds to anticipate the State construction of trunk highways within the counties, the aggregate of these county bonds being approximately $14,000,000 in the first two year period.

Thus we have the total of funds for the year 1921 as follows: Federal aid $2,840,000; state trunk highways fund derived from motor vehicles revenue, $5,750,000; state aid from one-mill tax, $2,084,000; county trunk highway bonds, $8,250,000; county road and bridge levies, $10,843,682; township road funds, $6,862,560; village road levies, $1,308,794; or a total of $37,940,000. Of this total, approximately $15,000,000 was used on the trunk or primary highway system of 7,000 miles and the remainder, $23,000,000 on the secondary system of county and town roads.

The foregoing summarizes the sources and amounts of Minnesota highway funds. As will be noted, they are derived from current tax levies on all property in the State, from bond issues for permanent construction and from a direct tax upon the user of the road. From this it will be seen that Minnesota recognizes the equity of three phases of highway financing: First, that all property is benefited by the improvement of transportation facilities; second, that it is reasonable and good business to borrow money for the purpose of making permanent improvements on highways as well as school houses and other public buildings, requiring those who will later enjoy these facilities to bear a part of the cost of them; and third, exacting a part of the expense for the construction and maintenance of roads from the motor vehicles which cause the greatest damage to the public highways and make necessary their greater improvement.

Sentiment For Increased Tax

There is a growing sentiment in Minnesota for increased taxes on motor vehicles, particularly motor trucks, and the people of our state are inclined to believe that the transportation companies using public highways for commercial, passenger and express uses should pay gross earnings taxes somewhat in the same manner as the railroads are required to do. It is very evident that taxation for highway purposes throughout the whole country is shifting from general property to vehicles using the roads, on the theory that the users of the highways should bear a greater share of the road construction and maintenance costs, and due also to the necessity of supplying additional funds for the more adequate highways demanded by the public.

Road officials should carefully analyze the situation before agreeing to the single standard of gasoline tax which might seriously affect the amount of available funds for road improvement. The popular idea is that a tax of 1 or 2c. per gallon would bring in sufficient revenues, but we find in Minnesota that the gasoline used in the State last year was 117,000,000 gal. which would have required a tax of 5c. for every gallon shipped into the state to produce the sum derived under the present motor-vehicle tax schedule.

Notable Drought in Great Britain Most Serious in Years

In 11 months of 1921 only 13.26 in. of rain was registered in London whereas the normal is around 23 in.; in other words, London is still 46.7 per cent short of her average rainfall. The previous smallest records were 16.93 in. in 1864 and 17.69 in 1898. The following records for the various quarters of England, Scotland and Ireland show that Scotland has suffered least, one section of it having even an excess of rain for the 11-month period:

	Fall to Nov. 30, 1921 In.	Normal Fall in this Period	Percentage Above or Below Normal
England, N. E.	15.65	21.05	—15
England, N. W.	25.09	29.35	—15
England, E	11.72	20.10	—40
England, Midlands	15.61	22.50	—30
England, S. E.	11.40	22.70	—50
England, S. W.	19.01	31.80	—40
Scotland, N.	44.03	41.60	+ 5
Scotland, E.	22.71	26.35	—15
Scotland, W.	39.91	38.73	+ 5
Ireland, N.	28.63	32.00	—10
Ireland, S.	27.29	33.05	—15
Channel	13.21	26.40	—50

Development of Light Railways in Great Britain

Standard Gage Preferable; or 30-In. for Isolated Lines—Light Rail and Load—Economic Operation—Road Motors

ECONOMIC transportation facilities for agricultural and other lightly populated districts by means of light railways, with low cost of construction and operation have been advocated in England for many years. Lack of progress in this direction led to the appointment of a government committee of investigation in 1920. In its report the committee attributes the slow and unsystematic progress before 1896 to restrictive legislation. The Light Railways Act of 1896 and the amending Act of 1912 represented a substantial advance, but have not fostered the development of light railways to an extent comparable with that attained in Continental countries. Of the $5,000,000 made available by the Act of 1896 for advance to light railway companies, only about 20 per cent had been disbursed up to the end of 1918, and of this the greater part was advanced during the earlier years. The following is a summary of the report:

Construction Cost—Actual cost of existing lines cannot be ascertained definitely, as heavy discounts often make a wide difference between the nominal amount of capital issued and the actual cash amount of capital raised. For narrow gage lines the cost has varied from $16,665 to $34,030 per mile. For standard gage it has ranged from $17,505 per mile for a line in an agricultural district to $126,310 per mile for a line having a fairly heavy industrial traffic.

Narrow or Standard Gage—The adoption of a gage distinctly narrower than the standard gage may effect a saving in length by use of sharper curves, and may effect economies in earthwork, ballast and ties. Where a light railway has to be laid on a public road a departure from the standard gage offers marked advantages. Narrow-gage railways carrying heavy engines and capacious rolling-stock have been built in South Africa and India, and an equally high ratio of paying load to dead load may be attained in narrow-gage equipment. Where it is decided to depart from the standard, the gage should be 2 ft. 6 in.

On the other hand, there is the disadvantage of transhipment. In certain cases, this difficulty may be overcome by organization and by the use of labor-saving appliances, especially when dumping of material is practicable. Or the objection may be more than counterbalanced by advantages incident to narrow-gage construction and operation, especially where a light railway is more than 20 miles long or has no prospect of connection with a main-line system. But except in rare instances where passenger traffic only has to be transferred, a break of gage is disadvantageous and should only be resorted to when it is clear that the objection to transhipment can be offset or overcome.

Weight of Rail—There should be a greater variation in relation to weight of rail to axle load. A sliding scale varying by 5-lb. increments is proposed: 30-lb. rails for 4- to 6-ton loads, 40-lb. for 6 to 8 tons, 50-lb. for 8 to 10 tons, 60-lb. for 11 to 13 tons, and 70-lb. rails for 15 to 17 tons.

Roads and Grade Crossings—In continental countries it is usual to operate railway equipment on tracks in streets and roads. Restrictions against such practice in Great Britain should be abolished. Light railways should be of two classes, with maximum speed of [illegible] m.p.h. respectively. Greater economy in grade crossing protection could be attained without loss of safety on the low-speed lines, but even on the higher speed lines there is room for a greater departure from [illegible] standards. Gates and gatekeepers should be employed less extensively, adequate protection being afforded by speed limits, whistle boards, cattle guards and warning signs.

Light Railways and Road Motors—In comparing the economic values of road motor and light railway service, individual cases must be considered on their merits. A road motor service may be a desirable alternative, and no light railway should be authorized where such a service is equally suitable and is likely to be established within a reasonable time. The policy should be to aim at co-operation rather than competition between light railway and road motor projects.

Other Conclusions—A new conception of the character and functions of a light railway is necessary. Light railways differ essentially from main lines and must depend for success upon the adoption of different standards of construction and operation. A lower standard of speed is a first essential. The poor financial results obtained from light railways in Great Britain have not been due to failure to exercise economy in operating expenses, but rather to the smallness of the earnings in relation to the capital involved.

Safety Provisions

Requirements as to signals, switching, etc., should not be relaxed in favor of the higher speed lines, but on the lower speed lines signals should not be required. Fencing should be provided only where local conditions, including the speed of trains, render it essential. Protection of crossings by gates and gatekeepers should be similarly limited. Where a road and light railway intersect, a bridge should not be provided except where it would be more economical than a grade crossing or where other conditions render a bridge essential. Undue weight should not be given to arguments presented by local authorities for bridges in place of grade crossings.

Station accommodations for passenger traffic should be simple shelters, except at important stations. Halts should suffice at wayside places. Tickets, fares and parcels traffic should be dealt with by the train conductors. Station facilities for freight traffic should be closely adjusted to the requirements. Economy in rolling stock should be obtained by standardization of types and parts. Economy may be effected, and traffic increased by the use of steam or internal-combustion rail-motor cars for passenger service. Greater economy in maintenance and operation is desirable. Existing facilities for the handling of traffic should be improved, as by the extension of sidings at stations and exchange points. In this respect the co-operation of the main-line companies would benefit both the light and main-line railways.

Saturated Bank Causes Turkey Creek Cave-In

A CAVE-IN of about 1,000 cu.yd. of the west embankment of Turkey Creek, Kansas City, Mo., occurred recently. Ultimately the creek will be put into the double-concrete sewer described in the *Engineering News-Record*, Nov. 17, p. 815. Water from a broken 4-in. service main saturated the sandy loam back of a loose-laid riprap wall. The operation of a heavy crane back and forth over this bank of the creek started the leak or break in the main, in the opinion of the engineer of sewers, Paul H. Hartung. When sufficiently saturated the embankment slid into the creek, carrying with it the tracks of the St. Louis-San Francisco, and Missouri, Kansas and Texas railroads. A limited of the "Frisco" was stopped just in time to prevent its plunging into the slide as no one saw the accident which occurred between 9 and 11 p.m. A pile trestle has been built across the depression and Mr. Hartung stated that progress on the sewer has not been affected to any great extent.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

A. A. E. in Baltimore Favor Licensing

Sir—In the *Engineering News-Record*, issue of January 19, p. 129, there appears an article entitled "Engineers Club of Baltimore Opposes Licensing." In the body of this article the following statement occurs: "The meeting was of a very representative character, including local members of the American Society of Mechanical Engineers, American Institute of Electrical Engineers, American Society of Civil Engineers, American Chemical Society and the American Association of Engineers."

This article is misleading in that it intimates that the American Association of Engineers is opposed to licensing, which is not a fact. It was the father of the original licensing bill in Maryland two years ago and any members (and they were very few) of the Baltimore Chapter, A. A. E. at the above meeting were, I am sure, in favor of licensing, and if they were opposed the expressions of opinion were as individuals and not as members of the A. A. E.

Baltimore, Jan. 21 B. L. CROZIER,
Secy., Baltimore Chapter, A. A. E.

For and Against a Small Dam

Sir—The writer has noted with considerable interest, an article in *Engineering News-Record*, Dec. 22, 1921, p. 1018, "Two Small Dams Good Examples of Amateur Engineering," especially that part of the article which was furnished by Gale Dixon, chief engineer of the Bureau of Water Works Improvement, of Akron, Ohio. The writer is the Secretary-Treasurer of the Wycoalin Club Co., building this dam.

The owners of the "unsafe mill dam," to which Mr. Dixon refers, brought a suit of injunction to prevent us from constructing our dam, relying principally upon an attack as to its stability. A temporary injunction was granted, pending the hearing of the case. At this juncture Mr. Dixon was employed by the owners of the "unsafe mill dam" as an expert witness and counselor to condemn our structure. After a trial which lasted for nine days, the judge dismissed the injunction with a minor suggestion with which we gladly complied.

In the deductions which Mr. Dixon draws, he ignores supplements to the plans and specifications which were made prior to his injection into the suit and to which he had access during the trial. The dam is not yet completed, but the work is progressing and it will be completed in the early spring.

It seems to me it would have been a very gracious thing for Mr. Dixon to have done in the interest of candor and sincerity, in making his report, to have stated that his engineering skill and technique had been rejected by the Court, and he might then, after having stated the facts fully and frankly, have said with some degree of consistency, that the dam was not designed or being built according to the most advanced engineering practice, as no profession for such a structure was advanced by our club.

Mr. Dixon's statement as to the valley floor at the dam site, having a "surface layer of some 14 ft. of soft muck and silt overlying gravel and sand," was entirely out of keeping with the testimony of all the witnesses in the case (himself included) that this clay, muck and silt valley floor reached down from 3½ to 5 ft.

Our plans and specifications were drawn by Major W. A. Wolffe, now of the Department of Public Works, Pittsburgh, Pa., a practical engineer with an experience covering twelve or fifteen years; they were submitted to the Superintendent of the Board of Public Works of the State of Ohio, his chief engineer and the canal land agent, all practical engineers of long experience, who even made a trip to the site of the dam in investigating the application of the plans and specifications, and whose depositions approving same were submitted at the trial; and the plans of our dam were supported in every major particular by the opinions of several engineers to whom they were submitted. C. W. STUART,

Massillon, Ohio, Jan. 20. Secretary-Treasurer,
The Wycoalin Club Company.

[This letter was submitted to Mr. Dixon, who has replied as follows: EDITOR].

Mr. Stuart's identification of the structure which I described is accurate.

The thickness of the layer of "clay and swamp muck" overlying the "gravel" at the dam site is shown correctly in the sketches as 4 ft.; in the third line of the left-hand column of page 1019 the thickness of "soft muck and silt overlying the gravel and sand" appears as 14 ft. through a typographical error. If you will refer to your copy, I believe you will find that I changed the original figure from 6 ft. to 4 ft. in blue pencil. [Mr. Dixon is correct.—EDITOR.]

The generic points of interest to hydraulic engineers in this case are three in number:—

(1) The use of a spillway design which at first glance might appear simple and economical, but which if conservatively designed in all its component parts would actually be more expensive than the more usual types.

(2) The lack of the precautions which a long and bitter experience has demonstrated to be necessary to successfully hold water by an earth dam on soft foundation.

(3) The decision of an eminent jurist—to be precise, Judge E. D. Fritch of the Summit County common pleas court—in an injunction suit that was brought against the construction of this dam, from which the following full paragraph is quoted:

"Criticism has been made of the release pipe, and especially owing to the fact that it has a gate valve at the lower end. I might say, in that connection, that the Court has no difficulty in finding, in this case, that this dam is not being constructed according to the most advanced engineering ideas on that subject, not in any respect, but the departures from that are not so great, in the judgment of the Court, as to warrant the interference, by way of injunction, except, possibly, in one particular, which I will discuss. On the other hand, the Court does not find that it has authority to compel the construction of the dam according to the most advanced engineering practice, but it might be advisable if the Court or some public body had that authority in this state to require structures of this kind to be built according to the very best sort of practice but the Court does not find that it has authority to enforce anything of that kind." GALE DIXON.

Akron, Ohio, Jan. 26.

More on Sand Shifting Preventives

Sir—Commenting on R. A. Hill's letter on grass as a sand-shifting preventive in *Engineering News-Record*, Jan. 5, p. 32, I had an interesting experience in which sage brush figured in the construction of a railroad and pipe line across the Sinai Desert from Egypt to Palestine—200 miles of shifting, drifting sand, and a region wherein rain was comparatively unknown. We revetted the foundation for both railroad and pipe line with cut sage brush, which grows up to a height of about 12 in., in order to prevent the sand from shifting and covering up the railroad tracks, and in order to prevent the pipe line covering falling off in storms. Although the desert is practically without rain there are heavy dews, and some mist, and it was found that the sage brush absolutely prevented the drifting of sand and actually took root and bonded itself and the surrounding material into a perfect revetment.

I have reason to believe that despite the terrific sand storms which occur in this desert, at times piling up drifts 10 ft. deep, that the railway and pipe line mentioned above, which were left by us at the close of the war three years ago, are still intact and in good shape and the sage brush revetment has so grown that it is now a permanent preventive of drifting sand. T. W. FAIRHURST,

Vancouver, B. C., Jan. 17.
Sales Engineer, Vancouver Machinery Depot, Ltd.

NEWS OF THE WEEK

New York, February 2, 1922

Wood Preservers' Association Meets in Chicago

Adopts Wood-Stave Pipe Specifications —Service Test Results for Bridges, Piles and Ties.

Convinced of the benefits of present methods of preventing decay and natural destruction of wood, the American Wood Preservers' Association, at its annual meeting Jan. 24-26 in Chicago, emphasized the need for the responsibility of the organization reducing the enormous waste in timber and increasing the comparatively small amount of wood—4 per cent out of 50 million feet—that is treated. Treatment now limited chiefly to cross ties, the association maintains, should be extended to such fields as car lumber and buildings, where practically no preservatives are utilized. Preservation for 20 per cent of the 50 billion feet, instead of 4 per cent, is the organization's goal.

Scope of Program

R. H. Aishton, president of the American Railway Association, in the opening address, startled the members when he told them that they needed a publicity agent to sell waste prevention by wood preservation to railroad executives. Apparently he had not heard that a well-equipped service bureau of the association, with a director and office force, was organized months ago and is now besieged with calls for lectures at colleges and engineering meetings; that 80 per cent of the dues of members go into publications of proceedings and bulletins; that car sills and floors are being treated on the Burlington; that wood-stave pipe treatment is now a success; that Douglas fir can now be treated successfully since "needling" or perforating had been perfected; that the experimental stage of treating mine timbers had passed and actual every-day use was an economy; that 80 per cent of the destruction of piles from marine borers in San Francisco Bay was due to misuse and injury in handling treated piles rather than to inefficiency of treatment; and that sodium flouride could be used on floors and house lumber. All of these facts were brought out at the meeting. Mr. Aishton should have stayed.

Other subjects of interest to the engineer included a proof of the solubility theory as the mechanism by which toxic properties are carried by oils into wood; tentative new wood and flooring specifications; a new vacuum drying method; the feasibility of introducing tropical ties into the United States; and a resolution passed unanimously protesting against the proposed change of the U. S. Bureau of Forestry from the Department of Agriculture to the Department of the Interior.

As a joint meeting with the Western Society of Engineers, A. F. Robinson, bridge engineer, Santa Fe System, gave a historical sketch of his road's experi-

(Continued on p. 210)

Roof Collapse of Washington Theater Kills 95 Spectators

Failure Occurs During Performance at Time of Heavy Snowstorm—No Evidence of Overloading—Main Members of Framing Not Broken or Buckled—Unseating of Truss From Wall Support Suggested by Displaced North Wall

Collapse of the roof and part of the balcony of the Knickerbocker Theater, a large moving-picture house in Washington, D. C., during a performance on Jan. 27, killed 95 persons and injured nearly 200 others. The accident occurred about 9 p.m., shortly after the beginning of the performance. A phenomenally heavy snow-storm was raging at the time, and the house was only partly filled; the attendance is said to have been about 500. Rescue work had to contend with great difficulties because of the snow-clogged condition of the streets, but was so efficiently organized by the Engineer Commissioner of the District, Col. Charles Keller, that the wreckage had been thoroughly searched by noon the following day and by evening practically all the débris had been removed, the tangled steelwork having been cut apart by torches during the rescue work.

Excessive weight on the roof from the heavy fall of snow was at first thought responsible for the failure, but examination of the wreckage by a representative of *Engineering News-Record* revealed no evidence of overloading or primary failure of a main carrying part. Investigations are under way by the Bureau of Building Inspection, the District Attorney and other local authorities, and positive statements of conditions and causes cannot be made at present. The following statements are given as results of a preliminary survey of facts and conditions, and represent merely the probable deductions from this survey.

Type of Structure

The Knickerbocker Theater, located at 18th St. and Columbia Road, N. W., was a modern structure with tile main walls, steel framing of balcony, roof and service floors, and reinforced-concrete floor and roof slabs. It was built about four years ago and has been in service since that time without exhibiting defects or instability so far as known. The architect was R. S. Geare, and the steelwork was designed by J. H. Ford, of the Union Iron Works, both of Washington. The builder was Frank L. Wagner. So far as can be learned at the moment the loads and stresses for which the structure was designed were safe and in accord with good practice. Officials of the Bureau of Building Inspection state that to their best knowledge it was constructed according to the approved plans and in satisfactory workmanlike manner.

The structure occupies a roughly triangular plot at the acute angle formed by 18th St., which runs north and Columbia Road, which runs northeasterly and curves toward the intersection. At the sharp corner formed by the street intersection is the stage; the rear of the main seating floor and balcony extends along the southerly

Harding Would Limit Federal Aid to $75,000,000 Yearly

That the federal government's annual contribution to the federal-aid fund be limited to $75,000,000 per annum for the present is the wish of President Harding. He expressed this desire when members of the House Committee on Roads called at the executive offices to discuss with him the legislation which would carry the authorization for the appropriations for the four-year period beginning July 1, 1923.

Rivers and Harbors Congress to Meet in March

The National Rivers and Harbors Congress will hold its seventeenth convention at the New Willard Hotel, Washington, D. C., March 1 and 2. The evening session on March 1 is to be devoted to a discussion of the proposed St. Lawrence River project. The secretary of the congress is S. A. Thompson, Colorado Building, Washington, D. C.

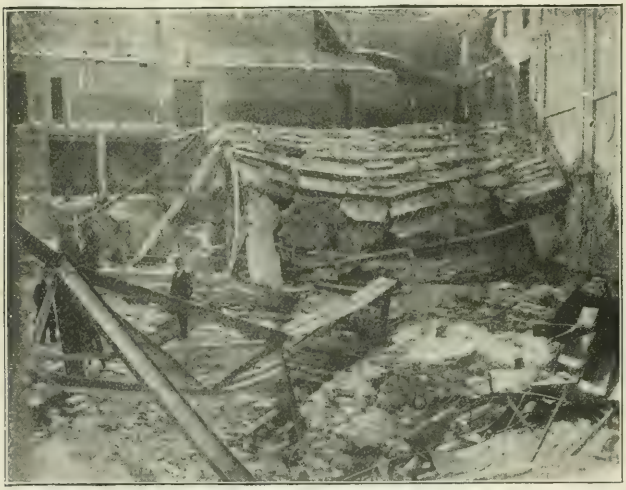
Questionnaire on Sewage Disposal in State of Indiana

The Engineering Division of the Indiana Conservation Department is sending out a sewage disposal questionnaire to the municipalities of the state. Maps showing the pollution of various streams will be prepared. John C. Diggs is sanitary engineer and Richard Lueber is director of the department.

New York City Plans Triborough Bridge

An appropriation to pay for surveys and borings for a bridge connecting Manhattan, Bronx and Queens boroughs, New York City, has been requested of the city's financial authorities by the Department of Plant and Structures. The bridge as proposed would extend from 125th St. and First Ave., Manhattan, to St. Ann's Ave. and Southern Blvd., Bronx, and thence to Second and Potter Aves., Queens, and would be about 15,000 ft. long. At present there is no connection from Manhattan to [illegible] Island north of the Queensboro bridge except one ferry line.







Inside the Theater After the Collapse

Upper—Looking Northeast Along the Curved Tile Wall on the Columbia Road Side. Northerly Auxiliary Truss (see text) Trailing from Wall to Floor.

Middle—Looking South Toward the Rear Wall and Part of Balcony Still in Place.

Bottom—Looking West Toward the Columbia Road Wall and the Part of Balcony Still in Place.

wall, which is shaped to an arc about the stage corner. Thus the seating space converges toward the stage, its left wall being formed by the curved wall along Columbia Road, while its right wall is parallel to 18th St., and is separated from the street wall by a lobby space 10 or 15 ft. wide.

Type of Framing

To suit this irregular ground plan the roof framing centered about a main truss some 55 ft. in span, 5½ ft. deep, running parallel to 18th St., about 56 ft. west of the right-hand wall of the seating space. The north end of this truss rested on a seat in the Columbia Road wall, which wall formed a sharp angle with the line of the truss; its south end rested on a column (*A*) extending through the balcony and carrying part of the balcony framing. Three trusses spanned east to west between the main truss and the east wall, engaging it at the first, third and fifth panel-points of the six-panel truss. A shorter fourth truss, parallel to them and one bay south, spanned from the east wall to a second column (*B*) about 20 feet southeast of the main column (*A*), being framed into the column. An I-beam connected the tops of *A* and *B*. Column *B* also served as a balcony support. West of the main truss, three principal carrying members extended back to Columbia Road wall, being in line with the three trusses framing into the east side of the main truss. Of these three members, the two northerly ones were beams, the southerly one a truss. Thus the main truss was held by trusses on both sides, at a point only 8 or 9 ft. from the column; except for this stiffening in an east-west direction and the staying action of the main truss in a north-south direction, the top of the main column *A*, was unbraced. Filling the meshwork of this main framing were purlin beams running north and south, and upon these rested a mesh-reinforced concrete roof slab.

Where the trusses were supported on walls (north end of the main truss, and east ends of the secondary trusses), seats were provided consisting of one or two short I-beams, three or four to seven or eight feet long, built in the tile wall. The trusses merely rested on these seat-beams, but were not bolted or otherwise fastened to them. Beams resting on walls were in some cases supported by metal wall plates and anchored by single bent-rod anchors; in other cases they merely rested on the tile.

Of the roof framing none remains in place, but the northerly auxiliary truss is wedged between floor and east wall, though its east end is some distance below its original seat. The main truss, cut into seven or eight sections by the cutting torches of the rescuers, is on the floor; slightly east of its original position, and with its northerly end swung around somewhat eastward; just after the collapse it lay almost under

its position in the roof, but hanging on a corner of the balcony, moved some 10 or 15 ft. south of its true position and at its north end, which rested on the floor, swung to the east. The main column still stands undisturbed, up to a cover-plate splice just above the balcony floor; the upper part, partly twisted free at this splice, leaned over southward till it bore against the south wall. It was later dropped, so that now the cap touches the ground seven or eight feet from the foot of the column. The truss rested on top of this column and was fastened to it by six bolts.

The column cap was formed by an angle knee on each flange, one on each side of the web, the former having each two bolt holes and the latter one. The column was set with the plane of the web pointing toward the stage, and the truss therefore made an angle of about 45 deg. with the column axes. There was a severe wrenching between column and truss at some time during the collapse, as shown by a twist of the end of the bottom of the chord and the fact that the front knee of the column cap is bent downward and nearly torn off. The stub of one bolt, bent and torn off, remains in the truss chord flange.

The main truss itself shows no break and little distortion. It was quite stiff laterally, the flanges being made up each of two channels 12 in. x 20½ lb. set about ½ in. back to back, and a cover plate generally 12 in. wide. While the cover plates were not spliced where they changed thickness, the truss does not exhibit any buckling. Its sections show slight bends at the panel points, all representing a curve concave eastward (to the right), referred to the original position of the truss.

Column *B*, which had been removed with other débris to a dump, is bent at the level of the bottom chord of its truss, and completely doubled up on itself just below the balcony level, besides being torn apart at the splice above the balcony floor. Of two other balcony columns, the one near the north end is intact, but forced out of position by the crushing of the balcony overhang; the south one, found at the dump, is twisted and torn apart through the solid metal just below the bottom chord of the balcony truss framed into it.

North Wall Leaning

The north wall, which is the curved wall along Columbia Road, leans outward about 5 in. and is separated from the short diagonal proscenium wall at the stage by a crack extending to the bottom. It is not known whether this wall became displaced before or during the collapse, and it is not known whether it received a blow. The beams forming the seat of the main truss in this wall are still in place. The same is true of the seats of the secondary trusses in the east wall, but these have their upper flanges bent down as if the trusses pivoted on them sharply; the most marked appearance of this kind is at the second and third from the north, while the north one shows a grinding of the edges of the [illegible] chord at its tip.

Below, the northwesterly half of the balcony is still in place, with its front cantilever part broken down by bending of the cantilever trusses. The southeast half of the balcony is gone. No reason was found for concluding that the balcony failure was other than a result of the fall of the roof

> *Report on $60,000,000 Water Supply for Boston District*
>
> *A 400-billion gallon storage reservoir on the Ware River at Enfield, thirty miles from Worcester, Mass., and an aqueduct connecting the proposed reservoir with the Wachusett storage reservoir of the Boston Metropolitan Water District, at an estimated cost of $60,000,000, are recommended in the majority report of the joint board representing the State Department of Health and the Metropolitan District Commission submitted to the legislature Jan. 28. The report is signed by Dr. Eugene R. Kelly, commissioner of health of Massachusetts, and X. H. Goodnough, chief engineer of the Depart[illegible] of Public Health. A minority report by James A. Bailey, chairman of the Metropolitan District Commission, the third member of the joint board, maintains that the present water supply to the district would be sufficient until 1935 if resort were had to filtration (presumably of portions of the supply).*

Such eyewitness stories as were obtainable indicated that the collapse was noticed first at the front, over the orchestra. This is in a region covered by beam framing between the north secondary truss and the north wall. Since no local failure at this point could have affected the main framing, it is concluded that the failure here was a result of preceding displacement of the main framing. The appearance of the wreckage points to an unseating of the north end of the main truss, leading to the fall of this truss and the forward part of the roof, followed by destruction of the two columns and their subsidiary truss and beam framing; the balcony was then crushed down by the falling masses from above.

However, the stability of the column connections as being a possible source of the unseating movement is still receiving study, and none of the local authorities is yet willing to express an opinion on the probable cause of the disaster. It is believed that the snow weight, assuming rather more than 24 in. of light snow (water equivalent probably less than 2½ in.), did not exceed 12 pound per sq.ft., which is only half the 25-lb. live-load assumed in the design and only a small fraction of the dead-load.

Some attention has been given the pressure of a large ventilating hood on the front part of the auditorium roof, containing a large fan and motor. Vibration set up by this machinery has been thought possibly responsible for loosening the connections of the roof [illegible] presumably the connection of steelwork to walls. Up to the present, however, no definite knowledge as to the operating condition of this fan has come to light, or any indication that it did, in fact, set up unusual vibration. At present this suggestion seems to have little more foundation than similar talk of vibratory effects of street-car traffic in Columbia Road, supported by statements of nearby residents that their [illegible] to the car traffic.

The real trouble is unquestionably to be sought in the structure itself; and here, while some details may be criticized, especially the staying of the tops [illegible] the framing, but in view of [illegible] the north wall, —rather the walls and their support of the framework. Expansion and contraction movement of the steelwork are being considered as a possible cause of creep of the main truss on its wall support, leading to its final unseating.

Colorado River Conference at Washington

A propitious start toward an agreement as to the utilization of the waters of the Colorado River, to which the representatives of the several states directly concerned and of the federal government will subscribe, was made at the first meeting of the Colorado River Commission, which was held in Washington, January 26. Secretary of Commerce Hoover was elected permanent chairman of the Commission. An effort will be made to draw up what Mr. Hoover calls a charter for the development of the Colorado River. It is believed fundamental principles can be laid down for this development which will permit of unanimous recommendations to Congress and to the legislatures of the seven states concerned.

Secretary Weeks Submits Ford Offer for Muscle Shoals

[*Washington Correspondence*]

In submitting Henry Ford's Muscle Shoals offer to Congress, on Feb. 1, Secretary of War Weeks made no recommendations, but indulged in very significant comment. He pointed out that the project might prove unprofitable to Mr. Ford and that there should be some assurance that the contracts made will be carried out.

Secretary Weeks expressed the opinion that it would be better policy to limit the contract to a term of fifty years, so as to conform to the policy as set out in the water-power act. One hundred years is too long a time, he believes, in view of the unknown possibilities surrounding water-power developments and the probability of changes whichh may be made especially in the transmission of power.

In case the Ford offer is not accepted, Secretary Weeks urged that the Wilson Dam be completed by the Government. He believes the returns from the sale of power will be profitable and that the project carried forward by the Government ultimately will be more profitable to the public than would the acceptance of the Ford offer.

Secretary Weeks also made public an analysis of the Ford offer, by the Ordnance Department, in which Major General Williams, among other things, says the Ford offer, from the standpoint of the Ordnance Department, has the very important advantage of assisting materially in the development of nitrogen preparedness and has the disadvantages of conflicting with contractual obligations with the American Cyanamid Co., and the Alabama Power Company and of making a net return to the Government of less than $5,000,000 for properties which have an estimated salvage value of more [illegible]

Secretary Weeks pointed out that [illegible] is without authority to dispose of this property as a whole, and that it is peculiarly the province of Congress to weigh the [illegible]

Fauntleroy Appointed Highway Engineer of Texas

Capt. J. D. Fauntleroy, former district engineer, U. S. Bureau of Public Roads, with jurisdiction over Texas, Oklahoma, Arkansas and Louisiana, has been elected to succeed Rollen J. Windrow as state highway engineer of Texas at a salary of $9,000 per year. For the past five years, Capt. Fauntleroy has been the Federal Government's highway engineer representative with headquarters at Ft. Worth. He is a graduate of the Virginia Military Institute, and has been in the federal service since 1891. Prior to the Spanish-American War he was engaged in railroad engineering and served in both the Spanish war and the Phillipine insurrection. After leaving the army Capt. Fauntleroy engaged in highway work in the Phillipines for three years, two years in sanitary engineering, five years in the U. S. Reclamation Service and one year as manager of a construction company in Wyoming. He has been with the U. S. Bureau of Public Roads for the past eight years, five of which have been spent principally in Texas.

Canadian Engineers Hold Annual Meeting

Election of officers for the coming year, the establishment of three new chapters of the society, the presentation of technical discussions, and various social gatherings were features of the annual meeting of the Engineering Institute of Canada held at the Montreal headquarters of the society Jan. 24-25.

The officers elected for 1922 are: President, J. G. Sullivan, consulting engineer; and vice-presidents, Brig. Gen. C. B. Mitchell and Arthur Surveyer. Three new branches of the society were founded at Sydney, Nova Scotia, London, Ont., and Lethbridge, Alberta, respectively. Leading technical papers were: one explaining the design features of the latest hydro-electric development of the Shawinigan Water & Power Co., read by Julian C. Smith, a member of the institute and vice-president and general manager of the Shawinigan Water & Power Co.; and an illustrated lecture presented by Major Draper on the construction of the new St. John cantilever bridge.

The social features of the society's meeting included a visit to the Dominion Engineering Works at Rockfield, the annual banquet and a smoking concert.

Illinois Drainage Association Considers Legislation

At the annual meeting of the Illinois Drainage and Rivers Improvement Association, held at Springfield, Ill., Jan. 11 and 12, the most important matters discussed were the promotion of the drainage provision now before the state constitutional convention and the proposed creation of a state division of reclamation by the legislature in 1923. The papers included a review of what various states are doing to aid land reclamation, by G. W. Pickels, and a discussion of the economic benefits of such reclamation in Illinois, by Ivan Wright, University of Illinois. The president is A. L. Maxwell, Lawrenceville; secretary, G. W. Pickels, Urbana Ill.

Wood Preservers Convention

(*Concluded from p. 207*)

ence with treated timber in bridges which was replete with statistics and service records, successes, failures and difficulties.

A strenuous debate was precipitated by a paper by Earl Stimson, chief engineer of maintenance, B. & O. R.R., on the subject "Should the Increased Cost of Treating Ties be Charged to Maintenance or Capital Account?" From a practical standpoint and because of the enormous amount of recording necessary if charged to capital, the consensus of opinion seemed to favor charging to maintenance. However, a resolution was passed calling for a committee to take up the matter with the Interstate Commerce Committee.

A tabulation of 374 records on 38 species involving 923,000 ties was presented by the committee on service test records, of which S. D. Cooper, assistant manager, treating plants, Santa Fe System, is chairman. The records were compiled by the Forest Products Laboratory. In discussing the report Mr. Cooper said that when 60 per cent of the ties in a track had been removed the test was considered complete. The report stated that only completed tests should be published, a position to which J. H. Waterman, in charge of timber preservation, C. B. & Q. R.R., objected.

Wood-Stave Pipe Treatment

A specification for creosote treatment of Douglas fir wood-pipe staves was adopted and ordered sent to letter ballot. Staves dried to at least 20 per cent moisture are called for. Treatment is to be by the boiling-under-vacuum, empty-cell-process. While 8 lb. was written into the specification as the amount of oil to be retained, the association finally left the amount blank. A feature not put into the specification, but borne out by experiments reported in a paper by H. D. Coale, chief engineer, Continental Pipe Manufacturing Co., was that sapwood should not be considered a defect in staves to be treated, as in every case the sapwood was completely penetrated by the creosote oil.

F. D. Mattos, manager, treating plants, Southern Pacific Co., as chairman of the San Francisco Bay marine piling committee reported progress for the second year of a three-year progress. Ravages of the teredo continue but in diminished form as the unprotected material on which to work becomes less and the salinity of the upper regions got back to normal after the drought conditions. Biological tests are to be continued, the committee having obtained pledges of $30,000 for the three years' work.

A gulf coast marine piling survey has just been started with E. E. Boehne, manager, sales, International Creosoting and Construction Co., as chairman of the committee. Finances have not yet been arranged for.

Effect of Perforations

As to the reduction in the strength of fir poles due to perforating to obtain an even penetration, a committee on the subject headed by L. L. Hill, secretary, Page & Hill Co., held that a deep and uniform penetration is of greater importance and will more than offset any reduction in strength. No one has yet been found to put up the $10,000 to $15,000 necessary to make the strength tests. Spreading of creosote from perforations in cedar poles after treatment takes place to an appreciable extent according to results reported by J. D. MacLean and C. E. Miller of the Forest Products Laboratory.

Dry heat obtained from the heating system of a building was reported by Walter H. Snell, department of botany, Brown University, Providence, R. I. as sufficient to kill certain "dry rot" species; destruction of the "mill roof" types, however, required higher temperatures.

None of the recommendations, including specifications for non-pressure or open-tank treatment, of the committee on preservatives could be accepted as standards because they had not been sent out 15 days previous to the meeting. Instructions were given to revise the definition and specifications of creosote to conform to modern practice, in which the origin as well as test limits of fractionation be given due consideration. Studies of sodium-flouride tests will be taken up.

Wood Block Paving

Specifications for flooring and street paving were submitted for information. Features in the paving block specification are the recommended cushions, mortar cushions, bituminous paint coat cushions and dry concrete too. Only bituminous fillers are noted.

Walter Buehler, engineer of wood preservation, the Barrett Co., explained the desirability of maintaining old wood block paving by an application of hot light oil, followed in 24 hours by a covering the chips. At this point A. E. Larkin, manager, Republic Creosoting Co., attempted unsuccessfully to reopen the age-old controversy relative to the merits of high-boiling and "adulterated" oils. "Explanations are of no use, a condition and not a theory confronts the engineer in charge of pavements," said Mr. Buehler. L. T. Ericson, chief engineer, Jennison-Wright Co., chairman of the paving and flooring committee, reported on the organization and preliminary work of the joint committee on wooden highway bridge design which has under consideration as its first problem the design of a more fire-resistant structure.

Nearly 300 members and guests registered at the convention. Next year's meeting will be held at New Orleans. It is proposed to increase the present membership of 407 to 1,000 during the year. The newly elected officers are as follows: President, F. J. Angier, vice presidents, W. H. Grady and H. S. Sackett; secretary-treasurer, George M. Hunt, Forest Products Laboratory, Madison, Wis.

Los Angeles Union Terminal Plan Before Supreme Court

The California railroad commission has extended the effective date of the Los Angeles union terminal decision pending action by the Supreme Court on an appeal for a writ of review made by the Southern Pacific, the Santa Fe and the Salt Lake Railroads. Announcement of the commission's decision appeared in *Engineering News-Record*, Dec. 22, 1921, p. 1039.

Federated Societies Plan Active Year

To Expand Work in Hand — Water Power Act and Patent Office to Receive Especial Attention

An indication of the faith which the Executive Board of the American Engineering Council has in the Federated American Engineering Societies was had at the recent meeting in Washington when a number of the representatives of member societies pledged that their organizations will refund to the Council the proposed discount on the assessment for 1922. (See *Engineering News-Record*, Jan. 12, p. 85.— Members of the Board and Council were outspoken in their endorsement of the work done during 1921. The intention to refund the discount is to enable the Federation to expand its activities.

In addition to the detailed accomplishments of the year, the opinion was expressed at the Council meeting that the 1921 work had crystallized the aims and purposes of the Federation to the point where much more in the way of concrete accomplishment may be expected in 1922.

During the coming year a study will be undertaken of the Water Power Act and its application, so that suggestions may be made as to its administration and amendments to the Act itself proposed if it should be decided that the fundamental law can be improved.

WORK CONTEMPLATED

The Executive Board authorized the American Institute of Agricultural Engineers to conduct an investigation of waste in agriculture. The Federation expects to render active assistance in the study of intermittency in the coal industry, which is being undertaken under the immediate auspices of the Unemployment Conference.

Every resource of the Federation is to be brought to bear immediately in an effort to secure legislative relief for the Patent Office; to secure an embargo on dyes and to secure authorization for the appropriations to carry into effect the plan of the U. S. Geological Survey for the completion of the topographic map of the United States.

The principal accomplishments of the Federation during 1921 were cited as follows:

Elimination of waste report.

The securing of employment for 1,221 engineers during the first eleven months of 1921.

Securing the publication of over 500 articles pertaining to the activities of the society.

Legislative activities which involved at least a study of the following measures: the Patent Office relief; topographic map of the United States; commissioned status for sanitary engineers of the United States Public Health Service; Department of Public Welfare; cyclical depressions; Federal road act; waterpower act; Muscle Shoals project; reclassification and compensation of engineers in government service; tariff on petroleum; embargo on dyes; war minerals liberalization; Winslow refunding bill; Ladd metric system bill; forestry legislation; St. Lawrence waterway; Department of Public Works, and general executive reorganization.

Participation in such conferences as: Elimination of excess variety of paving brick; standardization of contracts and specifications in the construction industry; Fall letting of highway construction contracts; unemployment conference; census statistical conference; Board of Surveys and Maps.

Continued study of problems involved in the licensing of engineers and participation in hearings in a number of states.

Addresses before numerous engineering societies.

Stimulation of interest among engineers of foreign countries which has led to the formation of federations of engineering socities in six countries and paving the way for an international federation.

Study of continuous process industries.

Progress toward the more definite establishment in the public mind of the place and prominence of engineers in modern civilization.

Establishment in the minds of federal legislative and executive officials that they now have a definite point of contact with engineers as a whole.

Missed Shot on Hetch Hetchy Tunnel Kills Three

A drill struck a "missed shot" on Jan. 9 in Priest Portal of the Hetch Hetchy tunnel, which is being driven as part of the water supply project for San Francisco, and the resultant blast killed three men and injured four others.

The men were drilling at the heading, which is about 2½ mi. from the Portal when they struck a powder charge placed by the preceding shift but which had failed to explode. The men had been warned of the danger, according to other members of the shift, and were proceeding with caution when the accident occurred.

Asphalt Association Opens District Office in Atlanta

J. E. Pennybacker, secretary of the Asphalt Association, New York, announces the appointment of James R. Valk as district manager for the association with headquarters in Atlanta, Georgia. Mr. Valk has had a long experience in all phases of asphalt work. His attention will be devoted principally to Georgia, South Calorina and Florida, and he will co-operate closely with H. P. Grier who represents the association in North Carolina.

Arkansas Water-Power Plant Well Under Way

One of Largest Installations in Central Southwest Will Have Three 5,000-kw. Units

One of the largest hydro-electric plants in the central Southwest is now being built on the Little Red River, about 6 miles northwest of Judsonia, Ark. It is known as Plant No. 1 of the Arkansas Hydro-Electric Development Co. and will have a present installation of three 5,000 kw. units, with a final development of 70,000 hp.

The drainage area above this point is 1,400 square miles, about 40 per cent of which lies within the Ozark National Forest and 80 per cent of which is unfit for cultivation and likely to retain its forest cover for many years. The dam will be of the hollow concrete type, 825 ft. long at the gate crest and 80 ft. high. The average working head will be 70 ft. There will be fourteen Taintor gates 26 ft. wide by 18 ft. high with provision for 5-ft. flashboards. These flashboards will be used until additional storage is available from dams constructed above. The total usable storage about Dam No. 1 with flashboards is 7,000,000 K.W.H.



BEGINNING COFFERDAM ON LITTLE RED RIVER, ARK., FOR NEW WATER POWER PLANT

Construction was started last June and is expected to be finished next summer. Stone for the concrete is taken from a quarry adjacent to the site by a derrick and lifted to the platform above the rock crusher, after which it is elevated to a revolving screen. This screen separates two sizes of rock and sand. The tailings from the screen go back to a disc crusher which will make the sand to be used in the concrete. From this crusher, the sand is delivered to the same elevator and delivered to the sand bin. From the sand and stone bins, small cars will deliver this material to the bins above the one-yard concrete mixer passing under the plane of the two cableways which span the river.

From the cement house, which holds 60,000 bags, the cement is delivered by gravity to the platform above the concrete mixer. From this mixer, the concrete is delivered to buckets on cars which run by gravity back under the plane of the cableways on which they are carried to the point of deposit. It will require some 800 tons of reinforcing steel and 35,000 bbl. of cement for the dam and power house.

All rough lumber for buildings, cof-

ferdams and forms is obtained a short distance above the dam from timber in the basin and this is furnished by a sawmill which is moved from one timbered tract to another as required.

The contractor is J. Livingston & Co., Inc. of N. Y. The Engineers are Dickinson & Watkins, Little Rock. J. E. Sirrine & Co. of Greenville, S. C., are the consulting engineers.

New Jersey Highway Commission to Hold Convention

The second annual convention of the New Jersey State Highway Commission is to be held in Trenton, Feb. 15-18, inclusive. Invitation to attend the sessions is extended particularly to county and municipal officers, contractors, material men and equipment dealers.

Water Power League to Meet

The Water Power League of America is to hold a power conference at the Engineering Societies Building, New York City, Feb. 7 and 8. The main questions to be discussed are the proposed superpower system for New England and eastern United States, financing water-power projects independent of interests which now seem to control, the development of the St. Lawrence River, and the amendment of the Federal Power Act. The secretary of the League is Frederick L. Long, 116 Nassau St., New York City.

Civil Engineering Research To Be Developed

In order to promote research in civil engineering and the dissemination of knowledge of the results brought out by such research, the American Society of Civil Engineers has established a committee on research, organized under the chairmanship of Prof. A. N. Talbot, Urbana, Ill. It has also established an advisory committee on civil engineering to the National Research Council, Division of Engineering, at the request of Alfred D. Flinn, chairman of the division. The activities of this Advisory Committee will relate to such research problems in civil engineering as embrace several fields or organizations, and such problems of research in other fields as involve civil engineering and therefore require the co-operation of representatives of civil engineering.

The society's Committee on Research is expected to deal with problems of civil engineering research within the field of the society itself. Its appointment resulted from recognition of (1) the fact that the field of civil engineering contains many unsettled questions and presents new problems from day to day, many of which demand investigation by research; (2) the relative scarcity of research in this field and the desirability of promoting and stimulating it; and (3) the possibility of furthering the spread of knowledge of the results of research by establishing a central agency through which any required functions of counsel, organization, coordination, and publication can be dealt with. Prof. Talbot states that the committee hopes to interest the entire membership of the society in the need for and the value of research and adds that correspondence concerning the committee's work may be addressed to him or to the secretary, F. E. Schmitt, 10th Ave. at 36th St., New York.

New Texas Motor Vehicle Law Becomes Effective

According to the Johnson motor truck bill, which became effective in Texas Jan. 1, 1922, the annual license fees on commercial vehicles range from $30 on a 1½-ton truck to $150 on a 5-ton truck equipped with pneumatic tires, and from $36 to $180, respectively, for trucks with solid rubber tires. For trailers or semi-trailers equipped with pneumatic tires, the fee is to be 15 cents per hundred pounds of the net weight, plus the carrying capacity; and for trailers and semi-trailers equipped with solid tires, 25 cents per hundred pounds of the net weight, plus the carrying capacity. For those equipped with iron, steel or other hard-material wheels, the fee is to be 35 cents per hundred pounds of the net weight, plus the carrying capacity. Tractors will be registered at from $5 on tractors weighing 2,000 lb. or less, up to $25 for those weighing between 8,000 and 10,000 lb.

Owners of passenger vehicles are required to pay the regular 35 cents per horsepower rating, and $1 for each passenger the vehicle will seat in excess of seven. Trucks with a carrying capacity of one ton or less and all trucks used exclusively for agricultural purposes shall pay the regular 35 cents per horsepower rate and are subject to the same law which governs commercial vehicles. No motor vehicle with a greater carrying capacity than 8,000 lb. shall be registered without special permit.

Other features of the bill are that no motor vehicle equipped with solid rubber tires shall be operated upon the highways if the rubber is less than one inch thick; that the road superintendent is given authority to post notices stating the maximum load which can be carried over the road during wet weather or after recent construction, or when bridges or culverts are unsafe; that persons guilty of negligence that leads to highway's damage shall be liable to the county for such damages; and that all commercial motor vehicles, tractors and trailers shall register according to the manufacturers' rating.

New President of Engineering Institute of Canada



JOHN G. SULLIVAN

John G. Sullivan Heads Canadian Engineers

Long Identified with Railway Work—Now Consulting Engineer for Canadian Pacific Ry.

John G. Sullivan, who was elected president of The Engineering Institute of Canada for 1922 at the annual meeting held in Montreal, January 24 and 25, brings to the office the experience of thirty-four years spent in the West, combined with that spirit of optimism and enthusiasm which characterizes men of the western provinces.

Mr. Sullivan was born at Bushnells Basin, New York, January 11, 1863, and at the age of twenty-five was graduated from Cornell University with the degree of C.E. He then became associated with railway development in the West, at which he remained for years in many and varied capacities with the Great Northern Ry. in Montana, Dakota and Minnesota, and with the Spokane Falls and Northern Ry. Later he was associated with the Great Northern Ry. system in charge of work as assistant engineer on the Seattle and Montana Ry., and in charge of work on the Pacific extension of the Great Northern Ry. In 1893 Mr. Sullivan became assistant engineer in charge of work with the Alberta Ry. and Coal Co., and the following year locating engineer with the Butte, Anaconda and Pacific Ry. Co.

In 1895 Mr. Sullivan was made locating and division engineer with the Kaslo and Slocan Ry Co., British Columbia. For the next four years he occupied various positions with the Columbia and Western Ry. Co.

In August, 1900, Mr. Sullivan joined the Canadian Pacific Ry. as divisional engineer of construction, and with the exception of a year and a half as assistant chief engineer of the Panama Canal, his association with the Canadian Pacific Ry. has been continuous up to the present time. In February, 1907, Mr. Sullivan was made manager of construction of Eastern Lines, and a year and a half later was appointed assistant chief engineer. In 1911 he became chief engineer of Western Lines, occupying that position and that of chief engineer up to 1918, since which time he has been retained as consulting engineer.

His previous association as an officer of the Institute includes councillor on two different occasions, and vice-president. Mr. Sullivan became a member of the Institute in 1900, having been elected a member of the American Society of Civil Engineers the year before. In 1918 he was president of the American Railway Engineering Association and is the chairman of the Manitoba Drainage Commission. He is a member of the Manitoba and St. Charles Country Clubs, Winnipeg, St. James Club, Montreal, and Cornell University Club, New York City.

International Railway Association to Meet in Rome

The International Railway Association is to resume its triennial meetings, which were omitted during the period of the war. The next session will be at Rome, Italy, from April 18-30, 1922. The secretary of the Permanent Commission of the Association is J. Verdeyen, 17 Rue de Louvain, Brussels, Belgium.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN CONCRETE INSTITUTE. Detroit, Mich.; Annual Convention, Cleveland, Ohio, Feb 13-16.
AMERICAN RAILWAY ENGINEERING ASSOCIATION. Chicago; Annual Convention, Chicago, March 14-16.
AMERICAN WATER WORKS ASSOCIATION. New York City; Annual Convention, Philadelphia, May 15-19.

The National Highway Traffic Association will hold a public meeting on Feb. 14 at 8 p. m. at the Automobile Club of America, New York City. The subjects for discussion are: Adequate Parking Facilities for Passenger and Commercial Motor Vehicles; Segregation of Slow Moving Traffic and Relief Measures for Terminal and Ferry Congestion. Dinner will be served at the club at 6:30. Reservations can be made through the secretary of the Automobile Club.

The Topeka Engineers' Club held its annual meeting and banquet on Jan. 24. Officers were elected for 1922 as follows: President, A. B. Griggs; first vice-president, F. W. Epps; second vice-president, Ray Finney; secretary W. L. Lammers; treasurer C. A. Funchess.

The New York Section Am. Soc. C. E. at its February 15 meeting will discuss the "Removal of Solid Wastes." The opening address will be by John P. Leo, Commissioner of Street Cleaning, New York City.

The Rochester Engineering Post, American Legion at a recent meeting elected officers for 1922. President, Ray M. Robinson; first vice-president, Allen Martin; second vice-president, Harold B. McElwain; secretary, George Strickland; treasurer, Clayton Hutchins.

The New Jersey Sewage Works Association will hold its annual meeting on Feb. 17 at 10 a. m. in the State House, Trenton, N. J.

The Engineering Society of Buffalo will hold its regular monthly meeting Feb. 14. Ralph H. McKee, professor of chemical engineering, Columbia University will deliver an address on "Gasolene from Oil Shale."

PERSONAL NOTES

CHARLES COSTIGAN, formerly county engineer of Summit County, Ohio, has become a member of the new Metropolitan Construction Co. in Columbus. The firm will specialize in bridge and road construction.

W. J. H. FOGELSTROM and H. V. JOHNSTON have opened offices in San Francisco for the practice of engineering. Mr. Fogelstrom was formerly structural engineer for the Southern Pacific Co., the Atchison, Topeka & Santa Fe Railway Co. and the Alaska Government Railway. Mr. Johnston was assistant engineer for the California Railroad Commission and chief engineer for the Sacramento Valley West Side Canal Co.

JOSEPH M. TRACY has resigned as city engineer of Ogden, Utah and W. S. Craven has been appointed to take his place.

H. R. F. HELLAND, for the past two years city engineer of Waxahachie, Texas, has entered an engineering partnership with his father, Hans Helland, who was formerly city engineer of San Antonio, where the firm has its offices. Mr. Helland was in France for a year during the war and was Commissioned Captain of Engineers.

OSCAR A. PIPER, who has been connected with the Seattle city engineer's department since 1908, with the exception of two years spent in the army during the war, has been appointed superintendent of streets and sewers for the city of Seattle.

HARRY A. KLUEGEL, until recently construction engineer in the Quartermaster corps, U. S. A., has been named chief of the division of water rights for the state of California.

HON. WILLIAM C. KENNEDY, gas and oil operator of Windsor, Ont., has been appointed minister of railways and canals for Canada.

JAMES COSTELLO has been appointed division superintendent in the county road department, Allegheny County, Pa.

FRANK C. LINGENFELTER, city engineer of Indianapolis, has resigned after serving in the city engineer's office in various positions for fifteen years.

H. W. MIXSELL, formerly construction engineer for the Bath Portland Cement Co., Bath, Pa., has been appointed town engineer of Phillipsburg, N. J., succeeding C. J. Tilton, resigned.

VICTOR H. COCHRANE, formerly of Hedrick & Cochrane, Kansas City, Mo., has resumed his practice as consulting engineer, in Tulsa, Oklahoma.

GERMAIN P. GRAHAM, former deputy city engineer of Albany, N. Y., has been appointed district engineer for the Asphalt Association in New York, Quebec and Ontario.

COL. JAMES W. EVERINGTON, U. S. A., retired, has been appointed chief of police of the city of Los Angeles, Cal. Col. Everington was formerly engineer of maintenance for the Great Northern Railway.

A. G. HUSTED has resigned as assistant sanitary engineer with the department of public service of the city of Cleveland, Ohio, to become assistant sanitary engineer of the sanitary engineering district of Cuyahoga County, Ohio.

G. N. MILLHAM, division engineer, state highway department of Alabama, has been elected president of the Montgomery chapter, A. A. E.

C. [illegible] R. GOODRICH has been [illegible] commissioner of public works by the recently inaugurated mayor of Utica, N. Y. Mr. Goodrich is a graduate in civil engineering, Cornell University, class of 1905, and [illegible] graduation has been engaged [illegible] engineering work. He early [illegible] connection with the [illegible] Water and Sewer Board, [illegible] Water and Sewer Board, [illegible] Water and South Lakes [illegible] was connected with power house work around Albany and with the construction of the Barge Canal from the contracting end. He has also had experience in mining in the Southwest and as a construction superintendent for James Stewart & Co. in the Middle West and Southwest. For the last six years he has been with the Vale Engineering Co. of Utica, engaged in the design and construction of reinforced-concrete buildings and the construction of concrete roads.

JOHN L. STANAGE, engineer and contractor, Milwaukee, Wis., has opened engineering offices in Oconomowoc, Wis.

CONRAD HANSON has been appointed highway commissioner for Douglas County, Wis., succeeding C. D. Conker, Jr., who has resigned to enter private practice in Los Angeles, Cal.

HARRY S. WRIGHT, formerly field superintendent with the Aberthaw Construction Co., has become associated with the Portland Cement Association as structural engineer covering the New England territory and having headquarters in Boston.

A. E. DOUCET, director of public works, Montreal, Quebec, has resigned, effective Feb. 1.

W. L. MCDOUGALD of Montreal, director of the Canadian Steamship Lines and president of the Ogdensburg Coal and Towing Co., has been appointed chairman of the harbor commission of Montreal.

CHARLES W. SPOONER, consulting valuation engineer, and ROBERT W. MERRILL have organized the firm of Spooner & Merrill, consulting engineers, with offices in Grand Rapids, Mich. Mr. Merrill has recently returned from a 3-year engagement in China at work on the Grand Canal under Joseph Ripley, chief engineer of the Grand Canal Improvement Board, and Col. Thomas H. Wiggin, in charge of canal structures.

BUSINESS NOTES

ROYALL D. BRADBURY has become associated with the Wickwire Spencer Steel Corporation as sales manager of the structural products department with headquarters in the Worcester office. Mr. Bradbury was formerly instructor in structural engineering in the Massachusetts Institute of Technology, afterward becoming connected with the Clinton Wire Cloth Co. as consulting engineer and later as vice-president of that company.

GEORGE P. SHUTE, manager of the Portsmouth (Ohio) water-works, has resigned to become general manager of the Shute Co., of Columbus, Ohio, mining and manufacturing clay products.

C. I. MILLARD has resigned as president of the John L. Roper Lumber Co., Norfolk, Va., to accept the presidency of the Chicago Lumber & Coal Co. with headquarters at St. Louis, Mo. Mr. Millard has been the head of the Roper Co. for the last [illegible] years and was [illegible] of the Virginia [illegible] Railroad during the period of [illegible]

Business Side of Construction

Facts and Events that Affect Cost and Volume

January Contracts Have Value of $88,584,166

Represent Double the Volume for Same Month of 1921—Road Work Continues Active

Contracts let for January, 1922, as reported to *Engineering News-Record* was $88,584,166. This figure includes no residential building nor any housing except that for industrial uses. The total also represents about double the volume of building put under contract in January, 1921, and approximately 65 per cent of the volume of construction put under contract for January, 1920.

As seen in the accompanying table, all classes of construction reported fair averages for January, 1922, as compared with the preceding year. In only two classes of construction—sewers and federal government work—were the actual figures of 1921 larger than those of 1922. There was considerable increase in industrial construction reported over the last months of 1921 as well as over the corresponding month of 1921, but this was due largely to putting under contract several large hydro-electric projects.

COMPARISON OF VALUES OF CONTRACTS LET FOR JANUARY 1920, 1921 AND 1922

Classification	1920	1921	1922
Waterworks	$1,143,777	$519,028	$1,727,136
Sewers	1,863,840	3,146,948	2,267,053
Bridges	2,021,553	3,030,477	3,148,793
Excavation, dredging	1,541,576	1,266,346	2,090,979
Streets, roads	12,203,970	11,597,810	15,126,386
Industrial	56,041,047	12,881,968	18,178,470
Buildings	87,095,987	17,455,673	36,354,079
Federal Government	4,980,945	2,071,141	1,186,673
Miscellaneous	8,256,071	2,358,976	8,504,597
Total	**$175,148,766**	**$54,328,367**	**$88,584,166**

Large Contracts Let

Among this week's announcements of contracts awarded in Construction News, pp. 41-50 are the following large projects: A hospital in New York City to G. R. Davis, 30 East 42nd St., $1,500,000; an 8-story cold storage and ice plant in Kansas City, Mo., to E. W. Sproul & Co., 39th and Robey Sts., Chicago, $1,000,000.

Cement Prices Adjusted Downward in 15 Cities

Competition and Removal of Tax Lowers Prices—Mill Prices Not Affected

Meeting competition and the removal of the 3 per cent transportation tax on Jan. 1 have caused cement prices to settle downward from 1 to 20 cents per bbl. A drop of 2c. is reported in Philadelphia, Boston, Cleveland, Indianapolis, Cedar Rapids, Minneapolis and Cincinnati, and a 1c. decrease in Milwaukee, Peoria and Davenport. The greatest decline was in Denver, from $3.10 to $2.90. Other reductions are 14c. in Detroit, 11c. in Toledo, 16c. in Seattle, 5c. in Kansas City. Mill quotations did not fluctuate in the last month. The regular monthly list of current prices, compared with month-ago and year-ago figures, will be found on p. 218 of this issue.

Engineering News-Record Construction Cost Index Number

February, 1922	**168.72**
December, 1921	167.82
January, 1921	230.87
Peak, June, 1920	273.80
1913	100.00

Engineering News-Record's Construction Cost Index Number is exactly the same as last month. The New York pine base remains $49 to contractors. Structural steel shapes have stood at $1.50 since Nov. 1. A number of cement price revisions are reported on this page, but the Chicago quotation is still $1.97. There have been certain wage adjustments, but the average common labor rate for the country remains at 45c. per hour. Thus, general construction cost is 26 per cent cheaper than one year ago and 38 per cent under the peak; it is 69 per cent above the 1913 level.

Engineering News-Record Construction Volume Index Number

Monthly	
January, 1922	**91**
December, 1921	118
January, 1921	41
1913	100
Yearly	
1921 (entire year)	88
1920 (entire year)	91
1913	100

Engineering News-Record's Construction Volume Index Number is 91 for the month of January, and 88 for the whole of 1921, as against 100 for 1913. This means that the actual volume of construction in 1921 (not the mere money value of the contracts let that year) is 12 per cent under the volume of construction for 1913. Our monthly volume number, 91 for January, 1922, is really the increment of construction, and indicates the rate at which contracts are being let as compared with 1913 awards.

E. N.-R. Cost Index Number Revised for 1914

Reconsideration of the steel situation in 1914 has led to the conclusion that the prices of structural shapes used in computing the *Engineering News-Record* Construction Cost Index Number were too high, and the index number based upon them correspondingly too high. The iron and steel market in this first year of the war was uncertain; it was not yet realized how the war would boom the industry. Taking prices more nearly in line with actual domestic selling gives the following values:

1914	Cost Index Number
January	89.22
February	89.22
March	88.97
April	87.97
May	88.62
June	87.87
July	88.12
August	90.11
September	90.36
October	88.51
November	87.26
December	86.51

The above values are to be taken as the official Cost Index numbers for the months of 1914, and should be substituted for the values previously published for that year.

The complete list of index numbers will be reprinted in July.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called in Construction News, pp. 41-50 are the following:

A theatre and store in New York City, $1,000,000.

An office building in Kansas City, Mo., $2,500,000.

A street and road project at Chicago, Ill., $7,000,000.

A bank and office building at Pittsburgh, Pa., $5,000,000.

Next Week—Production and Stocks of Construction Materials in the United States.

Wages and Hours of Labor Since 1914

According to a digest of its comprehensive report upon industrial conditions in the United States, the National Industrial Conference Board sets forth the following facts:

The composite hourly earnings of all wage earners (approximately 1,250,000 investigated) increased 156 per cent between July, 1914, and September, 1920. The decline from that period to the middle of 1921 amounted to 16.5 per cent.

The decline from the peak to July, 1921, for common labor was 17.3 per cent and for skilled labor, 15.2 per cent. The percentages of increase in June, 1921, over 1914 were 117 per cent for common labor and 111 per cent for skilled labor.

The composite weekly earnings of all wage earners increased 140 per cent between July, 1914, and July, 1920. The peak weekly earnings averaged $29.81. The decline from the peak to July, 1921, amounted to 23.2 per cent, leaving a net increase of 85 per cent over July, 1914, the money decrease being $6.91.

The composite weekly earnings of common labor increased 149 per cent between July, 1914, and July, 1920, and the composite weekly earnings of skilled labor showed an increase of 137 per cent for the same period. Percentages of decline from the peak were for common labor, 25.8 per cent and for skilled labor, 22.8 per cent.

The actual week per wage earner in all industries shows a decline from 51.1 hr. in July, 1914, to 48.9 hr. in June, 1920.

The beginning of 1921 marked a reduction to 44.1 hr. per week and the depression period occurred in April of 43.6 hr. In June, 1921, the average wage earner was working exactly 5 hr. less than in the preceding June, thus constituting a loss of approximately 10.2 per cent in working hours.

Union Pacific Places $9,000,000 Car Order

Recent reports are to the effect that the Union Pacific system has placed an order with car builders calling for 4,500 specially constructed freight cars, the total cost to be between $9,000,000 and $10,000,000. The cars are expected to be available for use in the early summer.

Labor Rates and Conditions Throughout the Country

Actual changes in labor rates have occurred in seven of the twenty-one cities reporting. The Impartial Wage Board of San Francisco has standardized the building trades wage scale for that city and will keep the present schedule in effect until Dec. 31, 1922. This board has taken into consideration the fact that while a craftsman must be paid in accordance with his skill and the amount of risk involved, his employment is not continuous and that drastic wage reductions will net him an annual income entirely disproportionate to the cost of living. Bricklayers and structural iron-workers have been reduced from $1.16 to $1.12½; carpenters, hoisting engineers and pile-drivers from $1.03 to $1 per hr. Skilled laborers receive 62½c., and common laborers 45c.@56¼c. per hr. for a 6-day week.

Bricklayers have been reduced from $1.12½ to 95c. in Cincinnati; hod-carriers from 87½c. to 85c. in St. Louis and structural iron-workers from 55c. to 50c. per hr. in Montreal.

Pick and shovel men in New York City are quoted at 60c. as against 75c. per hr., or $4.80 per 8-hr. day, at excavating work.

Twenty-six communities were represented at a convention of the Minnesota Building Employers' Association in Minneapolis recently. The Association instituted a 20 per cent wage reduction last Spring, which has applied to the bulk of building construction in the state since. It was decided to keep the current wage scale in force through 1922.

On Jan. 23 the New Orleans Association of Commerce opened an organized campaign to register all unemployed persons in the city. One purpose is to learn how many of those registering belong to the migratory element which comes South during the winter months, thereby taxing the resources of the local charitable organizations.

Los Angeles reports considerable unemployment among unskilled laborers due principally to the same condition that effects New Orleans: the influx of transients from the colder sections of the country.

Building construction is practically at a standstill in both Denver and St. Louis. In Denver the shutdown is mostly seasonal and local contractors are preparing for the resumption of Spring building activities of considerable proportions. In St. Louis the Building Trades' Council and the Master Builders' Association are arbitrating the proposed wage reduction, without having yet reached an agreement.

Cincinnati reports 28,000 unemployed. The skilled building trades mechanics, however, do not comprise a very large percentage of this total.

The wages of five building trades have been determined by the Builders' Exchange of Syracuse and seven more are under arbitration. Hod-carriers and building laborers now receive 30@50c. per hr. Bricklayers still receive $1.12½; painters 90c. and sheet-metal workers $1 per hr. These three trades have thus far successfully resisted reduction. Lathers and plumbers receiving $1 per hr., have not yet been asked to accept a cut. Electrical workers demand renewal of $1 per hour agreement.

Labor plentiful, all classes.—Higher rates indicated by +, decreases by—

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$0.90	$0.70	$1.00	$0.30		$1.00	$0.20
Baltimore	1.25	.80	.87½	.54	$0.74	1.00	.30
Birmingham	1.00	.75		.25		1.00	.15@.25
Boston	.90	.75	.90	.60	.90	.90	.40
Cincinnati	0.95	.87½	.87½	.72½	.77½	.77½	.37½
Chicago	1.10	1.00	1.10			1.05	.35@.40
Cleveland	1.04	1.04	1.04	.60	.91	1.04	.57½
Dallas	1.00	1.00	1.00	.60	1.00	1.00	.35@.45
Denver	1.37½	1.00	1.00	.75@.81¼	1.00	1.00	.35@.40
Detroit	1.00	.80	.80@.90	.50@.60	1.00	.60@.80	.50
Kansas City	1.07½	1.00	1.00	.80	1.07½	1.07½	.70
Los Angeles	1.25	1.00	1.00	1.12½	.87½	1.00	.50@.56¼
Minneapolis	1.00	.80	.80	.75	.80	.80	—.40
Montreal	.80	.60	.50	.30	.50	—.50	—.20@.30
New Orleans	1.00	.88	.90	.40	.80	1.00	.30
New York	1.—	1.12½	1.25	.87½	1.00	1.12½	.60
Pittsburgh	1.12½	1.00	1.00	.80		1.00	.40@.45
St. Louis	1.—	1.25	—1.25@1.37½	—.85	1.25	1.25	.45
San Francisco	—1.12½	—1.00	—1.00	—.75	—1.00	—1.12½	.45@.50
Seattle	1.00	.80	.90	.70	1.00	.80@.90	.50
Philadelphia	1.—	.90	.80	.75@.90	1.00	.90	

Oklahoma Cement Makers Ordered To Sell Direct to Users

Acting upon a complaint filed in July, 1921, by the secretary of the Oklahoma Chapter of the Associated General Contractors of America, the Corporation Commission of Oklahoma recently ordered the cement manufacturers of the state to sell cement, when ordered in carload lots, direct to any department of the state, any municipality or any general contractor or other user of cement willing to pay cash, at the same price as quoted to dealers. The practice in the past has been to add to the mill price a distributing agent's commission fee.

The complaint was filed with the Corporation Commission of Oklahoma by R. G. Marriott, the specific respondents being the Oklahoma Portland Cement Co. and the Dewey Portland Cement Co. manufacturing in Ada and Dewey, Okla., respectively. The complaint cited the fact that the 1910 revised laws of Oklahoma ordered that a public business be subject to control by the state, by the Corporation Commission or by an action in any district court of the state as to its practices, rates and charges. The decision rendered by the Corporation Commission defined cement manufacturing as a "public business," as set forth in the 1910 statute. The specific charge was made in the hearing that members of cement mills were refusing to sell their product in carload lots direct to contractors for either private use or use in construction of improvements undertaken by the state or other municipal subdivisions, requiring that the cement be handled through local distributors regardless of the service, if any, rendered by them.

The order, therefore, robs the practice of selling cement of all discriminatory features. When cement from mill is available a commission acts.

Trend of Business

Foreign Exchange—On Jan. 30 sterling moved to $4 28½, highest since August, 1919. This was a rise of 4c. in one day, and was 18c. above the lowest January quotation. Sterling was at $3.18 in February, 1920. Canadian dollar at 95.4 on Jan. 28. Other European exchanges higher.

Exports to Europe last year were $2,300,000,000 less than for 1920, and to South America $300,000,000 less.

Money—Call loan rate 5½ per cent. Time loans at 4¾@5.

Car Surplus for period ending Jan. 15 was 439,982 cars, a decrease of 53,375 cars since Jan. 8. Of this decrease 18,749 cars were box, and 24,160 gondolas. This is the first decrease effected in surplus cars since the week of Oct. 31, 1921. Total revenue freight loaded in the week ended Jan. 14 was 720,877 cars, an increase of 114,885 cars over the total of the previous week. Compared with the same week of a year ago, however, the increase was but 5,022 cars.

Lumber Demand Picking Up Through Country

Contrary to reports emanating from eastern financial circles to the effect that reduced rail rates on lumber had retarded the movement, a continuing recovery in demand is shown as the outstanding feature of the second week in January, according to the statistics collected by the American Wholesale Lumber Association. Reports from various reporting associations indicate production, shipment and orders all picking up, with orders 98 per cent of production, although the demand is still 26 per cent below normal.

A. Fletcher Marsh, statistician of the association, says: Yellow pine has shown a steady increase in demand for both weeks in January, in fact for the second week of the month demand exceeded even production, so that shipments which had not been showing such a rapid increase will probably pick up in the next report. Pine is still in heavier demand than fir, and so far this year has appeared in a healthier condition. The North Pacific Coast, he reports, is still being hindered with bad storms and hard weather, in spite of which production and shipments are increasing, and orders picked up from the slump which they experienced the first week of the year. Rail business took a decided jump in volume, having been 1,408 carloads for the week of Jan. 14 as compared to 940 for the previous week. This would indicate that the rail business is at present the sustaining feature of the West Coast, whereas in the past the export business has been the mainstay.

Monthly Prices of Construction Materials

Ups and Downs of the Market

Pig Iron—Eastern Pa., No. 2x, quoted at $22.26 one month ago, dropped to $20.76 on Jan. 20, 1922 and returned one week later to the current price of $22.26 per gross ton, delivered, in Philadelphia.

Railway Supplies—Light rail, 25 to 45 lb., quoted at $30@$36 as against $31@$32 per ton f.o.b. Pittsburgh. Reduction quoted on standard spikes at the Birmingham mills and on track bolts at Pittsburgh. Advance in price of standard spikes at Pittsburgh and on track bolts and standard section angle bars at Birmingham.

Pipe—Slight advance quoted on cast-iron pipe in Birmingham and a decline in Chicago. Clay drain tile, 6-in., quoted in New York at $100 per 1,000 lin.ft.; 8-in. at $150, as against $105 for 6-in. and $175 per 1,000 ft. for 8-in. Slight drop in sewer pipe, all sizes, in Philadelphia; price stable elsewhere.

Road and Paving Materials—Average drop of ¼c. per gal. quoted on road oils in New York. Asphalt in bulk down $1 in New York and $1 per ton both in packages and in bulk in St. Louis. Dressed paving stone up 5c. and wood block paving down 70c. per sq.yd. in St. Louis.

Sand, Gravel and Crushed Stone—Gravel ¾-in. up 20c. per ton in St. Louis. Sand down 3c. per ton in Birmingham and 20c. per cu.yd. in Philadelphia. Crushed stone quoted at $1.75@$1.85 as against $1.80@$1.90 in New York; and $1.65@$2 as compared with $1.65 one month ago in St. Louis and down 65c. per cu.yd. in Kansas City.

Lime and Cement—Hydrated finishing lime quoted in New York at $16.80 as against $16.99 per ton; common lump lime at $3@$3.48 as compared with $3@$3.49 per bbl. (280-lb. net) one month ago. Slight decline due to the removal of 3 per cent war tax on transportation, which became effective with January. Common lump lime down 15c. in San Francisco; lump finishing lime down 25c. per bbl. in Seattle and hydrated finishing lime up $5 per ton in Montreal.

Cement—Net price f.o.b. in Detroit, $2.17, as against $2.31; Toledo $2.20 instead of $2.31; Denver $2.90 as against $3.10; in Seattle at $2.94 reduced from $3.10 and in Kansas City at $2.40 as compared with $2.45 per bbl. one month ago. Current quotations in New York are $2.20@$2.30 as against $2.30 per bbl., delivered.

Structural Material—Reduction in triangle mesh in New York and Chicago; mill prices firm. Steel shapes, plates and bars down 15c. in New York; bars down 15c. and shapes 25c. in Chicago; bars down 25c., shapes 35c. and structural rivets $1 per 100 lb. in San Francisco.

Roofing Materials—Tar felt reduced 15c. per roll f.o.b. New York; asphalt felt down $5 per ton at plant.

Brick and Hollow Tile—Common brick declined $2 in Cincinnati; $1.50 in New Orleans; $1 in Birmingham and advanced $2 per 1,000 in New York and Detroit. Fairly active demand and an open winter have diminished the winter reserves in New York. While no actual shortage exists supply is sufficient to meet building requirements for the present time only. Reductions in hollow tile in Phila. and St. Louis.

Lumber—Long leaf yellow pine advanced $1 on all sizes in Chicago; declines ranging from $1 to $5 per M ft. reported in Kansas City, Philadelphia and Atlanta. Average rise of $2 per M ft. on Douglas fir in Seattle, Kansas City and Minneapolis; down from $1 to $5 in Los Angeles, Denver and Philadelphia. Hemlock and spruce also down in Los Angeles and Philadelphia.

Rope—Discounts increased on all regular grades of bright and galvanized wire rope. Manila rope up 1c. in Kansas City and St. Louis; 1½c. in Detroit; 2c. in Denver and 3c. in Cincinnati; down 1c. per lb. in Seattle.

Explosives—Price of 40 per cent and 60 per cent gelatin dynamite advanced in Cincinnati and St. Louis; declined in Kansas City.

Linseed Oil—Rise in price of flax seed reflected in advance of 5c. on linseed oil in New York and 6c. per gal. in Chicago.

Price advances since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Per Gross Ton—Quotations compiled by The Matthew Addy Co.:

	Current	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25 @ 2.75)	$22 50†	$38 50
Northern Basic	22 02†	34 50
Southern Ohio No. 2 (silicon 1.75 @ 2.25)	23 52†	34 00
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25 @ 2.75)	28 50†	44 26
BIRMINGHAM		
No. 2 Foundry (silicon 2.25 @ 2.75)	18.00†	34.00
PHILADELPHIA		
Eastern Pa., No. 2X (2.25@2.75 sil.)	26†	36 00*
Virginia No. 2 (silicon 2.25 @ 2.75)	28 74†	40 00*
Basic	20 75†	34 00†
Grey Forge	22 50†	34.00*
CHICAGO		
No. 2 Foundry Local (silicon 1.75 @ 2.25)	21 70†	35 00
No. 2 Foundry Southern (silicon 2.25 @ 2.75)	24.66†	40 60
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley (silicon 1.75 @ 2.25)	22 46†	36 96
Basic	20 96†	31.96
Bessemer	21.96†	33 96

*F.o.b. furnace † Delivered.

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh			Chicago
	Current	One Year Ago	Birmingham	
Standard bessemer rails	$40 00	$45 00		$40.00
Standard openhearth rails	40 00	47 00	$40 00	40 00
Light rails, 8 to 10 lb	1 55	2 45@3 00*	1 60*	1 65@1 80*
Light rails, 12 to 14 lb	1 55	2 41@2 95*	1 60*	1 65@1 80*
Light rails, 25 to 45 lb	30 00@36 00	2 32@2 85*	1 60*	1 65@1 80*
Rerolled Rails	1 45	1 50*		

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8 Ft.	7 In. x 9 In. by 8 Ft.
Chicago, White Oak	$1 35	$1 50
Chicago, Hardwood and Red Oak	1 20	1 30
Chicago, Empty Cell Creosoting Cold'll	45	50
San Francisco, Green Douglas Fir	75	97
San Francisco, Empty Cell Creosoted Douglas Fir	1 70	2 20

For the A.R.A. standard "railroad administration" specifications, f.o.b. cars, St. Louis:

	White Oak	Red Oak	Pine and Cypress
Grade 3	$1 15	$1 05	$0 95
Grade 2	1 05	95	85
Grade 1	.95	.85	.75

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh						San Francisco
	Current	One Year Ago	Chicago	St. Louis	[illegible]	[illegible]	[illegible]
Standard spikes, ⅝-in. and larger	$2 30@2 35	$3 65@3 90	$2 65	$3 60	$3 [illegible]	[illegible]	[illegible]
Track bolts	[illegible] 25	5 50@6 00	3 65	4 60	[illegible]	[illegible]	4 60
Standard section angle bar	2 40	2 75@3 75	2 40	3 25	4 [illegible]	[illegible]	3 45

PIPE

WROUGHT PIPE—The following discounts are for [illegible] on the West Pittsburgh basing card:

BUTT WELD

Inches	Steel Black	Galv.	Inches	Black	Galv.
1 to 3	71	58½	1 to 1¼	64	29
			LAP WELD		
2	64	51½	2	64	25½
2½ to 4	68	55½	2½ to 6	64	29
7 to 8	65	51½	7 to 12	64	27½
9 to 12	64	50½			

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1½	69	57½	¼ to 1½	44½	30
2 to 3	70	58½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	62	50½	2	40½	27
2½ to 4	66	54½	2½ to 4	43½	31
4½ to 6	65	53½	4½ to 6	42½	30
7 to 8	61	47½	7 to 8	35½	23
9 to 12	55	41½	9 to 12	30½	18

STEEL—From warehouses at the places named the following discounts hold for steel pipe:

	Black			Galvanized		
	New York	Chicago	St. Louis	New York	Chicago	St. Louis
1 to 3 in. butt welded	66%	60	56½%	53%	46%	42½%
2½ to 6 in. lap welded	61%	57 %	53½%	47%	43 %	39½%

Malleable fittings, Class B and C, from New York stock sell at list less 10%. Cast iron, standard sizes, 32-5% off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	New York					San Francisco	
	Current	One Year Ago	Birmingham	Chicago	St. Louis		Los Angeles
4 in.	$50 30	$73 30	$42 00	$[illegible]	$46.20	$54 00	[illegible]
6 in. and over	47 30@48 30	63 30	$35@36 50	[illegible]	43 20	50 00	[illegible]

Gas pipe and Class "A," $4 per ton extra; 16-ft. lengths, $1 per ton.

CLAY DRAIN TILE—The following prices are per 1000 lin. ft.:

	New York				San	
Size, In.	Current	One Year Ago	St. Louis	Chicago	Francisco	Denver
3	$40 00	$62 00	$35 00	$50 00		$55 00
4	50 00	77 50	85 00	60 00	$90 00	65 00
5	80.00	110 00	140 00	80 00	115 00	84 00
6	[illegible]	140 00	140 00	100 00	150 00	110 00
8	[illegible]	228 00	200 00	150 00	250 00	181 00

SEWER PIPE—The following prices are in cents per foot for carload lots f.o.b.:

Size, In.	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Denver
3	$0 14	$0 087		$0 087	$0 12	$0 12	
4	14	087	$0 09	087	12	15	$0 18
5	.21	1305		1225	18	18	165
6	21	1305	135	1225	18	21	25
8	35	203	225	20	28	30	35
10	52	3045			42	42	
12	67	3915	3825	36	54	54	80
15	1.15	522	5625		72	90	
18	1 55	725	765		1 00	1 32	
20	1 98	87	1 125		1 20		
22	2 64	1 16			1 60		
24	2 97	1 305	4625	1 20	1 80	2 16	2 40
27	4 50	1 885			2 55	3 00	
30	5 00	2 088	5 20		4 75	3 60	
33	6 55	2 61			5 50		
36	7 50	2 9725		5 65	6 00		
		3	5	8	12	24	
Boston		$0 108	$0 162	$0 252	$0 486	$1 62	$4 92
Minneapolis				40	77	2 55	3 60
Denver			15	30	58	1 95	
Seattle		145		36	72	2 59	
Los Angeles		11	165	225	495	1 65	
New Orleans			108	27	450	1 755	
Cincinnati		10	15	243	45	1 50	4 50
Cleveland		098	147	245	4165	1 225	
Milwaukee		30	45	70	135	4 50	6 00
Detroit		105	1575	245	4725	2 115	5 4325
Baltimore		1225	2275	35	6825	2 20	5 25
Portland, Or.		17	21	333	60	2 41	4 74
Portland, Me.							

[illegible]

ROAD AND PAVING MATERIALS

ROAD OILS—The range of prices per gallon in tank cars of 8,000 gal. and over, f.o.b. place named:

		Current	One Year Ago
[illegible]	[illegible]	$0 05	$0 10
New York, 65% asphalt	[illegible]	[illegible]	05
[illegible]	[illegible]	[illegible]	09
[illegible]	[illegible]	[illegible]	10
New York, [illegible]	[illegible]	[illegible]	1
[illegible]	[illegible]	011*	11
[illegible]	[illegible]	05	6
[illegible]	[illegible]	05	7
[illegible]	[illegible]	10	11
[illegible]	[illegible]	13	11
[illegible]	[illegible]	15	11
San Francisco, [illegible]	[illegible]	[illegible]	[illegible]

* Prices $11.75 per ton. Waiting [illegible]

† [illegible] $0

ASPHALT—Price per ton in packages (350-lb. bbl., or 425-lb. drums) and in bulk in carload lots

	Package	Bulk
New York (Bayonne, N. J.)	$25 00	$15 00
Boston	quotations	
Chicago	25 85	19 50
San Francisco *delivered*, Oleum, Cal.	18 50*	13 00*
Dallas	35 00	27 00
Seattle	35 50	29 40
Denver	45 00	65 00
Minneapolis		20.50
St. Louis	25 00	19 00
Baltimore	25 00	20.00
Los Angeles, *f.o.b. dock*	22 50	15.00
Montreal	28 00	21.00
Atlanta	27 00	
Detroit (Petroleum Asphalt)	24 50	20 00
Cincinnati	26 10	21 80
Maurer, N. J. (natural asphalt)	36 00	33 00
Maurer, N. J. (artificial asphalt)	22 00	20 00
Philadelphia	24 00	17.00
Kansas City	28 83	22 83

*Freight to San Francisco, 80c. per ton.

NOTE.—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums. Rebates of about $1 per bbl., no rebate for drums.

PAVING STONE—

New York	5-in. granite, 28@29 blocks per sq yd	$130.00 per M
Chicago	About 4x8x4 dressed	3 35 sq.yd.
	About 4x8x4 common	3 00 sq.yd.
San Francisco	Basalt block 4x7x8.	65 00 per M
Boston	5-in. granite	125.00 per M
Atlanta	Granite	2.00 sq.yd.
Detroit	Granite, 26½ blocks per sq.yd	107 00 per M
Baltimore	Granite	2.00 sq.yd.
Montreal	Granite	125.00 per M
New Orleans	Granite, 4 x 8 x 4.	3.25 sq.yd.
Cincinnati	Granite	4.30 sq.yd.
St. Louis	4x8x4 dressed	3 35 sq.yd.
	4x8x4 common	2.95 sq.yd.
Kansas City	No. Granite	3.95 sq.yd.
Philadelphia	Granite	125 00 per M.

FLAGGING—

New York	Bronx	$0 25	sq.ft.
	Manhattan, 4 ft.	26	sq.ft.
	Queens, 5 ft.	26	sq.ft.
	6x20-in. cross-walk	1 00	lin.ft.
Chicago	18 in. wide	99	lin.ft.

CURBING—Bluestone per lineal foot, in New York, costs 77c. for 5x16 in., 88c. for 5x18 in., in cargo lots

WOOD BLOCK PAVING—	Size of Block	Treatment	Per Sq.Yd.
New York	3	16	$2 09
New York	3½	16	2 17
New York	4	16	2 37
Boston	3	16	2.17
Chicago	4	16	3 00@3 25
Chicago	3½	16	2 50@2 75
St. Louis	3½	16	2 50
St. Louis	4	16	3 00
Seattle	4	16	Off market
Minneapolis	3½	16	2 13
Atlanta	3½	16	2 30
New Orleans	3	16	1 60
New Orleans	3½	16	1 80
New Orleans	4	16	2.00
Dallas	4	18	3 90
Baltimore	3½	16	3 45
Montreal	4	16	4 50
Detroit	3	16	2 84
Detroit	4	16	3.00
Cincinnati	4	16	2 60
Kansas City	4	16	2 15
Philadelphia	3½	16	3 50

CONSTRUCTION MATERIALS

SAND AND GRAVEL—Price for cargo or carload lots to contractor is as follows, per cu.yd.:

	Gravel 1½ In. Current	Gravel 1½ In. One Year Ago	Gravel ¾ In. Current	Gravel ¾ In. One Year Ago	Sand Current	Sand One Year Ago
New York	$1 75	$3 00	$1 75	$3 00	$1 00	$1 50
Denver	2 50	2 00	2 50	1 80	1 10	1 60
Chicago	2 00	2 75	2 00	2 75	2 00	2 75
St. Louis, *per ton*	0 75	1 65	1 50	1 70	1 20	1 70
Seattle	1 50	1 50	1 50	1 50	1 50	1 50
Dallas	2 00	1 75	2.00	1.75	2 00	1 75
Minneapolis, *at pit*	1 50	2 00	1 50		50	1 00
Cincinnati, *at pit*	1 00	2.00	1 50	2 00	1 50	1 30
San Francisco	2.25	2.50	2.25	2.50	1.50	1.65
Boston	2.65	2.60	2.65	2.60	2.00	1.60
New Orleans	2 08‡	3.60	2 08‡		1 35	1 85
Los Angeles, per ton	1 35†	1.55	1 35†		1 20†	1 30
Atlanta, per ton	1 85	3 00	1.85		1 25	1 50
Detroit	2.00	1.85*	2.00	1.85*	2.00	3 50
Baltimore, per ton	1.40	1.40‡	1.60	1.60‡	2.00	.70
Montreal, per ton	1 25	1 50‡	1 50		1 25	1 25‡
Birmingham, per ton (Crushed slag used instead of gravel)					1 75	1 25‡
Philadelphia	1 50		1 57		1 50	
Kansas City	2.00		2.00		1.20	

* Fine white sand: Pacific, $4 per ton; Ottawa, $4.50

† Freight from quarry to Los Angeles is 70c. per ton, and is included in above price.

‡ Per cu. yd.

CRUSHED STONE—Price for cargo or carload lots f.o.b. city, unless stated otherwise, is as follows, per cu.yd.:

	1½ In. Current	1½ In. One Year Ago	¾ In. Current	¾ In. One Year Ago
New York	$1 75@1 85	$1 90@2 00	$1 75@1 85	$2 15
Chicago	1.60	2.75	1.60	2.75
St. Louis *delivered*	1 65@2 00*	1.89	1 65@2 00*	1.89
Dallas, *delivered*	2.93	2.25	2.93	2.25
San Francisco	2.25	2 50	2 25	2.50
Boston, *delivered*	3 00*	3 00* del.)	3 00*	3.00* (del.)
Minneapolis, *at plant*	2.00	2.00	2.25	2.25
Kansas City, *at plant*	2 10	2 35	2 10	2.35
Denver	3.50		3 50	
Seattle *delivered*	3.00	3.50 (del.)	3.00	3.50 (del.)
Atlanta	2.00*	3 25*	2 00*	
Cincinnati *delivered*	2.37‡	2 30	2.08	2.15
Los Angeles	1.60*	1.70*	1.70*	1 80*
Detroit	1.90*	2.00	1.90*	2.00*
Baltimore	1.75*	1.75*	1.65*	1.75*
Montreal	2.00*	2.40*	2.10*	2.60*
Birmingham *delivered*	3.20		3 10	
Philadelphia	1.70*		1.55*	

*Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plants:

	1½-In.	¾-In.	Roofing	Sand
Youngstown District	$1.30	$1.30	$2.00	$1.30
Steubenville District	1 40	1 40	2 00	1 40
Ironton District	1.40	1.40	2.00	1.40
Emporium, Pa.	1.25	1.25		1 25
Easton, Catasauqua, Pa.	1 00	1.00	2.00	0 90
Birmingham, Ala.	1 05	1.15	2.05	0 80
Buffalo, N. Y., and Erie, Pa.	1.25	1.25	2.25	1.25
Cleveland, Ohio	1.20	1.20		1.00
Eastern Pennsylvania and Northern New Jersey	1 20	1.20	2.50	1 20
Western Pennsylvania	1.25	1.25	2.50	1.25

LIME—Warehouse prices:

	Hydrated, per Ton Finishing	Hydrated, per Ton Common	Lump, per Barrel Finishing	Lump, per Barrel Common
New York	$16.80	$12.50	$3.68@3.98	$3.00@3.48*
Chicago	18.00			1.95†
St. Louis	22 20	19 00	2.50†	2.50†
Boston	23.00	20.00	3.35†	3.10†
Dallas	25.00			2.75†
Cincinnati	18.40	16 00	19.00‡	
San Francisco	22 08	18 00		1.75‡
Minneapolis	29.00	22.00 (white)	1.70†	1.40†
Denver	30.00			2.95†
Detroit	15.25	13.25	11.50‡	10.50‡
Seattle	27.00		3.00†	2.75†
Los Angeles	30.00	30 00		3.00*
Baltimore	15.00	13.00		12.00‡
Montreal	26.00	21 00	15.00‡	11.00‡
Atlanta	19.00	16.00	2.00†	1.50†
New Orleans		17.25		1.75†
Philadelphia	13 00	11 50	10.50‡	9 50‡

*280-lb. bbl. (net). †Per 180-lb. bbl. (net). ‡Per ton—Refund of 10c. per bbl.

Minneapolis quotes brown lime; Kelly Is. white is $1.70, Sheboygan $1.55. Seattle quotes hydrated finishing lime in cloth sacks; paper sacks, $24.00 per ton.

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, f.o.b., exclusive of bags

	Current	One Year Ago
Minneapolis (Rosendale)	$2.80	$2.80
Kansas City (Ft. Scott)	1.60	1.60
Atlanta (Magnolia)	11.00 ton	11.00
Cincinnati (Utica)	1.93	2.75
Boston (Rosendale) per bag	.85@.95	2.35

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b. points listed *without bags*. Cash discount for payment within 10 days from date of invoice, not deducted.

	Current	One Month Ago	One Year Ago
New York*	$2.20 to 2.30	$2.30	$3.10
New York, alongside dock to dealers	2.00	2.00	
Jersey City	2.12	2 12	2.39*
Boston	2.50	2.52	3.41
Chicago	1.97	1.97	2.17
Pittsburgh	2.02	2.02	2.17
Cleveland	2.26	2.28	2.43
Detroit	2.17	2.31	2.51
Indianapolis	2.21	2.23	2.31
Toledo	2.20	2.31	2.51
Milwaukee	2.18	2.19	2.39
Duluth	1.95	1.95	2.10
Peoria	2.13	2.14	2.43
Cedar Rapids	2.26	2.28	2.51
Davenport	2.21	2.22	2.47
St. Louis	2 20	2 20	3 45
San Francisco	2 84	2 84	3.09
New Orleans	3 20	3 20	4 20
Minneapolis	2.24	2.26	2 41
Denver	2.90	3.10	3.25
Seattle	2.94	3.10	3.10
Dallas	2.40	2.55	2 85
Atlanta	2.69	2.55	3 00
Cincinnati	2.35	2.37	2 57
Los Angeles	3.31	3 31	3 21
Baltimore*	2 50	2 50	2.93
Birmingham	2 27	2.27	
Kansas City	2.40	2 45	2.76
Montreal	3.10	3 10	3.52
Philadelphia	2.21	2 23	

NOTE.—Bags 10c. each, 40c. per bbl.;

Current mill-prices per barrel in carload lots, without bags; to contractors:

Buffington, Ind	1.70
Universal, Pa.	1.75
Steelton, Minn.	1.75
Fordwick, Va.	1.95
Hudson, N. Y.	1.90
Lehigh Valley District	1.70
Kingsport, Tenn	1 95
Richard City, Tenn.	1 95

*Delivered by truck at site of work

TRIANGLE MESH—Price per 100 sq.ft. in carload lots.

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh, Mill	Warehouse — New York	Chicago	Dallas	San Francisco
032	22	$0 68	$1 08	$0 76	$1 15	$1 75
049	28	3 87	1 25	88	1 46	1 58
066	35	1 05	1 58	1 18	1 80	1 80
093	45	1 35	1 99	1 52	2 30	2 30
126	57	1 65	2 45	1 87	2 86	2 87
153	68	1 97	2 91	2 25	3 40	.....
180	78	2 26	3 28	2 56	3 93	.....
245	103	2 99	4 36	3 38	5 15	.....
287	119	3 45	4 97	3 90	5 96	6 01
336	138	4 00	5 52	4 52	7 32	.....
395	160	4 64	6 61	5 20	8 00	.....

PAVING

036P	17	$0 52	$0 87	$0 58	$0 88	.....
053P	24	73	1 14	87	1 24	.....
072P	31	91	1 40	1 00	1 57	.....
097P	40	1 18	1 77	1 29	2 02	.....
049R	24	73	1 14	67	1 24	.....
067R	31	91	1 40	1 00	1 57	.....
084R	40	1 18	1 77	1 29	2 02	.....

Made in 16-, 20-, 24-, 28-, 32-, 36-, 40-, 44-, 48-, 52- and 56-in. width in rolls 150-, 200- and 300-ft. lengths. Galvanized is about 15% higher.

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted strands as follows.

Gage	Weight	*New York	Chicago	St. Louis	San Francisco	Dallas
27½ R	2 3	$21 20	$23 36	$23 39	$25 86	$25 50
26½ R	2 5	22 65	24 90	26 21	27 56	30 71
25 BR	3.0	25 30	27 42	27 45	30 71	33 16
24 SR	3 4	27 10	29 33	29 33	32 90	35 10
22 HR	4 33	31 75	34 06	.....	.....	.....

* Price to contractors at warehouse or delivered on job in Manhattan, Bronx or Brooklyn.

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Inches	*Pittsburgh Mill	Birmingham Mill	Warehouse, Uncut — New York	Chicago	St. Louis	Dallas	San Francisco
⅜ and larger	$1 50	$1 70	$2 53	$2 53	$2 87	$3 50	$2 75
½ and larger	1 55	1 75	2 58	2 58	2 92½	3 55	2 80
⅝ and larger	1 60	1 85	2 63	2 63	2 97½	3 60	2 85
¾ and larger	1 75	1 95	2 68	2 28	3 12½	3 75	3 00
⅞ and larger	2 00	2 05	2 73	3 03	3 37½	4 00	3 25

* Pittsburgh mill prices on large tonnages only.

Includes 15c charge for cutting to lengths of 2 ft. and over.

Twisted bars cut to length take extra of 27½c. per 100 lb.

ROLLED FROM RAIL

	Chicago	St. Louis	Dallas		Chicago	St. Louis	Dallas
½ and larger	$1 60	$1 90	$3 25	⅜	$1 85	$2 15	$3 50
⅝ in.	1 65	1 95	3 30	¼	2 10	2 40	3 75
½	1 70	2 00	3 35	.....	.....	.....	.....

BRICK—Contractors' price per 1 000 in cargo or carload lots is as follows:

	Common — Current	One Month Ago	One Year Ago	Paving Block, 3-inch*	Paving Block, 4-inch*
New York (del.)	$20 40	$17 40–18 40	$22 70	$44 50	$49 50
New York (at dock)	14 15	14@15	.....	.....	.....
Chicago	11 00	11 00	15 00	34 00	42 00
St. Louis, salmon	16 00	16 00	15 00	.....	.....
Denver, salmon	14 00	14 00	15 00	.....	.....
Dallas	11 00	12 65	25 00	[illegible]	
San Francisco	15 50	15 50	18 00	44 38	
Los Angeles	15 50	15 50	14 50	.....	
Boston (del.)	17 00	17 00	25 00	46 50	52 60
Minneapolis (del.)	15 00	15 00	24@26	43 00	
Kansas City	14 50	14 50	22 00	.....	
Seattle	14 00	14 00	19 00	48 00	53 50
Cincinnati	17 00	19 00	21@22	41 00	.....
Montreal (del.)	16 00	16 00	20 00	100 00	120 00
Detroit (del.)	16 50	17 00	15 00	20 00	41 30	44 00
Baltimore (del.)	20 00	20 00	20@25	36 00†	.....
Atlanta	9 00	9 00	15 00	40 00	.....
New Orleans	12 50	14 00	25 50	.....	.....
Birmingham	10 50	11 50	.....	.....	.....
Philadelphia	16 00	16 00	.....	.....	42 00

* For paving blocks 3"x8"x3" and 3"x8"x4" respectively. † Natural [illegible] plant, Baltimore.

HOLLOW TILE—Price per block in carload lots to contractors f. o. b. [illegible] ing tile.

	— New York — Current Quotation	One Year Ago	Chicago	Philadelphia	St. Louis	[illegible]	[illegible]
4x12x12	$0 11120	$0 2444	$0 0821	$0 095	$0 08	[illegible]	[illegible]
6x12x12	10670	3259	0950				
8x12x12	20840	4345	1295	175	145		
10x12x12			1584				
12x12x12			1811	255			

* 3 per cent for cash.

	4x12x12	8x12x12	12x12x12
Boston	$0 0960	$0 182	$ [illegible]
Minneapolis (f. o. b. cars)	0672	126	[illegible]
Minneapolis (delivered)	0752	1175	155
Cincinnati	0670	126	174
Kansas City	085	167	229
Denver	08	145	21
Seattle	10	175	30
Los Angeles factory	103	185	22
New Orleans	13	26	40
Detroit (delivered)	070	135	225
Montreal		30	50
Buffalo	15	27	40
Atlanta	0675	13	
Dallas	13		
Birmingham	095	175	

San Francisco, Philadelphia and New York quote on [illegible]

STRUCTURAL MATERIAL—Following are base prices f. o. b. mill, Pittsburgh and Birmingham together with quotations per 100 lb. from warehouses at places named:

	*Pittsburgh, Mill	Birmingham Mill	New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in.	1.50	$1.75	$2 63	$4 00	$2 97½	$2 63	$3 10
Channel, 3 to 15 in.	1.50	1.75	2 63	4 00	2 97½	2 63	3 10
Angles, 3 to 6 in., ¼ in. thick	1 50	1 75	2 67	4 00	2 97½	2 63	3 10
Tees, 3 in. and larger	1.50	1 75	2 63	4 00	2 97½	2 63	3 10
Plates	1 50	1 75	2 63	4 00	2 97½	2 63	3 10

* Pittsburgh mill price on large tonnages, small tonnages $1.60 per 100 lb.

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Pittsburgh, Mill	Warehouse — New York Current	New York One Yr Ago	Chicago	St. Louis	San Francisco	Dallas
½ in. and larger	$2.25	$3.50	$5 23	$3 43	$3 77½	$4 50	$5 50

CONE HEAD BOILER

½ in. and larger	2.35	3.60	6 00	3 53	3 87½	4 60	5 65
⅝ and ¾	2.50	3.76	6 15	3.68	3 87½	4 75	5 80
⅞ and 1⅛	2.75	4 00	6 40	4 18	3 87½	5 00	6 05

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in. take an extra of 25c.

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh, Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire	$2 50	$3 25	$5 00	$5 00	$3 48	$4 95
Cut	2 25	6 10	5 90	7 75	4 08	5 00

PREPARED ROOFINGS—Standard grade rubbered surface, complete with nails and cement, costs per square as follows:

	New York — 1-Ply l.c.l.	2-Ply l.c.l.	3-Ply l.c.l.	Philadelphia — 1-Ply l.c.l.	2-Ply l.c.l.	3-Ply l.c.l.
No. 1 grade	$2 08	$2.38	$2.80	$1.92	$2.28	$2.70
No. 2 grade	1.77	2.08	2.45	1.67	1.98	2.35

Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs $1.90 per roll in carload lots and $2.15 for smaller quantities f.o.b. Philadelphia.

Shingles, red and green slate finish, cost $5.40 per square in carloads; $5.65 in smaller quantities, in Philadelphia.

ROOFING MATERIALS—Prices f.o.b. New York:

Tar felt (14 lb. per square of 100 sq.ft.) per roll of 432 sq.ft.	$2 00
Tar pitch (in 400-lb. bbl.), per 100 lb.	1 85
Asphalt roofing (in barrels), per ton, f.o.b. plant*	47 50
Asphalt felt (light), per ton, f.o.b. plant*	67 00
Asphalt felt (heavy), per ton, f.o.b. plant*	68.50

* Delivered in Metropolitan Dist., $3.00 additional.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh, Mill Large Lots	St. Louis	Chicago	San Francisco	New York
No. 10	$2 25	$2 87½	$3 38	$4 10	$3 28
No. 12	2 30	2 92	3 43	4 15	3 33
No. 14	2 35	3 97	3 48	4 20	3 38
No. 16	2 55	3 07½	3 58	4 30	3 48
Black					
No. 18 and 20	2 85	3 95	3 95	5 20	3 80
No. 22 and 24	2 90	4 00	4 00	5 25	3 85
No. 26	2 95	4 05	4 05	5 50	3 90
No. 28	3 00	4 15	4 15	5 60	4 00
Galvanized					
No. 10	3.00	4.15	4 15	....	4 00
No. 12	3 10	4 25	4 25	5 [illegible]	4 10
No. 14	3 10	4 25	4 25	[illegible]	4 10
No. 16	3 40	4 55	4 55	[illegible]	4 40
No. 22 and 24	3 55	4 70	4 70	[illegible]	4 55
No. 24 and 26	3 70	4 85	4 85	[illegible]	4 70
No. 28	4 00	5 15	5 15	[illegible]	5 00

[illegible] 30c. per 1 000 lb. for 5 to 28 gage. 25c. for 19 to 24 gage [illegible] and 1 to [illegible] gage.

LINSEED OIL—These prices are per gallon

	Chicago — Current Quotation	Year Ago	Current	Year Ago
Raw in barrel (5 bbl. lots)	$0 77	$0 80	$0 80	$0.91

WHITE AND RED LEAD—Base price in cents per pound

	Red — Current		Red — 1 Year Ago		White — Current	White — 1 Yr Ago
	Dry	In Oil	Dry	In Oil	Dry or In Oil	Dry or In Oil
100-lb. keg	12 25	13 75	13 00	14 50	12 25	13 00
25 and 50-lb. kegs	12 50	14 00	13 25	14 75	12 50	13 25
12½-lb. keg	12 75	14 25	13 50	15 00	12 75	13 50
5-lb. cans	15 25	16 75	16 60	17 50	15 25	16 00
1-lb. cans	17 25	18 75	18 00	19 50	17 25	18 00

LUMBER

Prices wholesale to dealers in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in more than carload lots:

Lumber Prices to Contractors in Yards at San Francisco

	6 8 and 12 Ft	10 16 18 and 20 Ft	22 and 24 Ft	25 to 32 Ft.
3x3 and 4	$28 00	$31 00	$34 00	$36 00
3x6 and 8	28 00	31 00	32 00	34 00
4x4-6 and 8	30 00	33 00	34 00	36 00
3x10 and 12	30 00	32 00	34 00	36 00
3x14	31 00	33 00	35 00	37 00
4x10 and 12	32 00	34 00	36 00	38 00
4x14	33 00	35 00	37 00	39 00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft
6x10	$33 00	$35 00	$37 00
6x14	35 00	37 00	39 00
8x10	33 00	35 00	37 00
3x14	35 00	37 00	39 00

New York, Chicago, St. Louis and Detroit—Wholesale prices to dealers of long leaf yellow pine.

	New York* — 20 Ft. and Under	New York* — 22–24 Ft	Chicago — 20 Ft. and Under	Chicago — 22–24 Ft
3x 4 to 8x8	$38 00	$39 00	**$40 00**	**$42 00**
3x10 to 10x10	41 00	42 00	**42 00**	**44 00**
3x12 to 12x12	44 00	45 00	**44 00**	**46 00**
3x14 to 14x14	47 50	48 50	**48 00**	**50 00**
3x16 to 16x16	52 50	53 50	**53 00**	**55 00**
3x18 to 18x18	60 00	61 00	**59 00**	**61 00**
4x20 to 20x20	70 00	71 00	**66 00**	**68 00**

* Wholesale price to dealers; to contractors, on lighters or cars, about $5 additional. Short leaf pine up to 14 x 14 costs $15 per M. less.

St. Louis: Yellow pine, 100 20 ft. long, 3 x 4 to 6 x 6, $20 00; 3 x 8 to 8 x 8, $19; 3 x 12 to 5 x 12, $25; 3 x 14 to 5 x 14, $28. 3 x 16 to 4 x 16, $32. 12 x 14 to 14 x 14, $27

Detroit—Norway pine 2 in. x 4 in., 10 ft. x 16 ft. long, $35, 2 in. x 12 in., 10 ft. x 16 ft. long, $37; short leaf yellow pine 2 in. x 4 in, 9 ft. x 12 ft. long, $27.50 2 in x 8 in., 18 ft x 20 ft. long, $31; yellow pine flooring No. 1 common 1 in x 3 in., $39 75. 1 in x 4 in., 6 ft x 12 ft. long, $37 25; yellow pineshiplap $37 00

Over 24 ft—Add $1 for each additional 2 ft in length up to 30 ft. for sizes 12 x 12 and under, for sizes over 12 x 12 add $2. for merchantable add $2 to sizes 10 x 10 and under. For pine add $2 to the price of merchantable for all sizes.

Other Cities

	8 x 8-In. x 20 Ft. and Under — P	Fir	Hemlock	Spruce	12 x 12-In. 20 Ft. and Under — P	Fir
Boston	$50 00	$52 00	$55 00	$45 00	$54 00	$52 00
Seattle		**19 00**				**20 00**
New Orleans	28 00				25 00	
Baltimore	36 50				38 50	
Cincinnati		50 00			46 00	64 00
Montreal	78 00	85 00	68 00	78 00	78 00	100 00
Los Angeles		*41 00*	*40 00*			*47 00*
Denver		*33 25*	*31 25*	33 75		*34 25*
Minneapolis	40 00	40 00	37 00		47 00	38 00
Atlanta	*39 00*				*45 00*	
Dallas	33 00				34 00	
Kansas City	33 00	**34 00**			*36 00*	**35 00**
Birmingham	20 00				26 00	
Philadelphia	32 00	*35 00*	*39 00*	*42 00*	*38 00*	*37 00*

	1-In. Rough, 10 In. and Under — P.	Fir	Hemlock	2-In. T and Gr. 10 In x 16 Ft — P	Fir
Boston	$47 00	$48 00	$32 00	$45 00	$48 00
Seattle		**15 00**			**16 50**
New Orleans, at mill	65 00			32 00	19 50
Baltimore	35 00			36 50	
Cincinnati	62 50	80 00		33 50	
Montreal	120 00	60 00	60 00	80 00	80 00
Los Angeles		*34 00*	*33 00*		63 00
Denver		*29 25*	29 25		**30 25**
Minneapolis	38 50	**36 25**	33 25	36 00	**34 75**
Atlanta	*42 00*			*40 00*	
Dallas	32 00	30 00		36 00	
Kansas City	*35 00*	**34 50**		*39 00*	31 00
Birmingham	18 00			18 00	
Philadelphia	*30 00*	*35 50*	**37 00**	*38 00*	*36 00*

Montreal—Up to 32 ft.; over which, $3 00 per M. increase up to 30 ft

Birmingham—Quotes carload lots, f.o.b. sidings. $2 additional per M. ft. for delivery.

Boston and Cincinnati—Prices to contractors in carload lots, f.o.b.

Denver—Quotes dealers prices to contractor on large projects.

FREIGHT RATES

On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

Baltimore	$0 33½	Detroit	$0 32½
Birmingham	76½	Kansas City	81½
Boston	40½	New Orleans	51½
Buffalo	29½	New York	38
Chicago	38	Pacific Coast (all rail)	1 66½
Cincinnati	325	Philadelphia	35
Cleveland	24	St. Louis	47½
Denver	1 35½	St. Paul	66½

Minimum carload, 40,000 lb.

†Minimum carload, 50,000 lbs., structural steel only; 80 000 lb for other iron or steel products.

CONTRACTORS' SUPPLIES

STEEL SHEETPILING—The following price is base per 100 lb. f.o.b. Pittsburgh, with a comparison of a month and a year ago:

Current	One Month Ago	One Year Ago
$2 75@1 80	$1 80	$3 00

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern Territory New York and East of Missouri River
Hercules red strand, all constructions	50%
Patent flattened strand, special and cast steel	40%
Patent flattened strand, iron rope	15%
Plow steel round strand rope	15%
Special steel round strand rope	40%
Cast steel round strand rope	35%
Round strand iron and iron tiller	15%
Galvanized steel rigging and guy rope	12½%
Galvanized iron rigging and guy rope	+5%

California, Oregon, Nevada and Washington: Discount 5 points less than discount for Eastern territory.

Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.

Arizona: Discount 10 points less than discount for Eastern territory.

Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.

North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ½-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ⅝-in., 8 ft.; ¾-in., 6; ⅞-in., 4½; 1-in., 3½; 1¼-in., 2 ft. 10 in.; 1½-in., 2 ft. 4 in. Following is price per pound for ½-in. and larger, in 1200-ft. coils:

Boston	$0 20	New Orleans	$0 17½
New York	18½	Los Angeles	16½
Chicago	18	Seattle	16
Minneapolis	19½	St. Louis	**19**
San Francisco	**17**	Montreal	30
Atlanta	21	Detroit	**19**
Denver	**20**	Baltimore	20
Cincinnati	**20**	Kansas City	**18½**
Dallas	29	Birmingham	**20½**
Philadelphia	17½		

EXPLOSIVES—Price per pound of dynamite in small lots

	Gelatin 40%	Gelatin 60%
New York	$0 3075	$0 3425
Boston	**24**	275
Kansas City	*24*	*27*
Seattle	1875	2125
Chicago	2275	2525
Minneapolis	2274	2530
St. Louis	**26**	**295**
Denver	2350	2700
Dallas	29	375
Los Angeles	25	29
Atlanta	2675	3025
Baltimore	2550	27
Cincinnati	**2475**	2725
Montreal	22	26
Birmingham, *delivered*	165	205
New Orleans	.2725	.3075
San Francisco	19½	23
Philadelphia	2525	2875

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York.

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in	30 to 50 ft	$0 14	$0 19
12 in.—2 ft. from butt	6 in	50 to 59 ft.	0 18	0 25
12 in.—2 ft. from butt	6 in	60 to 69 ft	0 21	0 27½
14 in.—2 ft. from butt	6 in	50 to 69 ft.	0 24	0 32½
14 in.—2 ft. from butt	6 in	70 to 79 ft.	0 26	0 34½
14 in.—2 ft. from butt	6 in	80 to 89 ft	0 33	0 42

SCRAP—The prices following are per gross ton paid to dealers and producers in New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

	New York	Chicago	St. Louis
No. 1 railroad wrought	$10 50	$11 50	$13 50
Stove plate	10 50	12 00	13 50
No. 1 machinery cast	16 50	13 50	16 00
Machine shop turnings	**4 00@5 00**	4 00	6 50
Cast borings	**7 50@8 00**	5 50	8 50
Railroad malleable cast	*9 50@10 00*	12 50	11 00
Rerolling rails	*9 50@10 00*	13 00	12 00
Relaying rails	*2 00@25*	30 00	27 00

SHIP SPIKES—Current prices per 100 lb.

	San Francisco — Galv	San Francisco — Black	Seattle Black
In.	$9 10	$5 20	$8 55
¾	8 65	6 65	8 25
½	8 50	6 50	8 30

Pittsburgh base in lots of 200 kegs or more $2 25@2.30

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. Mehren
Editor

Volume 88 — NEW YORK, FEBRUARY 9, 1922 — Number 6

Conflicting Society Dates

MUCH criticism was heard at the annual meetings of the American Society of Civil Engineers, the Associated General Contractors, and the American Road Builders' Association, of the fact that these three organizations held their meetings in the same week. It is of no avail, now, to cry over the spilt milk. The important thing is to prevent a repetition in the future. An agency is needed which will record dates of prospective society meetings. We suggest it is an activity for the Federated American Engineering Societies.

Arms Conference Results

IT WILL be recalled that this journal hailed with enthusiasm the calling of the Limitation of Armaments and Far Eastern Conference. The enthusiasm was heightened by the great stroke of Secretary Hughes' opening address. We saw in the conference not merely the obvious and most important possibility, a contribution to peace, but an economic result—in a more confident and less burdened industrial world. We preferred to stress the latter aspect because it is the one allied with that part of our readers' life interests which *Engineering News-Record* is designed to serve.

Now we are at the close of the conference. What are the results? Have the expectations been realized?

For ourselves we answer that the fruits have exceeded the promise. In the arms-limitations, the Pacific and the China treaties we have accomplishments that in peace-making possibilities are epochal. They contrast strongly with previous conferences between nations, when the machinations of statesmen playing with the lives and liberties of millions have resulted in a peace that contained the germs of war and was but the breathing spell in which the combatants prepared for inevitable battle!

The conference has stopped naval rivalry between us and the only nation financially able to give us a naval race. It has, by the same act, rolled back indefinitely danger of war between us and Japan—shall we not also say with Britain, even though there were no clouds or occasions for disagreement visible. It has removed the early likelihood of aggression in China, recognized since the European Armistice as the greatest danger in world politics.

Consequent on these accomplishments has come a spreading of confidence throughout the business world. There is relief from the prospect of a [illegible] burden for armaments and freedom from the intangible but nevertheless existent fear of war between the United States and Japan. These are economic gains—second, it is true, to the larger benefit of saving of human life—but gains that in the present state of world business will react to the benefit of individuals everywhere.

We are fully aware, of course, that the real justification for our enthusiasm must be [illegible] ten and twenty years hence. It may be premature. The immediate gain may be followed by a lapse from present high thinking. Nevertheless, the conference has elevated moral leadership to a new plane in international affairs. We shall see whether that appeal goes beyond the statesmen and enlists the sympathy of the common people of every land, so that they may exert themselves and stand fast, as we do in America, against aggression, for peace and for upright dealing between nation and nation.

These results are good as they stand. The immediate effect is excellent. The accomplishments are all that could be expected.

The Knickerbocker Theater Disaster

RELUCTANTLY the mind accepts as real the strange sequence of events revealed in the collapse of the Knickerbocker Theater in Washington. The circumstances of the tragedy are unprecedented in modern building construction, but, though a deep shadow of the unexplained conceals the ultimate moving causes, the course of the final catastrophe is so obvious as to compel belief in spite of its strangeness. Once the facts are accepted they utter certain insistent warnings, which, together with the great toll of death, will make the Knickerbocker Theater long remembered.

From the tangled remains of the structure one may read that the building gradually wedged itself apart during the four years since its erection. It was strong enough to bear its loads, but it was flimsy and lacked bond; under the peculiar conditions of its plan and arrangement this fault led to its destruction. That the final moment when it lost its coherence and fell a wreck-heap came at a time when the theater was occupied seems but the evil play of fate.

So much can be learned from the ruins. More will probably never be determined. Why the roof and walls wedged themselves apart remains an unanswered question, nor is it likely to be answered by anything more positive than inference. The effects of expansion and vibration are not amenable to calculation or test, and it is these effects that must be looked to as the agencies of destruction.

Bolts and anchors to tie together the roof and walls would doubtless have prevented or postponed the collapse. But it will not do to write down this statement as a blanket indictment and record the case as simply one of negligence in planning or building. Bolts and anchors have been omitted in other buildings, and though such practice ever was faulty, and more than elsewhere was faulty in the Knickerbocker structure, yet it has not previously been convicted by disaster. Careful designers have always braced and tied their structures securely, but so far as anchorage is concerned they did this more as a matter of [illegible] than as one taught by failures.

Buildings, and above all roofs, have been regarded quite universally as dead-load structures in the fullest meaning of the term as [illegible] devoid of [illegible]

possibility of shift or displacement. That view is seen to be wrong. In the Knickerbocker at least it was terribly wrong, and potentially it is just as wrong for many another building. *Sound building practice must take full account of the possible cumulative effect of even slight motions or vibrations. It must look upon its structures as live-load structures.* The emphasis placed upon this view is the outstanding gain from the collapse.

No alarm need be felt concerning ordinary buildings because the Knickerbocker Theater collapsed without warning after a period of satisfactory service. The Knickerbocker was not an ordinary building. It involved quite exceptional conditions.

It contained as a main element of its structure a curved wall, a long, thin wall lacking solidity and mass, much broken by doors and windows and devoid of stiffening by piers. Upon this wall the designers supported a truss load of fifty tons. Entering the wall at a sharp angle—another most remarkable condition—the truss nevertheless was placed not upon a square seat but upon one directly in the face of the wall. In this combination even the normal deflection of the truss under the weight of the roof introduced a canting effect and exerted a slight push against the wall.

There was, thus, an initial disturbing force. By reason of the curved wall and the skew truss bearing, expansion and contraction movements of wall or roof took on an abnormal importance. Further, a perceptible tremor was set up by passing street-cars. The building contained an organ, whose notes may have been capable of setting up vibration, and seated in the roof framing it had large motor-driven ventilating fans whose humming noise often was noticed by spectators. It is from these conditions that conclusions as to the genesis of the collapse must be drawn, for no other causative factors have been discovered. And these conditions must be taken into account in judging of the relation of the case to the safety of other buildings.

The precise weight of the several factors, and how far they should have been provided for in the original plan, will doubtless be among the subjects of discussion in the official inquiry. But however exceptional the present case, a simple reference to the inevitableness of vibration and expansion in buildings and to the possibilities of imperfect bearing of heavy members on their supports will suffice to validate the general principle that unless buildings are planned with due regard to their live-load character they will be subject to danger —slight, no doubt, but definitely present.

Two months ago, after the American Theater collapse in Brooklyn, it was urged in these pages that heavy superstructure concentrations should be carried integrally by supporting framework, so that the structural parts of important buildings will form a rigid, self-contained skeleton. From the facts of the Knickerbocker disaster there emerges the clear showing that this principle should have primary and universal application to theaters and other buildings of public assembly, involving a large hazard to human life. *Columns under trusses and girders, securely braced to form a framework capable of resisting all forces acting on the completed building, should be made mandatory in our practices and our regulations governing building.* There is no reason why we should continue to be bound by the traditions of former ages, which made a virtue of utilizing masonry walls for heavy-duty service because better materials of support could not be had.

Building codes are also brought into the focus of attention by the case before us. Regrettable as it may seem, the fact is that the construction of the Knickerbocker Theater was in full accord with the requirements of the Washington building code. Still more regrettable, one of the prime weaknesses of the ill-fated structure was founded on what appears to be error or oversight in that code, namely that no separate provision was made for theater walls, so that the rules set up for ordinary building walls automatically applied also to the walls of a theater. It was under this provision that a hollow-tile wall 18 in. thick was erected to support a 50-ton truss load at a height of nearly 40 ft., and that it was cut into a meshwork of windows and doors to resemble an apartment house—avowedly in order to harmonize with the character of the neighborhood. There will be occasion for revising and improving the Washington code.

What may be accomplished by code improvement is strictly limited, however. Building codes cannot assure safe buildings. They cannot take the place of constructional skill and knowledge. In the Knickerbocker case the code was relied upon as the sheet-anchor of safety. Walls were designed as the code demanded; for that reason they would be safe! Steel roof framing was designed (by the steel contractor), in changing the original design prepared by a consulting engineer, with no other stipulation than that the design must be approved by the city bureau of buildings. Such dependence upon the guardianship of code and routine administrative process, though in good faith, is an easy path to destruction. It is not uncommon among architects, we fear—and no engineer was involved in the Knickerbocker case in authoritative, responsible position. Fostered by excess of detail in code requirements, this dependence upon formal rules needs to be combated by simplification of codes rather than by increase in detail and complexity.

Safety in the last analysis rests upon the personal responsibility of architect and builder.

For a Joint Port of New York

ON ANOTHER page of this issue there is presented in as extended form as space allows the engineering defence of the plan proposed by the city of New York for the development of its port. In next week's issue there will appear the latest analysis by the Port of New York Authority of its solution of the same problem, a solution which has been fully outlined in these pages, but for which up to now there have not been given the cost figures which in the latter report are made public. These two statements, much more fully presented in the original documents of the two bodies, will place before engineers some technical facts which have been lost in the fog of political discussion. In our opinion these facts lead to the conclusion that the Port Authority should be authorized to go ahead with its by no means perfect scheme and that, thereafter, every effort should be made to effect a compromise with the city so that the development of the port can proceed.

Speaking academically, engineering factors should govern in the selection of a proper plan for the port. Practically, however, political influences and legislative procedure seriously affect the solution of the current dilemma. After many years of effort the states of New York and New Jersey are about to pass the final acts

legalizing a joint control of the port, an economic conjunction obviously necessary and one which was practically demanded by the Interstate Commerce Commission decision refusing a freight differential to the New Jersey district. The separate state bills are written so as to compel the Port of New York Authority to proceed along certain very definite lines of physical construction, and no deviation from those lines is permitted except by future legislative enactment. The city, on the other hand, is ordered by a state law to start, within two years, the construction of a tunnel under the Narrows, which must be self-supporting, and this tunnel is not a part of the Port Authority scheme. In order to make this tunnel self-supporting, the city has planned connecting water-front lines in Long Island, a railway and classification yards in Staten Island and a bridge across Arthur Kill to New Jersey and has suggested an outer belt-line in New Jersey which, it thinks, will be so attractive that the trunk line railways will, in their own interests, be required to finance it.

If the port bills go through, and the city continues in its present intention, there will be little if anything done, because no community will allow itself to be saddled with two schemes of such magnitude and cost which contain duplicating features. Some compromise must be reached, and that compromise must be on an engineering basis. In the end, then, engineering considerations must govern.

It may be laid down as a basic engineering principle, not susceptible of contradiction, that the freight traffic in and out of the New York port district must be treated as a whole, regardless of state or city lines. That means that not only should the great ocean traffic of the port be carried through the district at the least expense but that it should discommode as little as possible the internal activities of the district. It means that the various industrial districts, actual and potential, in both states should be encouraged by proper rail connections. It means that the great eastern coast rail traffic should be by-passed around congested areas.

The city's scheme answers these requirements only in part. It does by-pass coast freight, but by a route below the center-of-gravity of trunk line traffic; it relieves congestion in Manhattan and New Jersey, but only insofar as it removes from those districts the freight now going through them, it encourages those industrial areas that lie in the boroughs of Richmond, Brooklyn and Queens and tends to build up the ocean terminals that are or may sometime be in those boroughs. It is, in effect, a New York City scheme, with the biggest part of New York City, that is Manhattan, left out. Furthermore, it depends for its success on the approval of the trunk-line railways, which, according to a letter they have just sent to the city, have decided that they cannot use the Staten Island-Narrows route.

The plan of the Port Authority answers all of the requirements but two; it puts Staten Island (and the city's new $28,000,000 Stapleton piers) on a stub-end and puts a large burden on the congested New Jersey water-front area. Decidedly in its favor is that it is a progressive plan, which can be put into force gradually and which can be revised from time to time, though it would be much better if such revisions did not have to pass the difficult barriers of bi-state legislation.

Staten Island, unquestionably, has great industrial possibilities which would be made actual by a through railroad, though its possibilities as a steamship terminus for east-bound freight can be well cared for for many years to come by lighter service, especially as the Stapleton piers, thanks to the lack of foresight of the city, are not designed for the most effective rail-head service. If Staten Island were connected to the rest of New York by effective rapid-transit passenger service, which the city's scheme does not do, and to the west by a railroad with belt-line connections, its eastward railroad connection could well be left for the future.

As to the contention that added congestion would result from the Port Authority's middle belt, such added congestion will probably not develop until some distant date when the traffic has measurably increased. The first result of this middle belt would be to relieve the immediate pier-head area from its present lighter-bound freight, which is now its greatest burden, and carry it to the joint terminals or the tunnel. When the yards and tracks in this middle belt area cannot longer accommodate the traffic, it will be possible to consider the outer belt with, what will be probably necessary, break-up yards at each railroad intersection. The probable impediment of a low-grade crossing of Newark Bay and Arthur Kill is more serious and will have to be cared for sooner or later by either tunnel or high bridge.

These brief arguments do not consider one of the principal features of the bi-state plan, the automatic electric railway into Manhattan. That is entirely outside the present controversy and something which apparently the Port Authority itself is now ready to put off for some time. There is no great enthusiasm for it outside the bi-state body and most engineers and railway men are still very much in doubt as to its effectiveness or economy. For immediate relief of Manhattan, however, the Port Authority seems willing to put into effect a more systematic control of lighter service and to encourage, if not to direct, store-door delivery and ferry-borne motor truck loads to interior stations. Such plans, not included at all in the city's scheme, are a proper first step toward a solution of Manhattan's freight difficulties.

As to costs, leaving aside the automatic railway, the estimates, each by its own proponent, are, for the city scheme, $110,000,000 (not including the Brooklyn middle belt, estimated by the Port Authority as $40,000,000) and for the bi-state scheme, $128,000,000, including the middle belt but not the Staten Island connection. Each has presented figured savings of great complication, and the railways have prepared others. These seem to indicate that the Port Authority plan would show greater economies, but the basis for all of the figures is on so many unknown and prospective conditions as to make comparison difficult. Certainly the cost prospects are of a most uncertain nature.

The questions of city representation on the Port Authority, the possibility of loss to the city from taxes on property taken over, the probable lack of co-operation of the railways in either scheme—all important features in the situation—are outside the range of this discussion. In our opinion they could well be made a matter of compromise although they are not important enough to kill the Port Authority bills. Under these bills, there is at least a possibility that the great New York port district will be considered as an engineering and economic whole and there seems to be no other way in which it can be so considered. The so-called "comprehensive plan" is not perfect but it is a start toward a solution. If in the future more feasible plans are presented, modification of the present plan can be made

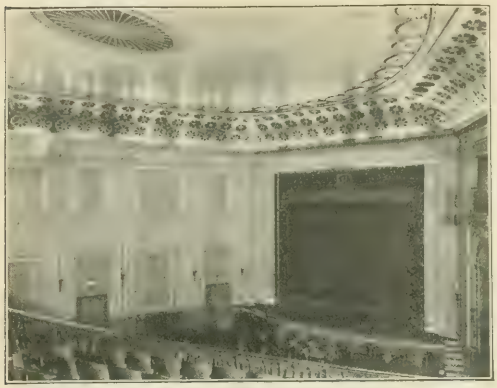


Fig. 1—Interior of Theatre Before Collapse



Fig. 2—Interior of Theatre After Failure

Facts of the Knickerbocker Theater Collapse

No Failure of Roof Steel Preceding Fall Has Been Discovered—Unseating of Main Truss the First Traceable Event—Skew Bearing on Curved Wall—Revision of Steel Design and Field Changes

FULLER examination of the ruins of the Knickerbocker Theater in Washington after the preliminary survey from which our report of last week (p. 207) was prepared confirms that report in its main elements. The steel-frame and concrete-slab roof fell in its entirety, without preliminary fracture of any part of the frame or failure of its supports. It fell within the walls and only one wall is slightly displaced. The bearing points of the steelwork show a sliding-off of the trusses, and all the detail phenomena point to initial unseating of the main truss and the nearby beams resting on the curved north wall. Slowly-acting cumulative causes seem to be responsible. Beyond this point the accident is unexplained; no adequate reason has been found for the unseating. However, the conditions of the truss bearing were abnormal. A review of the chief facts follows.

Drawings of the steel framing and truss diagrams are shown herewith (Figs. 3 and 4), from the design sheets of the fabricator. The detail drawings have only just been found, after being misplaced in a change of ownership of the shop, and were not available for the present report.

History of Work.—When the Knickerbocker Theater was planned six years ago the architect, R. W. Geare, retained M. S. Rich as engineer to design the steel roof framing. Later, the successful bidder for the steelwork stipulated that he be allowed to substitute trusses for the plate-girders and heavy beams to expedite delivery. The architect authorized such change subject to approval of the new plans by the city bureau of buildings, which was duly obtained; he did not check them himself or have them examined by an engineer. The re-design involved extensive change of the arrangement of the framing, so that the resultant design (Fig. 3) is substantially independent of the original design.

Mr. Geare prepared the architectural plans and supervised construction. C. A. Schneider's Sons were the steel contractors, and J. H. Ford of that firm prepared the design. Frank L. Wagner was the general contractor.

Two essential changes were made during the building: (1) As a result of discussion of the stability of the

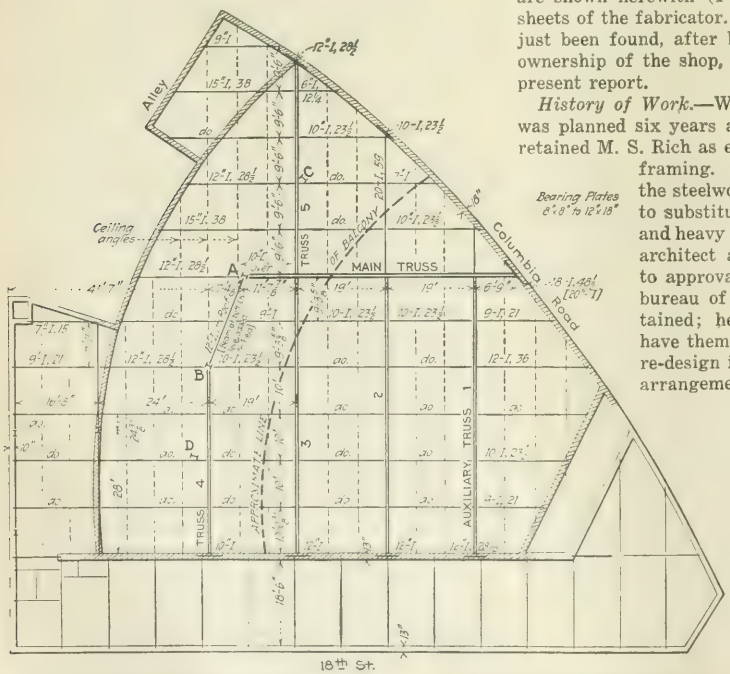


FIG. 3—FABRICATOR'S ROOF FRAMING PLAN OF KNICKERBOCKER THEATER (Eighteenth Street runs about north and south, north being to the right of the plan)

north wall before work started, Mr. Wagner secured the architect's authorization to strengthen this wall by inserting a reinforced-concrete belt course. This course as put in is described as having the full thickness of the wall and a depth of ten or twelve inches. (2) When the steelwork was partly erected, Mr. Geare concluded that the unstayed condition of the top of column *A* was hazardous and ordered a strut put in to connect the two roof columns at bottom-chord level. The strut was put in and is sketched in the perspective detail, Fig. 12.

Except for these changes the work as built was substantially in accordance with the design. The detailing of the steelwork was not first-class in all respects, but no pronounced weakness was developed even in its fall. The field connections were bolted.

Last summer, four years after the completion of the building, the balcony was extended 18 in. at the front to take two additional seat rows, according to Mr. Geare. A cantilever floor was laid on the floor of the bottom platform of the old balcony, consisting of pairs of 4-in. channels laid on the old floor and anchor-bolted into the riser of the first step, and a floor-slab construction supported by these channels. Three rows of seats were set on the extended bottom platform, and the passage-way moved to the first step. The steel supports of the balcony were not strengthened. At this time also the interior of the building was redecorated. No other change was made in the structure and no trouble or need of repairs was reported since the erection of the building, Mr. Geare says.



FIG. 5. POSITION OF MAIN PARTS AFTER COLLAPSE
Dotted lines show where upper section of Col. A was moved in clearing.

During the evening performance of Saturday, Jan. 28, at about 9:10 p.m., the roof of the building fell. Of the 400 or 500 people in the theatre at the time nearly 100 were killed—at last reports the fatalities had reached 97. A number of survivors have been able to make eye-witness reports, many of these telling of the fall of plaster or plaster dust near the front of the house, or even directly over the head of the orchestra leader. There has been a report also of a crack being seen to open in the ceiling. But it seems established that all the noticeable happenings at the time of the collapse occurred with such rapidity as to preclude the likelihood of any dependable observation or recollection of events.

Because of the cutting apart and removal of wreckage during the rescue work, knowledge of the position and appearance of the parts of the structure directly after the collapse is fragmentary, and the evidence as to what happened is therefore relatively indirect.

Arrangement of Structure.—Referring to the plan of the steel framing, Fig. 3, it will be seen that two roof columns near the rear of the house carry a truss system centering about a main truss which extends from Column *A* to the curved northwesterly wall. The main truss supports six secondary members (trusses and heavy beams). This column carries a load of about 135,000 lb., maximum roof live-load included. The other column, *B*, carries one end of a secondary truss. The relation of these two columns to the immediately adjacent roof framing is sketched in perspective in Fig. 12, from which it will be seen that Column *A* has a cap at roof-line level on which rests the bottom chord of the main roof truss, while Column *B* has the truss framed into it. In this sketch

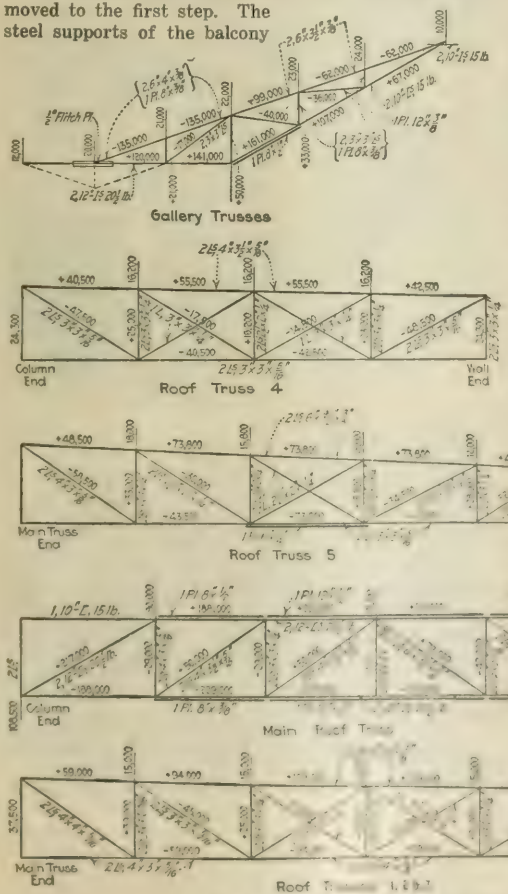
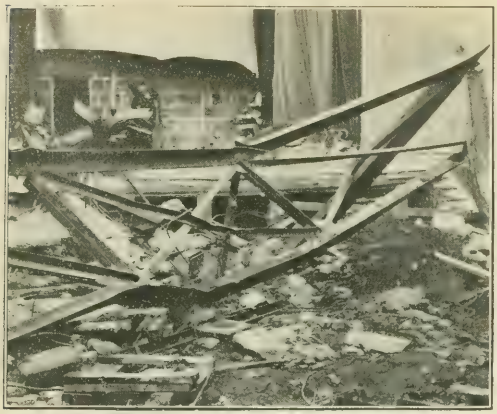


FIG. 4 MAKEUP OF [illegible] TRUSSES
From [illegible]













SOME DETAILS OF THE KNICKERBOCKER WRECKAGE

FIG. 6—NORTH AUXILIARY TRUSS (TRUSS 1)

FIG. 7—LOOKING WEST TOWARD REMAINING PART OF BALCONY

FIG. 8—SOUTH END OF MAIN TRUSS—Truss was not braced to column; two-angle strut seated on end of top chord and attached by two bolts supported three roof beams

FIG. 9—NORTH WALL, WITH 20-IN. I-BEAM ON WHICH MAIN TRUSS WAS SEATED

FIG. 10—UPPER PART OF THE EAST BALCONY COLUMN (COL. D), REAR FACE UPPERMOST—Column wrenched apart just below balcony truss

FIG. 11—BALCONY REMAINS AND MAIN ROOF COLUMN (COL. 1)—Upper part of column tipped over, top end on floor

appears the 10-in. 23½-lb. I-beam added in the field to brace the structure more completely.

The wall ends of all the trusses were supported by short I-beam distributing girders. The support at the north end of the main truss, for example, was a 20-in. I-beam about 8½ ft. long, supported on 16 x 16-in. steel bearing plates resting on wall piers of the same size. The seat of the truss was 30 in. from the northwest end of this beam. The other trusses were supported on single I-beams of smaller depth. The minor roof beams rested on small steel wall plates bedded in mortar in recesses of the tile wall.

The east and north walls of the auditorium were built throughout of hollow tile, with cells vertical, and were proportioned in thickness according to the requirements of the Washington building code prevailing at that time. The Columbia Road wall (at left in Fig. 1) was detailed in its exterior facade to appear like a three-story building, in order that the structure might harmonize better with the general residential character of this part of the city. The windows accordingly provided pierced the entire thickness of the wall, but were closed off by cloth screens behind the glass of the sash.

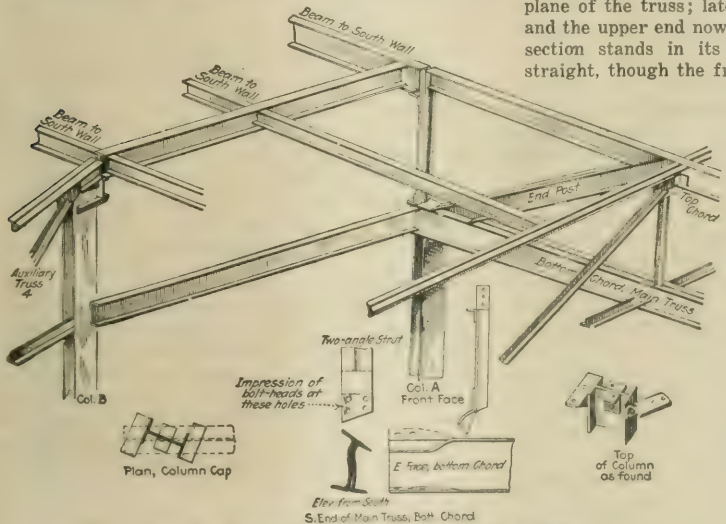


FIG. 12. FRAMING AT TOP OF COLUMNS A AND B
Lower strut between columns added during erection

The Collapse.—The entire roof, including steel framing and reinforced-concrete roof slab, fell into the interior, crushing down part of the balcony in its fall. It scratched some of the walls, and left the north or Columbia Road wall leaning out and somewhat cracked. There are several horizontal fissures on the inner face of this wall, at various levels, the lowest not far above ground, the wall is about 5 in. out of plumb (as measured by the city Bureau of Building Inspection), and a wide crack appears at the junction of the proscenium wall. With this exception, the walls are not involved in the accident, and all the seats of trusses and girders are in undisturbed position. Some of them show scratching and bending of the seat face, but none appears to be displaced. One or two beam-seat plates are missing.

Because of lacking knowledge of the position of all the parts of the roof framing, the sketch, Fig. 5, is confined to the parts that were left in the building when the wreckage was cleared out. The north half of the balcony is still in place, though its overhang was crushed down and a short stub column (*C*) supporting the balcony bent over forward to a sharp angle at the bottom of the balcony cantilever. The rest of the balcony was entirely crushed down, and has been removed. The main truss was found hanging across the east corner of the remaining part of the balcony, with its north end lying on the ground some distance east of the original line of the truss; the truss as a whole was 10 or 15 ft. south of its original position in the roof. It was subsequently cut apart with oxygen flame, and the several pieces of the truss now lie on the ground as may be seen in one of the views. Column *A* also went to the south. Its upper section, quite straight and undistorted, was found broken from the lower section at the splice just above balcony floor, but still standing on the lower section and simply tipped over against the south wall, about in the plane of the truss; later it was released from the wall and the upper end now rests on the ground. The lower section stands in its original position, and is quite straight, though the front flange is slightly twisted by lateral bending of the balcony truss overhang. The column is seen clearly in the photograph, Fig. 11. In Fig. 6, the truss leaning against the east wall is the north auxiliary truss (No. 1), fallen a little south of its position in the roof and apparently bent pretty badly in its fall.

No break is found in the main truss, and the truss is nowhere buckled. It exhibits some slight bends at or near the panel points, the first panel point from the south end being bent concave to the west (referred to the original position of the truss) and the other panel points slightly concave to the east. The main column, in spite of a high working stress, also is not buckled. Similarly, all other trusses and main members of the steel framing, as well as the subsidiary beams, show no indications of a primary failure. Numerous cracks, breaks, tears, and distortions are found, but in all cases they are evidently effects of falling or of the wrenching apart of members.

Column Distortions.—Contrasting with the straight and little disturbed condition of the main column, Column *B* is badly distorted in both upper and lower sections. Its several sections were found in the dump heap a mile or more from the building site, and separately sketched give a picture as reproduced in Fig. 13. At bottom-chord level of the truss there is a smooth but short bend in the column, in the plane of the flanges, the rest of the 23-ft. upper section being straight. The lower section is straight from the base plate to the bottom of the balcony truss, but here is folded over forward and to the right very sharply, about 45 deg. beyond a right angle. The bends of lower and upper part are not in the same plane. The destruction of the lower part is doubtless a result of the crushing down of the

balcony, the more so as it is nearly like that seen in Column *C*, where the bending however did not progress so far. The bend of the upper part of Column *B*, free from evidence of great violence, has more static character and may be concluded to have resulted from bending applied by Truss 4, after this had become free of the wall at its east end, and before the crushing of the lower section.

The fourth column of the building, a balcony column (*D*), is broken or torn entirely across just below the level of the balcony framing. This break, to all appearances, is the same as that of columns *B* and *C* at the same level but carried to complete fracture at the fold.

It is evident that none of these column failures was primary, and that all the columns stood up to their work until they were displaced laterally or bent by movement of the roof framing, or were crushed by falling masses from above. Thus, both trusses and columns are free from failure.

Wall Supports.—Examination of the seat of the main truss in the north wall and the seats of the four auxiliary trusses in the east wall discloses the following: The 20-in. I-beam which formed the seat of the main truss, supported on two 16 x 16 steel plates on mortar bedding on the tile wall (which here is carried out 5 in. inside the inner face to form concrete-filled pilasters which are flush with the main body of the wall below the ceiling line), is undisturbed on its bearing plates and shows no evidence of having been jarred or pushed out of place. The top of the beam shows faint scratches having the general direction of the truss, 1½ in. long, and then curving at right angles to the beam, stopping near the edge. The front edge is abraded for a length of 3 or 4 in. near the east edge of the truss chord to a width of perhaps ¼ in. Directly below this abrasion a small mark appears on the edge of the bottom flange, the size of a dime, which may be the effect of a blow; this mark does not go through to the bare metal. As may be seen from one of the photographs, the wall below the beam is practically free from scratches and shows no indentations, although the plaster line is six or eight inches beyond the edge of the I-beam flanges.

In decided contrast, the four auxiliary-truss seats in the east wall all show decided scratching, scoring and abrasions, and in general show a bending down of the inner flange (in the case of the middle two, nearly an inch). Abrasion is most decided in the case of the northerly seat, where at points corresponding to the edges of the truss chord the edge of the beam flange is decidedly cut in. The directions of the scratching and scoring on the top faces of the beams are: Truss 1, nearly at right angles to the wall or inclined a little southwest; Truss 2, about 30 deg. south of west; Truss 3, about 45 deg. south of west; Truss 4, more than 45 deg. Scratches and scorings on the wall below, where the trusses quite evidently struck in their fall, agree with these directions of scoring in indicating a swing or pivoting of the roof steel about points near the south end. The scoring and abrasion of the truss seats indicate that the auxiliary trusses moved on their seats rapidly and under load, while at the seat of the main truss there is no sign of rapid motion.

In the south wall, the beam seat directly in line with the main truss is missing. A plate, presumably this seat, was found in the alley outside the wall, below and three or four feet horizontally distant from the seat location in the wall. There was an appearance of the

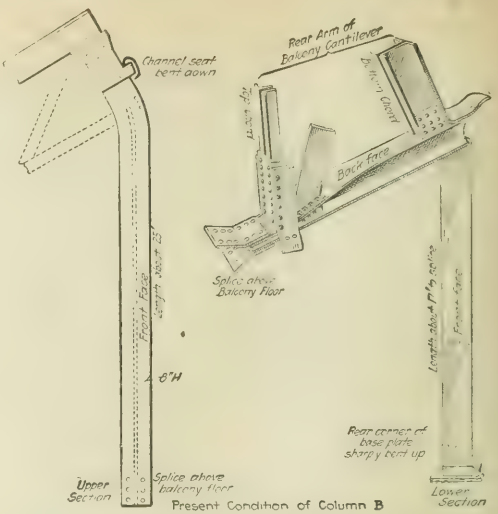


FIG. 13. PRESENT CONDITION OF COLUMN B

beam having moved southward (into the wall) 4 in. before pulling out of the wall. The beam seat on either side of this one had a similar appearance.

The north wall, whose 5-in. outward tipping has been mentioned, shows one or two holes, cut in the wall during the rescue operations. Some of the steelwork lay against the wall near its southwesterly end. Nothing could be learned from officials engaged in the rescue work to indicate that the wall was shaken or pushed out of plumb at this time. Air pressure developed within the auditorium during the fall may have played a part in forcing the wall out. No information on the condition of the wall before the collapse was obtainable.

Probable Cause of Failure.—In the absence of any discoverable steel failure, and in view of the lateral anchorage of the entire roof produced by the interconnection of roof slab and steel framing, only a displacement of the supports of the steelwork on the walls can be looked to as immediate starting-point of the collapse. From the direction of motion of the several parts the fall evidently progressed from the north side or the northeast corner southward.

The appearance of the bearing plates shows that the four auxiliary trusses were pulled off their seats by rapid motion under load, thereby becoming scored and ground. Further, the very great bending downward of two of the seats, which in the case of one of them was even great enough to bend upward the rear flange of the beam, points to the fact that they did not leave their seats until the middle part of the framing was much lower down. On the other hand, the seat of the main truss in the north wall does not show rapid motion under load, and this truss was displaced by a slow movement.

Considering the nature of the framing, it was virtually impossible for a slab failure to bring down the adjacent beams, for a beam failure to destroy the truss carrying it, or for an auxiliary-truss failure to wreck the main truss. Moreover, the appearance of the truss bearings and of the marks showing the direction of the fall make it clear that the auxiliary trusses came down after the main truss. The collapse therefore originated in a fall of the north end of the main truss, which event

would bring about all the effects of the collapse substantially in the way they were observed.

Failure Theories.—Several other critical points which have been under consideration during the examination of the wreckage by Washington engineers and investigating experts should be noted.

The unstable assemblage of parts on the main column, and the bending stress developed in this column by eccentric bearing resulting from truss deflection and from an apparent lack of perfect verticality of the column, has received much study. No buckling or other metal failure of this column occurred, however. Lateral deflection of the top, to east or west, would appear a most obvious danger, but failure in this direction was in a measure forestalled by the brace strut placed between Columns *A* and *B*, and in any event the column did not fail in lateral direction, but moved directly back against the south wall. Primary failure by backward movement of the top of the column could not occur so long as the entire structure was held in place by the roof slab and by the bearing friction of the trusses and beams on their wall bearings. However, such forcing back southward would occur as the first and most necessary result of a fall of the truss at the north wall. Calculations appear to show an uncomfortable overstress in Column *A*. Overstressing of the balcony columns is probable, in view of the widening of the balcony last summer; but only a small part of the full live-load was on the balcony at the ime of the collapse, and the failure of the balcony columns was obviously a result of the roof fall.

Other Observations

Failure of the north auxiliary truss has been discussed, because of a break about mid-length of the top chord, where the north outstanding leg of the top chord shows a rather brittle tension fracture. The truss is bent laterally at this point, and gives every evidence of having been distorted to its present shape by the fall. There is no appearance of buckling.

Reports of persons in the theater that the collapse followed immediately after the fall of some plaster dust or the like on the orchestra leader, who was just giving the signal for the music to begin at the close of the playing of the organ, led to a search for evidence of a beginning of failure in that part of the roof directly in front of the proscenium wall. The plate seats in the wall are in place, and show sliding marks on their top faces. A movement of the entire roof framing away from the north wall (or vice versa) might have carried some of the minor beams off their seats before the main truss was off its seat; but as the dropping of these beams could not have brought down the main truss it would be necessary to conclude that the truss reached the edge of its wall seat only a moment later, and then started the general collapse.

Loads.—As to the load conditions, and especially the heavy snowstorm raging at the time of the collapse, the best estimate of conditions fixes 12 lb. per sq.ft. snow load as maximum allowance. This corresponds to about 2½ in. water, about what was reported by the U. S. Weather Bureau as the precipitation during the storm up to the evening of the collapse. The weight of the motor and fans in the large ventilating hood on the roof, about over the center of the auditorium, does not appear to be a significant item. There was no other extra loading on the structure.

North Wall.—In view of the probability that the main truss was unseated by outward movement of the north wall going on during a long time rather than in one abrupt motion, the construction of this wall is of interest. The wall was in general 18 in. thick in the body, slightly increased in thickness by pilaster formation on the outside; in addition to the 18 in. thickness there was 4 in. of ornamental facing, either brick, stone, or stucco on tile, varying according to location on the wall. The wall was broken by numerous windows and doors, as already mentioned.

Prior to 1913, walls of hollow tile were not admitted as bearing walls in the District of Columbia, but revision of the code in 1913 made such walls permissible on even terms with brick or other walls for buildings up to 40 ft. high. There is no evidence to show that this provision contemplated the construction of walls in open-space buildings such as theaters, but the code appears to have lacked a structural section in its theater portion and therefore made the general structural clauses applicable to theaters as well as to dwellings or stores. Skeleton construction is required for heights above 40 ft. when tile walls are used; the Knickerbocker was about 35 ft. high from curb to bottom chord of roof trusses.

The wall is still in place, and except for an outward tipping and breaking at horizontal joints appears to be unshattered as a whole. No explanation has been found for outward movement of this wall, or in fact for the possibility of such movement without detection. The ornamental ceiling of the auditorium, connecting with the wall plastering by a sweeping cove in which were numerous ornamental ventilation grills, would appear to preclude the possibility that a large outward motion of this wall could have developed in course of time without revealing itself by cracking or tearing apart of the interior finish or the fall of tile fragments as the single-angle roof strut on the end of the bottom chord tore out of the tile in which it was imbedded. Such occurrence would have been brought to the attention of the architect, and Mr. Geare states that nothing of the kind was done.

Summary.—In the face of this absence of advance indications, the physical evidence establishes that the collapse was caused by separation of the main truss and the north wall. It seems probable, but is not clearly proved by the facts available for the present report, that this movement was a slow creep rather than a rapid or violent separation, and in the same degree it seems probable that the wall was a more important factor in the movement than the steel frame.

Motor Fees For Roads Total $108,000,000

Of $108,213,165 collected in registration fees from 9,245,195 passenger cars and commercial vehicles, 28,114 trailers and 177,234 motor cycles as well as chauffeurs' licenses in the 48 states and the District of Columbia, Jan. 1 to July 1, 1921, according to the U. S. Bureau of Public Roads, the sum of $101,793,416 or 94 per cent is available for good roads. The total revenue for the year 1920 in registration fees was $102,546,212.25. The revenue for the first half of this year, therefore, exceeded the entire revenue for 1920 by $5,666,953.08 Of the 9,245,195 registered vehicles, 8,363,427 are passenger cars, 844,110 trucks, and 37,658 are taxis and buses.

Antenna Tower Erection For New York Radio Central

Floating Gin-Pole Erects Body of 410-Foot Tower—Method of Raising the Pole—Cross-Arms 150 Feet Long Weighing 16 Tons Hoisted in Two Counter-balancing Sections—Upper Part of Tower Bolted

By David S. Fine
Assistant Erecting Engineer, American Bridge Co., Philadelphia

IN THE RAPID development of tower-erection methods called forth by the great expansion of radio work during recent years, new requirements are apt to call for improved and modified methods, or ingenious application of existing methods. This was the case with the towers of the New York Radio Central Station at Rocky Point, L. I., where the use of four-legged instead of the usual three-legged construction, and very long, heavy cross-arms led to novel methods of construction. It may be here noted that the 150-ft. cross-arms, weighing 16 tons, were raised in two completely assembled sections to the top of the tower, which furnished a working base only 10 ft. square. Such cross-arms are larger than ever used before but they promise to become a standard feature of radio design.

The station, recently opened by the Radio Corporation of America, occupies a plot of 10 sq.mi. located about



FIG. 1. NEW YORK RADIO CENTRAL; TWELVE 410-FOOT TOWERS

70 miles from New York City. It is planned to have ultimately 72 towers, in twelve radial wings of six towers each, radiating from a central radio power house. When completed it will be the largest and most powerful in existence, and will communicate with all parts of the world.

Twelve towers (Fig. 1), forming two wings of six towers each, were erected. They are spaced about 1,250 ft. apart, making the length of each wing more than a mile. They are 410 ft. high and carry eight antenna wires on either side of the 150-ft. cross-arm. The lower 250-ft. part was riveted and painted, while the remaining 160-ft. height and the cross-arm were bolted, the latter for the reason that this part of the structure is galvanized, to avoid the necessity of closing down a wing for painting near the antenna wires.

The towers are square in plan, and have rolled angle members for diagonal bracing, thereby differing from most of the previously constructed high radio towers, which are three-legged and have adjustable rod bracing. Permanent steel ladders extend from ground to cross-arm, on the outside of the tower. The two end towers of each wing are heavier than the four intermediate towers, though of similar construction, as the antenna

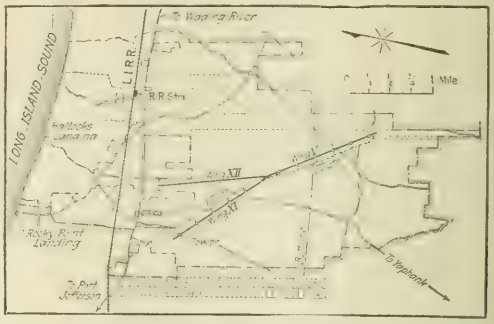


FIG. 2. PLAN OF RADIO CENTRAL AT ROCKY POINT, LONG ISLAND

wires on one side run to the ground instead of the next tower; the weight of an end tower is 142 tons and that of intermediate towers 130½ tons. The total tonnage in all the towers is 1,615 tons.

Material Storage.—The delivering and storage yard was located about 4 mi. from the central power house. Material was handled in the yard by one steel stiff-leg derrick of 12 tons capacity. The steel was not shipped tower by tower, but instead, in the case of the large members the total number of pieces of one kind required for all the towers was shipped together in a car, while in the case of the smaller pieces the total number needed for one tower was wired and shipped together. In the yard the steel was not sorted into twelve towers but all pieces of one kind were kept together.

A road, newly built for the most part, ran from the yard along the tower line, with a short tap road to each tower (see site plan, Fig. 2). The steel was distributed to the tower sites by auto trucks. As shortage of storage space made it necessary to haul the steel as soon as delivered, most of the distribution was done during March and April, when the freezing and thawing of the roads (in sand and clay soil) made hauling difficult.

Erection of Base of Tower.—The base of the tower (Fig. 3) is 60 ft. square and 70 ft. high, a height suitable for erection with a gin-pole. An 80-ft. gin-pole composed of 20-ft. sections of 10-in. gas pipe was raised to vertical position tipping it up with another gin-pole made of a 12 x 12 timbers 30 ft. long; the 80-ft. pole was picked simultaneously at three points.

In erecting the base, as many pieces as practicable

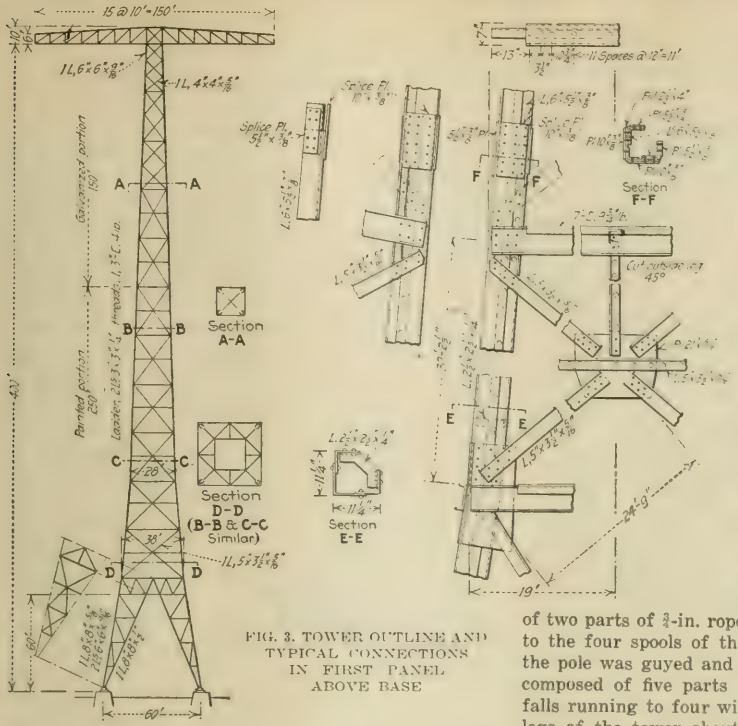


FIG. 3. TOWER OUTLINE AND TYPICAL CONNECTIONS IN FIRST PANEL ABOVE BASE

were bolted together on the ground and erected at one time (see view at left in Fig. 4). The gin-pole, which always worked inside of the tower, could be shifted to any part of the tower and tilted to any angle. The four triangular corner sections of the base were each supported, until connected so as to be self-supporting, by one wire-rope guy running back diagonally. The heaviest piece in the base weighed 3,000 lb., but the heaviest lift was 5,100 lb., this being the base section of leg with two auxiliary legs and bracing.

Erection of Body of Tower.—The body of the tower, composed of 10 panels of 30 ft. and one of 40 ft., is 38 ft. square at the top of the base section and 10 ft. square at the top of the tower. It was erected with a floating gin-pole, which is similar to the ordinary gin-pole except that it is suspended in several sets of falls instead of resting on the ground. The floating pole was the same 80-ft. gas-pipe pole used in erecting the base, with the addition of a steel saucer and fittings at the foot for the attachment of the four suspending falls, and a large special spider at the top. These changes were made while the pole was suspended from a runner line leading from the top of the base.

The floating pole (two views are given in Fig. 4) was rigged entirely with wire rope. It was suspended in four sets of falls composed of two parts of ¾-in. rope, the leads of the falls running to the four spools of the hoisting engine. The top of the pole was guyed and controlled by four sets of falls composed of five parts of ½-in. rope, the leads of the falls running to four winches fastened to the auxiliary legs of the tower about 20 ft. above the ground, one winch at each corner of the tower. The winches had single drums, with handbrakes and pawls, and were supplied as permanent items of the tower equipment, to be placed on the cross-arms for raising the antenna wires. The lower suspending falls were fastened to the tower by means of a wire-rope sling wrapped around the tower leg and over the horizontal strut at a panel point (Fig. 5), while the upper falls were fastened to the tower at the same point in a like manner with another sling wrapped around the tower leg but under the strut. The bottom of the pole was usually about

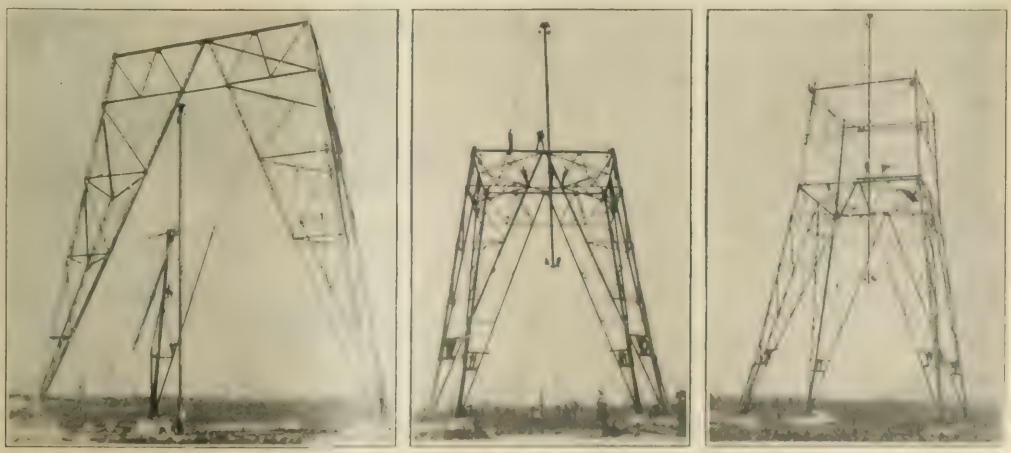


FIG. 4. ERECTING BASE AND BODY OF TOWER, FLOATING GIN-POLE

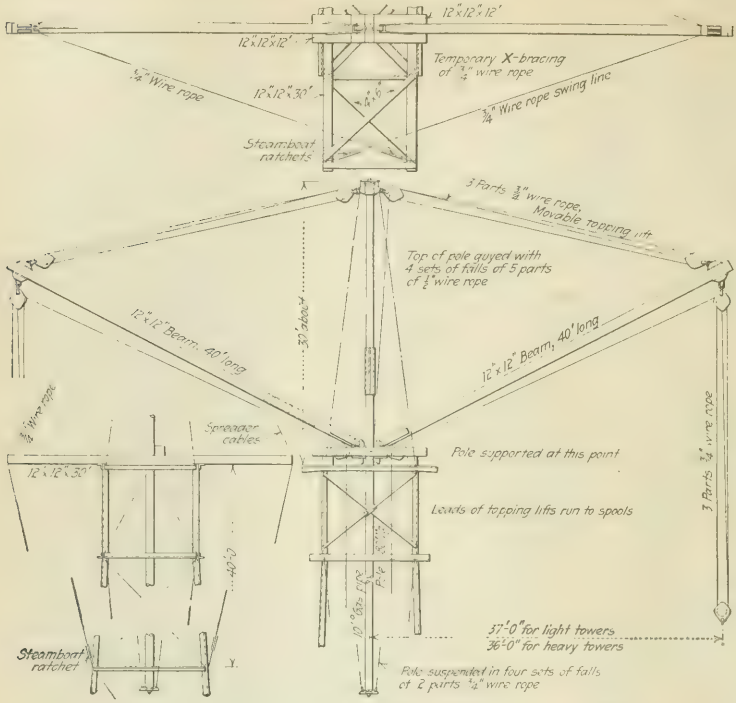


FIG. 6. TOWER-TOP RIGGING FOR ERECTING CROSS-ARMS

30 ft. below the horizontal strut. The load line consisted of a single part of ⅝-in. wire rope, the lead running outside of the pole.

All steel for the body of the tower was hoisted outside of the tower. In the lower portion of the tower the pole was leaned over, without load, to the proper tilt, and the steel while being raised to place was outhauled with manila-rope tag lines. However, in the upper portion of the tower it was necessary to lean the pole farther over the side of the tower than its final position called for, in order to reduce the amount of outhauling, and then, after hoisting the steel, boom up the pole with the winches before connecting. The top of the pole was very easily controlled by the upper falls and the four winches and it could be placed wherever desired.

In erecting the first six panels the tower legs were erected singly and the bracing in panels. In the upper five panels, where the steel was lighter in weight, two tower legs and a panel of bracing bolted to it were erected at one time. Where a panel of bracing alone was erected, it was necessary in order to prevent injuring the lower diagonals to turn them up and tie them temporarily to the intermediate horizontal strut. The bracing in the horizontal plane which occurred at every other panel point (Fig. 3) was not erected until the foot of the gin-pole passed that point, thus avoiding interference of the bracing with the lateral movement and tilting of the pole.

The heaviest pieces in the body of the tower were 3,400 lb., but the heaviest lift was 4,850 lb., which consisted of two legs and bracing of the fourth section below top of tower.

No elevator was provided for the men, but they used the permanent ladder for climbing up the tower; the men were able to climb from the ground to the cross-arm in ten minutes. Signals were given by megaphone, which proved more satisfactory than electric bell signaling. As the tower was not riveted until completely erected, the members had to be well connected with plenty of drift-pins and bolts as the erection proceeded.

Raising the Floating Gin-Pole.—After erecting a complete panel of tower the floating gin-pole had to be raised vertically about a panel height. But before this could be done, the sheave blocks of the upper and lower falls, fastened to the tower at a panel point, had to be raised to the next higher panel point and fastened to the tower as before. For this purpose the pole would be well leaned over to one corner of the tower and, while three sets of upper falls held the top, the block of the fourth or slack set of falls would be unfastened from the tower. The lead line of this falls would then be wound up on its winch, thus shortening the length of the falls and raising the block to the next panel point where it would be fastened to the tower. Then the block of the lower falls at the same corner would be raised, but as this set of falls was necessary to hold the pole in inclined position, it had first to be temporarily replaced by a

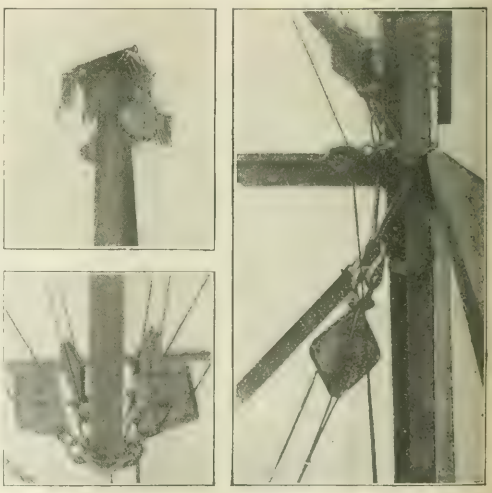


FIG. 5. SUPPORTS AND FASTENINGS OF FLOATING GIN-POLE

manila rope falls, after which the block of the lower falls was unfastened from the tower and by means of the load line of the floating pole was then raised to the upper horizontal strut as the lead of the falls was let out and the lower falls lengthened. When this raising of upper and lower falls was completed the pole would be leaned over to the other corners in succession and the operation repeated. The pole would then be placed in a vertical position and raised about 30 ft. by shortening the lower falls through winding their leads on the spools of the engine while the top guys were being let out, and the leads of the lower falls finally were clamped to the spools. The average time required to shift falls and raise the pole was fifty minutes.

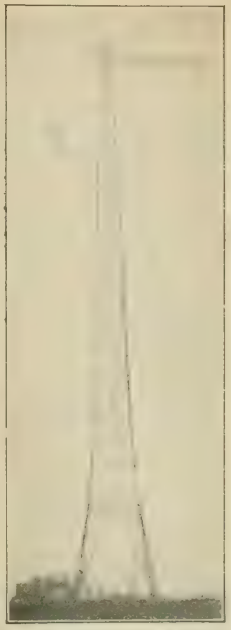


FIG. 8. HOISTING A HALF CROSS-ARM

The rigging of the floating gin-pole together with the method of erection as described is believed to be more adaptable to the type of tower erected than the rigging and methods which originated in the erection of three-legged towers with rod bracing, i.e., suspending the pole in cables of fixed lengths, raising the pole by one or more extra falls, hoisting the steel through the inside of the tower, and controlling the top of the pole from the tower top.

Erecting the Cross-Arm.—The cross-arm is 150 ft. long out to out and is composed of two sections 70 ft. long connecting to the sides of the tower, which itself forms 10 ft. of its length. The two half cross-arms weigh 8 tons each. A rather unusual and difficult problem was presented in their erection on account of their length and weight and the small working base.

While the cross-arm probably could be erected piece by piece by cantilever erection with a traveler working on each side of the tower, such method would be very costly and unsafe, particularly on account of the large number of small pieces and the difficulty of making connections at a considerable height from the ground. An original and unique method avoided these objections. It consisted of assembling the cross-arm in two sections on the ground, balancing them against each other, and raising first one and then the other to the top of the tower while maintaining the counterbalance. The method proved very practical and economical.

The rigging used for raising the sections of the cross-arm (Figs. 6 and 7) was essentially a two-boom guy derrick for which the floating gin-pole served as mast. The booms were 12 x 12 timbers 40 ft. long fitting into Chicago foot blocks resting on bearing plates fastened to two stringer timbers 12 ft. long. These timbers in turn were fastened to two 12 x 12 timbers 30 ft. long which were at right angles to the final position of the cross-arm and resting on the top of tower, which as stated is 10 ft. square. The booms were held fixed in position and in line with each other by swing lines running to the ends of the 30-ft. cross-timbers. The topping lifts consisted of three parts of ¾-in. wire rope, and after the booms were set for the proper reach the leads of the topping lifts were clamped to the spools. The floating gin-pole, which acted as a mast, was suspended in the four lower falls and guyed at the top exactly as when erecting the body of the tower, but with additional guying by four spreader cables which passed over the ends of the 30-ft. cross-timbers. The load falls consisted of three parts of ¾-in. wire rope. The timbers and booms with their rigging were placed and dismantled by the floating pole. The pole projected about 30 ft. above the top of tower, while the front reach of the booms was about 36 ft.



FIG. 7. BALANCED BOOMS ON TOWER TOP

Balancing the Cross-Arm Sections.—Each section of cross-arm was completely assembled and bolted by hand on the ground on its side of the tower at right angles to its final position. To avoid throwing an eccentric load on the tower and to prevent excessive unbalanced stresses in the floating pole and rigging, it was necessary when raising the cross-arm on one side of the tower that the effects of its weight be counterbalanced on the other side of the tower. This balance was obtained by simultaneously picking both sections clear of the ground, this throwing only a downward compressive force on the tower and equal loads on each boom. Then, while maintaining this relation, the section of cross-arm on one side was raised to the top of the tower (as the other section hung in the load falls close to the ground), turned at right angles by means of the tag lines, and

connected to the tower. Keeping the strain in this set of load falls, the other section of cross-arm was now raised (Fig. 8), turned and connected. Then the strains in both load falls were released and the rigging dismantled. The time spent in raising and connecting the two sections of cross-arm in calm weather was approximately four hours.

Riveting.—All rivets were ⅞ in. in diameter. Air was furnished by a cross-compound pump, the compressed-air outfit being placed at every third tower and the air piped to the adjacent towers. An L-shaped scaffold was used for riveting the columns. It was suspended from a small set of falls so that the scaffold could be lowered by hand as the riveting was carried down the tower leg. A float scaffold suspended in a set of falls was used for riveting the intersection of the diagonals (see Fig. 9, at left). The heaters with their forges, tools and supplies worked on a platform (at right in Fig. 9) suspended in the center of the tower, raised and lowered by a skeleton engine operated by air.

The galvanized portion of the tower was bolted with

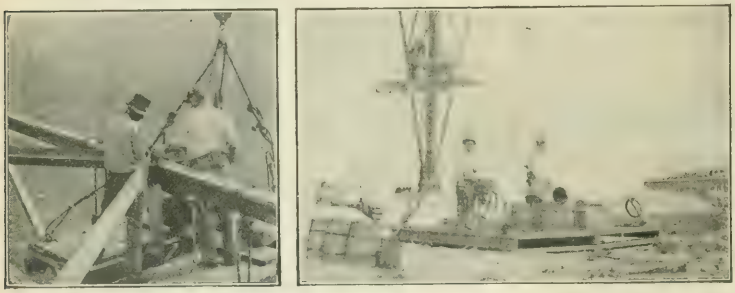


FIG. 9. ONE OF THE RIVETING STAGES—HEATERS' FLOAT

sherardized bolts which were checked with a diamond point to lock them. During the erection of the galvanized portion and the assembling of the cross-arms, as many bolts as possible were placed and checked on the ground, thus eliminating this work after erection. The cross-arms and the galvanized portion of the towers, which were bolted, formed a very rigid structure.

Organization.—The erection of the tower proper was carried on by a raising gang composed of a pusher, a hoisting engineer and thirteen bridgemen, five of whom were stationed on top. When raising the floating pole, four of the ground men were assigned to the winches and the other four to the spools of the engine. The average time required to erect the steel of one tower was 18 days and the best record made was 14½ days. Three towers were erected at one time.

The cross-arms were assembled on the ground by a separate gang some time in advance of their erection. The finishing of the erected cross-arms and the bolting of the towers was done by another gang. A tower was not riveted until completely erected, but the riveting was carried on during the erection of the other towers.

Very few men were hurt on the work and all injuries were of a minor nature.

The towers were designed by the tower department of the American Bridge Co., fabricated at the company's Ambridge plant and were erected by the Eastern Division erecting department, of which J. B. Gemberling is manager. Jerry Kennedy was foreman of erection in the field and the writer was resident engineer.

Winter Road Work Proving Successful in Minnesota

By E. M. Richter
Minnesota Highway Department

MINNESOTA is demonstrating both the practicability and the economy of winter highway work. Gravel surfacing operations are going forward on a large scale on both state and county projects; some heavy excavating is showing favorable progress, and three big paving contracts on the state trunk system have been let.

Foreseeing an unemployment situation of possibly serious proportions and anticipating action on federal aid highway legislation following prolonged delays, Commissioner Charles M. Babcock last August began making preliminary plans to continue highway operations on a maximum scale through the winter months.

An opinion from the attorney general that the collection of motor vehicle taxes accruing to the trunk highway fund might be anticipated, opened the way to match federal aid which was voted finally. Within ten days the Minnesota highway department announced a first list of winter work projects on the trunk system. It included approximately 300 miles of gravel surfacing, 50 miles of grading, and 50 miles of paved road.

That prospective contractors saw ways of cutting the costs of moving gravel by hauling on hard frozen roads and in many cases with sleds was evidenced by the low bids secured. Gravel surfacing figures averaged 23c. a yard-mile, and went as low as 17c. Three important concrete paving projects have also been let at low prices. Butler Brothers Building Co., St. Paul, was awarded the state job for 25 miles on trunk highway No. 1, between Westcott and Northfield at $2.26 a yard, with bar reinforcing and rock aggregate. McCree, Moos & Co. got the 22-mile project on T. H. No. 27 between St. Cloud and Royalton at $2.36 for the same type. An award remains to be made on the 10-mile extension between Royalton and Little Falls on which the low bids were $2.23 for bar reinforcement and gravel, and $2.40 for bar reinforcement and crushed granite.

The decision to let paving contracts followed inquiries which developed that much preliminary work could be done during the winter, including rock crushing and stockpiling. General Gustaf Widell, Mankato, an experienced builder, estimated that he could use fully one-fourth of his regular organization through the winter on any paving contracts awarded during November and December.

In addition to the state program comprising to date about $922,000 of winter graveling and grading, exclusive of paving projects, many "local team jobs" of gravel surfacing have been initiated both by state and country road authorities. In the extreme northwest section 388 farmers with teams were listed on the December payroll of the state district maintenance engineer covering special winter work on graveling operations. Traverse County on the west border

employed 367 men and teams to gravel state-aid roads under county supervision. J. H. Mullen, state highway engineer, predicts that barring extremely unfavorable conditions during the next two months, the Minnesota winter highway operations will be successful beyond expectations. The program has, it is stated, given employment to more than 7,500 men, who otherwise might have been jobless, according to the best available estimates.

Water Intake Protected Against Severe Conditions

Largest Traveling Screen Outfit in World—Pivoted Crane with Grab Bucket Removes Logs and Dirt from Deep Well

AN EXTREME water level variation of 71 ft. in the Ohio River, combined with an exceptional accumulation of debris, has led to the introduction of special plant for screening the water and removing the debris at the intake well of the West End power station of the Union Gas & Electric Co., at Cincinnati, Ohio. This plant includes the largest installation of traveling screens in the world, having sixteen screens 91 ft. high, and also a novel swinging crane for cleaning the well.



FIG. 1. PIVOTED CRANE WITH GRAB BUCKET FOR CLEANING INTAKE WELL

This equipment is shown in Fig. 1. Particulars of the intake well and tunnel, in connection with the foundation work of the station, were given in *Engineering News-Record* of Sept. 27, 1917, p. 593. With the four 30,000-kw. turbines in operation this station uses water at the rate of 208,000 gal. per minute.

At the power station site the river bed is rather contracted and the Licking River, entering the Ohio on the opposite side and above the station, deflects the debris toward the power station. In addition to the usual accumulation of leaves, boughs, straw and miscellaneous trash there are such large pieces as telephone poles, railway ties, logs and entire trees, besides which the water carries a large amount of mud and sand in suspension.

The intake tunnel, extending 164 ft. from the station, has its end entirely open, as it was feared that any grill would become blocked by logs and debris which could not be removed during high water and might thus put the station out of service. This tunnel is 25 x 10 ft. in section, with crossbraces about 10 ft. above the bottom. Its floor is 10 ft. below extreme low water and 5.7 ft. above the bottom of the intake well, 60 ft. in diameter. In spite of the well screens, a considerable amount of leaves, straw and mud found their way into the condensers. At numerous times it has been necessary to cut out a turbine to allow of cleaning the condenser, other stations then taking the load.

Original Screen Plan.—In the original arrangement, shown at the left in Fig. 2, screens or grills of vertical bars prevented the larger material from passing beyond the intake well. These grills had bars 3 x ½ in. spaced 2¼ in. c. to c. Finer material passing the grills was caught on traveling screens, one for each unit, consisting of endless belts of ⅜-in. mesh. These carried up the material to a trash trough, into which it was washed by water jets. Behind the traveling screens were vertical screens in 7-ft. movable panels, these being in duplicate, so that one panel could be removed for cleaning while the other was in service.

But with the tops of the traveling screens at the 34-ft. stage of the river any further rise of the water made it necessary to raise the panel screens, the space below them being then closed with blank or solid panels. This work required about seven hours, so that it was necessary to anticipate the river rise by several hours, removal of the screens being impracticable when the water rose above them. Several times the rise has been so rapid that all the screens could not be raised. With the blank plates in place they formed a pocket 40 ft. deep which filled with sand and debris. After the river fell, this had to be cleaned out before the screens could be lowered.

Removal of the vertical screen panels by means of electric hoists was such wet and disagreeable work that it was difficult to get men to handle it. If the men were not watched, they would fail to remove the lower panels, so that these became blanketed with dirt. Further, the dirt and trash sometimes accumulated so rapidly, in spite of the traveling screens, that the stationary screen panels could not be removed and cleaned fast enough. Under the high head of water the blocked screens sometimes buckled, requiring the service of a diver to get them out. Screen panels left in the lower position when the water rose above the 34-ft. stage were often found buckled when the water went down.

Improved Screen Plan.—These difficult and serious conditions led to a careful study which resulted in extensive changes in the screen system during 1921, as

will be seen from the drawing at the right of Fig. 2. Briefly, the single traveling screens were replaced by double traveling screens and the fixed screen panels were removed entirely. New grills with bars 4 x ⅜ in. spaced 3 in. c. to c. were set in the lower part of the openings, up to El. 452 (or river stage 23 ft.). Above this, some of the old grills were left but others were replaced with the new bars. The traveling screens were altered to make a closer fit with the frames and were lengthened to reach El. 502, making a total length of 91 ft., so that they will meet the conditions of flood stages in the river. To assist in cleaning the screens and intake well the floor above them, at turbine room level, was cut out and gangways were provided for maintenance and inspection of the screens.

For slush ice conditions, it is proposed to cut a connection from the discharge tunnel into the intake tunnel, which it parallels, so that the warm discharge water can be directed into the intake tunnel. This improvement has not been carried out as yet. A proposed system of water jets for cleaning the tunnel is to be investigated. This provides for three or four lines of 6-in. pipe laid on the floor and having ¾-in. jets about 3 ft. apart, inclined at about 45 deg. toward the well. These jets at 100 to 150 lb. pressure would be operated for about an hour daily. A further development would be the provision of two or three large jets in the river bed at the mouth of the tunnel in order to remove accumulations of mud and debris. This scheme has been used with success at the Licking River intake of the power house of the Covington & Cincinnati Street Railway Co., at Newport, Ky.

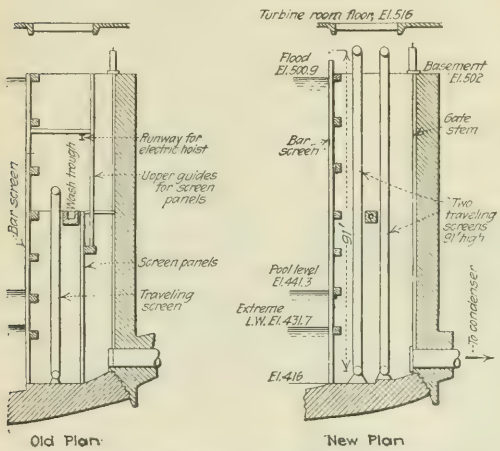


FIG. 2. OLD AND NEW SCREEN ARRANGEMENT IN INTAKE WELL

Cleaning the Intake Well.—For removing the accumulation of trash, logs and sand from the intake well, a grab bucket handled by a radial 5-ton traveling crane above the well was adopted after different plans had been considered. This crane swings on a vertical pivot at one side of the well and its outer end has wheels riding on a curved rail on the circular wall, as shown in Figs. 1 and 3. The span from pivot to rail is 49 ft. 10 in. and the vertical lift of bucket is about 100 ft. A ¾-yd. bucket is used, fitted with heavy teeth for gripping logs and other large obstructions. Two 7½-hp. motors operate the bridge and trolley travel and two of 45 hp. operate the bucket hoist. The crane covers the entire well and swings over a hopper having a discharge opening 4 x 6 ft., sufficient to carry off logs and other large pieces. These improvements were designed and carried out under the direction of C. W. DeForest, manager of the electrical department of the Union Gas & Electric Co., and Sargent & Lundy, Chicago, consulting engineers for the company. The new traveling screens were made by the Chain Belt Co., Milwaukee, Wis., and the pivoted crane by the Whiting Corporation, Harvey, Ill. Since the new installation was made there have been several bad river conditions, due to sudden rise of water bringing down great quantities of debris, but it is stated that these situations have been met without trouble.

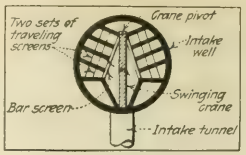


FIG. 3. PLAN OF SCREENS AND CRANE

The Average Engineer's Civic Duty

(Extract from paper by Prof. John H. Dunlap, president, Iowa Engineering Society, at Sioux City meeting Jan. 17 to 20, inclusive.)

HOW can the average, garden variety sort of engineer bring his training in applied science to bear upon the solution of the problems of the new era, for which his profession is so largely responsible? In Iowa the way is easy. In our principal cities our district clubs of engineers are meeting regularly and taking active interest in municipal affairs. These clubs are component parts of a strong state organization, which serves as a clearing house for the activities of clubs and seeks to render to the state the service for which the engineer is qualified. Moreover, our state organization is a member of the Federated American Engineering Societies. This is a comprehensive organization dedicated to the service of the community, the state and nation. In taking his part in public affairs, however, no engineer should think of his own selfish interest or reward. Each one of us should undertake to assist in the solution of at least one community problem, and give to it the best that is in him. In case the general public finds our service of value, whatever reward is attached to valuable service will naturally be ours. But the service must be first.

One plain duty of everyone is to initiate a plan, not in China or Africa, but right where he lives, which will gradually bring to pass a more intelligent and a more consecrated citizenship. As Theodore Roosevelt has said, the members of our communities should be graded not according to color, race, creed, wealth, education, family, but according to their performance of the duties of citizenship. To this end your attention is called to the booklet entitled, "A Plan for Unified Community Effort in American Citizenship." by Martin J. Wade, judge of the United States District Court. In brief, Judge Wade suggests a community council, representative of all patriotic and fraternal societies and clubs of the community, to meet at least monthly. Such a council could lay out a comprehensive program for a community and transform it in a generation into the best possible place in which to live, to build homes and rear children.

Second Simplon Tunnel Completed

On Dec. 4 the lining of the second Simplon tunnel, connecting the head of the Rhone valley in Switzerland, with the Italian slope of the Alps, was completed. Work had been in progress for nine years. It was not direct tunnel driving but enlargement work of the heading or ventilation tunnel which was driven at the time the first tunnel was put through. The tunnel is about 12¼ miles long.

New Committees for Highway Research

AT ITS meeting in New York City Jan. 16, the Advisory Board on Highway Research approved the report of the Committee on Researches and Research Committees (Prof. T. R. Agg, chairman) as noted in the news section of this journal Jan. 19, p. 125. The report, which carries the title "Suggested Researches and Research Committees," indicates certain problems needing study and outlines the following program of activities:

I. Committee on Economic Theory.

Problem: To determine all of the elements of cost of highway improvement.

The following will suggest the type of research involved:

A. Effect of grades, alignment, rise and fall, weather and speed and methods of operation on cost of transport.

B. Determination of all of the elements entering into the resistance to translation of vehicles (Tractive Resistance) and magnitude of each element.

C. Determination of the elements of cost of vehicle transportation classed as capital costs, and operating costs exclusive of those included in A and B.

D. To determine the relation between traffic and capital and maintenance costs of roads.

II. Committee on Structural Design of Roads.

Problem: To establish all of the data required for rational design of a road surface.

The following will suggest the type of research involved:

A. Determination of all facts relative to the behavior of the soil upon which roads are constructed, when under load from the road structure.

B. To determine the relation between traffic loads and stress in road surfaces, and to establish the laws that control.

C. To determine the effect of the elements on road structures.

D. To determine the structural strength of all types of road surfaces.

E. Relation of the vehicle to the road.

III. Committee on Road Materials.

Problem: To determine the most effective combinations of materials to give desired strength and to investigate possible new combinations of materials.

The following will suggest the type of research involved:

A. To establish the most effective combinations of materials now in use, with particular reference to the exigencies of field control.

B. To promote research looking to the establishment of new combinations of materials, or of the new materials suitable for road surfacing.

IV. Committee on Highway Traffic Analysis.

Problem: To establish an adequate method of studying highway traffic and to show how traffic records should be interpreted.

The following will suggest the type of research involved:

A. A study of relation of community development to the origin and destination of traffic, and to devise means for estimating potential traffic.

B. Proper methods for studying and recording volume of traffic, and for interpreting traffic records.

C. To devise units of measure to apply to traffic and to define those units.

D. To study the relation of highway betterment to traffic increases.

V. Committee on Highway Bridges.

Problem: To establish all of the facts required for the design of highway bridges.

The following will indicate the type of research required:

A. Determination of loads for which bridges should be designed.

B. Study impact on highway bridges.

C. Determination of the proper ... for standards of design as regards allowable stresses, widths and requirements of foundations.

VI. Committee on Highway Finance.

Problem: To determine the equitable basis for financing highway improvements.

The following will indicate the type of research involved:

A. Definition of an equitable basis for highway financing.

B. Study possible methods of financing improvements in the various political units.

C. Administrative methods required to insure equitable financing.

VII. Committee on Maintenance.

Problem: To determine the relation between traffic and maintenance costs of roads to investigate methods of maintenance and organization of maintenance forces.

The following will suggest the type of research involved:

A. Establishment of accounting methods that will give accurate data on cost of maintenance.

B. Methods of correlating maintenance costs and volume of traffic.

C. Relation of maintenance costs to methods of maintenance.

VIII. Committee on Subgrade.

Problem: To determine the supporting power of soils under all conditions; to investigate methods of increasing the stability of subgrades and to consider any similar problems having to do with the characteristics of subgrades.

Committees VII and VIII were added to this report at the suggestion of the Director of Highway Research and have not been considered by the entire Committee on Research, due to the lack of time for the necessary correspondence. If these are constituted, the field of Committees I and II should be modified so that no overlapping exists.

It is believed that the results of the work of the six committees suggested herein will show the need for investigational committees on Vehicle Design and Construction Methods, but the establishment of such committees is not recommended at this time.

Experience with Creosoted Piles

The practice of steaming piles and timbers as a part of the creosoting process is not approved or followed on the Atchison, Topeka & Santa Fe Ry. It is found to lead to irregular penetration of the oil, according to a recent paper by A. F. Robinson, bridge engineer of the railway. Examinations of old treated piles which had been subjected to steaming showed that the thickness of the treated shell might be from that of a mere skin to a thickness of 2 in., the thickness varying all around the pile. This irregularity was considered due to moisture in the piling as a result of steaming and improper seasoning. When the railway opened its own treating plant at Somerville, Tex., in 1907, all the material was carefully air cured and no steaming was done. In this way a very uniform penetration has been obtained. In Mr. Robinson's opinion different rules for air curing will be required in sections having varying moisture conditions.

Where damaged creosoted piles were found in trestles, they were cut down to solid wood and the heads then covered with three or four coats of hot creosote mixed with heavy road oil. A sheet of prepared roofing was placed on each head and a ... was set in place, being drift-bolted to the [illegible] piles. It was found that decay was sure to start promptly where the new chamfered pile joined the cap on the [illegible] age. Bored holes for easy brace pins or trimmed [illegible] pile keys to make the easy brace pins draw straight.

Live-Loads for Motor-Truck Storage

Amount and Distribution of Weight in Trucks of Different Sizes and Makes—Grouping of Wheels Producing Maximum Floor Stresses—Equivalent Uniform Loads

By E. L. Verveer
Structural Engineer, New York City

STORAGE buildings and garages for commercial vehicles present a special problem because of the high concentrations involved, the variation of weights and dimensions of trucks, and the variable grouping of the loads on the floors. A study of these variables is presented in the following, based on the data of some 45 different makes of truck. It is intended to apply only to floors of slab-and-beam construction, but covers all sizes of modern motor truck up to 6 tons capacity.

In its effect on the floor itself, or the slab, a truck wheel is practically a point load. With respect to the supporting beams and girders, while the load might be considered distributed over the width of the tire, no material error is introduced by assuming the wheel loads concentrated. The actual distribution to the floor framing depends upon the style of construction employed. In a monolithic floor, the wheel loads will deploy more uniformly than where the floor is merely supported by independent members.

Motor-truck load comprises chassis weight, superimposed body weight, and weight of the maximum carrying load (pay load). The chassis weight is a definite quantity, depending upon the type and make of truck. The same is true of the pay load, but the body weight depends upon the use to which the truck is to be put. The chassis length of any particular make for a specified capacity often varies, depending in a measure upon the type of body. This variation in chassis length occurs in the loading space, that is, the distance from the back of the driver's seat to the rear end of the frame. The length from the center of the rear axle to the rear end of the body will also vary from a minimum for a dump-body to a maximum for other styles. Although the chassis weight for any particular capacity will increase with its length, this increase is very small and not large enough to influence the calculations materially.

Body and Chassis Weight.—To avoid overloading the chassis when the full pay load is applied, the maximum body weight for a given truck is limited. For the sake of uniformity, the National Automobile Chamber of Commerce in 1912 adopted the standard body-weight allowances given in Table I. These weights were used by the majority of truck makers up to the past year, when they were revised to the weights shown in the third column of Table I. These weights are in common use, or in any case they will not differ much from the weights of actual truck bodies.

TABLE I—STANDARD BODY-WEIGHT ALLOWANCES

(National Automobile Chamber of Commerce)

Capacity Tons	Standard Body Weight, Lb. Old Std.	New Std.
½	750	1 200
1	900	1,200
1½	1,050	12,00
2	1,200	1,500
2½	1,350	15,00
3	1,500	2,000
3½	1,600	2,000
4	1,700	2,000
5	1,800	2,500
6	1,900	25,00
7	2,000	25,00

For information furnished by the leading truck manufacturers, chassis weights are found to range as listed in Table II.

Weight Distribution.—From 45 to 60 per cent of the chassis weight is carried by the rear tires, the average being 55 per cent. The percentage should be assumed at 60 when not known. In most cases, 80 per cent of the body weight is borne by the rear axle, but quite frequently this percentage may be as low as 60 or as high as 100. If not known, not less than 90 per cent should be used for purposes of floor-load computations. The pay load is distributed in the same proportion as the body weight. The portion of the combined chassis and body weights carried by the rear tires varies from 52 to 66⅔ per cent for different makes. It is about 60 per cent for 3½-ton trucks and under and 66⅔ per cent for those over 3½-tons capacity. When the actual amount is not given, it is advisable to assume it at 66⅔ per cent.

TABLE II—WEIGHTS OF COMMERCIAL CHASSIS

(Data from Manufacturers)

Truck	Range, Lb.	Average Lb.
1-Ton....	3,000—4,600	3,500
1½-Ton....	3,400—5,000	4,200
2-Ton....	3,800—5,500	4,800
2½-Ton....	4,200—6,000	5,000
3-Ton	5,400 -7,500	6,200
3½-Ton....	6,400 —8,100	7,000
4 -Ton....	7,200—8,100	7,600
5- Ton	7,500 —9,300	8,800
5½-Ton..	8,500—8,750	8,700
6- Ton..	8,500—9,600	9,200

When a truck is fully loaded, the rear tires support from 58 to 80 per cent of the total load, depending upon the make of truck, but for use in practice 75 per cent of the total weight (chassis, body and pay load) is a good value to use for normal conditions of loading.

Total Weight.—Table III gives the range and average of combined chassis, body and pay load for trucks of different capacities, according to data furnished by the makers. Table IV gives dimensions and weights for standard trucks of typical makes.

TABLE III—LOADED WEIGHTS OF COMMERCIAL TRUCKS

Truck	Range, Lb.	Average, Lb.
1- Ton	5,400— 6,800	6,400
1½-Ton	7,300 — 9,300	8,200
2- Ton	9,000—11,000	10,300
2½-Ton	10,500—12,500	11,300
3- Ton	12,800—15,200	14,000
3½-Ton	14,300—17,100	15,600
4- Ton	17,000 —17,600	17,500
5- Ton	19,300—21,700	20,600
5½-Ton	21,200—21,700	21,300
6- Ton	22,400—24,000	23,600

The upper floors of a garage, that is, those above the first or ground floor, are very seldom called upon to sustain any pay load. The live loads to be used for the design of such floor systems are, therefore, those derived from the chassis and body weights only. Where ramps are employed, impact should be included.

The ground floor usually rests upon the soil, but for cases where there is to be a basement, necessitating an independent floor system, both impact and pay load should be provided for, as loaded trucks are often driven into the first story.

The loading diagrams used to compute the bending moments, shears, etc., are shown in Fig. 1 herewith. The second column represents the rear axles of two trucks placed side by side, the third column the rear wheel of one truck and the front wheel of another directly behind it, the fourth column the rear wheels of two trucks back to back.

Floor-Beam Stresses—Ordinarily trucks are placed parallel or at right angles to the floor beams. Investiga-

tion of both arrangements will show that the maximum conditions of loading occur when the trucks are at right angles to the floor beam and the axles directly over and parallel to the beam. The maximum bending moment may then be obtained by applying as many multiples of the loading diagram in Fig. 1 (Col. 2) as can be placed on the beam and at the same time fulfill the criterion for maximum bending moment. The same method applies to finding the shears.

Tables V to VIII inclusive give the maximum bending moments, equivalent uniform loads, maximum end shears, and concentrations, for beams of 15 to 30 ft. span, for trucks of 1, 1½, 3½ and 5 tons capacity. The corresponding data for 2 and 2½-ton trucks may be obtained by proportion from Table VI, those for 3 and 4-ton trucks in the same manner from Table VII, and those for 6-ton trucks from Table VIII.

The coefficients K, Z and E, if multiplied by the rear wheel load P_R, will give the bending moment M, equivalent uniform load W, and beam concentration R, respectively. These coefficients are given so that, in case it is desired to substitute different values for P_R from those used in the tables, the corresponding values of M, W and R may readily be obtained. These tables apply to simply supported beams. For any other assumption of the supports, the maximum bending moments and shears may be found by proportion; the values of W, however, will not change.

For the maximum end shears (Col. 6) the first wheel is placed 9 in. from the center of the beam support for 1 to 2½-ton trucks, and 1 ft. for those of 3 to 6-ton capacity. Allowing for the flattening of the tire and the width of the supporting girder, such assumptions seem reasonable. Fig. 2 shows a typical diagram of maximum shears at various points on a beam when the loads move off from left to right, which is the same as assuming the beam partially loaded. Approximate working quantities for these shears may be found from the equations $V = V_m x^2/(l - 0.75)^2$ for 1 to 2½-ton trucks, and $V = V_m x^2/(l - 1)^2$ for the others, where V is the maximum shear at distance x from the right support, l is the length of the beam, and V_m is the maximum end shear. For rolled steel sections the end shears are ordinarily sufficient, but for reinforced-concrete or built-up steel beams the maximum shears at various points are required in order to provide proper diagonal

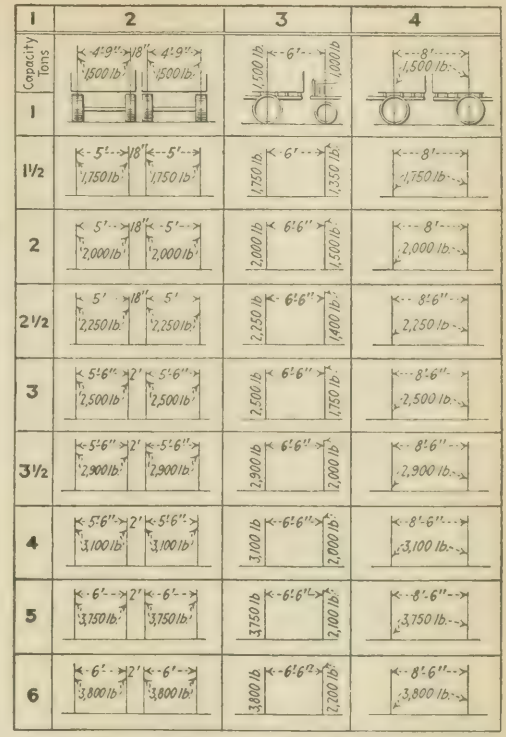


FIG. 1. LOADING DIAGRAMS FOR TRUCK STORAGE

TABLE IV. DIMENSIONS AND WEIGHTS OF TYPICAL TRUCK



Capacity Tons	L	W	A						Rear Axle	Gross and Body Weights		Gross Body and Pay Load	
										Front Axle Lbs.	Rear Axle Lbs.		Total
	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	In.				
1	16	7	5	11	4	8	4	5	5	1,942	2,428	4,370	2,102	4,268	6,370
	16	2	5	8½	4	8	4	10	4	1,700	3,100	4,800	2,095	4,705	6,800
1½	18	8	5	9	4	8	4	5	5	1,920	2,700	4,270	2,170	5,100	7,270
	18	1	6	1	4	10½	4	5	6	2,730	3,570	6,300	2,690	6,610	9,300
2	17	10	5	9½	4	8	4	5	5	2,020	3,000	5,020	2,240	6,780	9,020
	18	1	6	1	4	10½	4	5	7	2,600	3,800	6,400	3,000	7,400	10,400
2½	17	3	6	2	4	10	4	5	5	2,944	3,480	5,825	3,225	7,600	10,825
	18	8	6	2	5	0	5	0	7	2,700	4,100	6,800	3,110	8,690	11,800
3	17	11	5	10	4	8	4	5	10	4	6	2,700	4,122	6,822	5,460	7,362	12,822
	20	2	7	0	5	4	5	4	8	3,000	4,700	7,700	5,600	10,100	13,700
3½	21	7	7	2½	5	6	5	4	10	3,000	4,200	7,200	5,450	9,250	14,700
	18	6	7	0½	5	5	5	0	13	0	4,625	5,345	9,970	5,705	11,175	16,880
4	19	7	7	4	5	7	5	7	13	0	10	3,530	5,910	9,460	4,430	13,030	17,460
	23	7	7	4	5	7	5	7	13	6	12	5,020	6,020	9,570	4,430	13,140	17,570
5	20	6½	7	2½	5	6	5	4	13	4	12	5,616	5,684	9,300	4,818	14,482	19,300
	26	9	7	7½	5	8	5	4	17	0	14	4,110	7,890	11,800	4,850	17,150	22,000
5½	17	10	7	7	5	5	5	6	13	0	8	4,730	5,820	10,550	4,450	14,990	19,440
	22	10	7	7	5	5	5	6	15	6	8	4,715	5,985	10,700	6,305	14,995	21,300
6	18	1	7	0	5	7	5	7	13	0	8	4,025	7,225	11,250	6,370	17,620	23,990
	23	7	7	4½	5	7	5	7	15	6	8	4,500	7,600	12,100	5,505	18,495	24,000

tension reinforcement or web thickness and rivet spacing.

The maximum beam concentration R is the maximum load on the floor girder from the two beams of equal length framing into it, one on each side. These concentrations can be used for designing the girder. Since the total load computed from the unit load W does not differ much from the actual value of R, the same uniform live load can be used for the girders as for the beams.

As will be seen from Fig. 1, when the distance between beams, or panel width, exceeds 6 ft. for 1 and 1½-ton trucks, and 6½ ft. for the others, a part of the loads from the front axle of the next truck will be transferred to the beam carrying a set of rear wheels. Similarly when the panel is 8 ft. to 8½-ft., a portion of an adjacent rear-axle load may be transferred. Although it is possible that these additional load increments will be brought to the beam as uniformly distributed increments, it is on the safe side to assume them as concentrated. Then, if the panel width is 7½ ft. for example, and the trucks are of 3½-tons capacity, the total wheel concentration on the beam to be designed will be

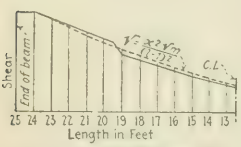


FIG. 2. MAXIMUM FLOOR-BEAM SHEARS FOR 25-FT. SPAN

$$2{,}900 + \frac{2{,}000}{7.5} \times 1 = 3{,}167 \text{ lb.}$$

When great accuracy is not required, the average uniform load per foot of beam, found at the foot of Column 5, or the average equivalent shear load per foot of beam at the bottom of Column 6, may be used irrespective of beam length. Dividing these loads by the panel width will then give the live load per square foot for bending moment and shear respectively. These average equivalent unit live-loads are given in Table IX.

The tests available at the present time from which to obtain practical working rules for the design of the floor itself are those of Prof. C. T. Morris (Ohio State Highway Dept., Bulletin No. 28), and W. A. Slater, E. B. Smith, E. B. McCormick and A. T. Goldbeck (Proc. Am. Soc. Testing Materials 1913; Am. Concrete Inst. 1915, 1916, 1917). All the tests were made on reinforced-concrete slabs, but from tests made on small models of heavy cardboard and wood the writer is convinced that the general conclusions reached by Goldbeck and other investigators apply also to other homogeneous material used in floor construction.

In general, it was found that when a concentrated load is placed in the center of a slab supported on two

MAXIMUM BENDING MOMENTS, EQUIVALENT UNIFORM LOADS, MAXIMUM END SHEARS, AND CONCENTRATIONS FOR BEAMS OF 15 TO 30 FT. SPAN, FOR 1, 1½, 3½ AND 5-TON TRUCKS

TABLE V—1-TON TRUCK

Dead Weight Pf on Front Wheel 1,000 Lb.
Dead Weight Pr on Rear Wheel 1,500 Lb.

1 Length c. to c. of Supports	2 Values of K (M = KPr)	3 Maximum Mom. M Foot-Lb.	4 Values of Z (W = ZPr)	5 Equivalent Uniform Load W Lb. per Lin. Ft.	6 Maximum Shear Vm Lb.	7 Values of E (R = EPr)	8 Maximum Beam Concentrations R Lb.
Ft.							
15	9.4	14,100	0.334	501	4,300	4.7	7,050
16	10.8	16,200	0.338	506	4,650	5.22	7,850
17	12.3	18,450	0.341	511	4,900	5.5	8,250
18	13.7	20,550	0.338	507	5,150	5.764	8,650
19	15.3	22,950	0.339	509	5,300	6.04	9,050
20	16.77	25,150	0.335	503	5,550	6.437	9,650
21	18.27	27,400	0.331	497	5,800	6.8	10,200
22	16.81	28,200	0.328	491	6,050	7.1	10,650
23	21.57	32,350	0.326	489	6,350	7.41	11,100
24	23.3	34,950	0.324	486	6,550	7.7	11,550
25	25.45	38,200	0.326	489	6,800	8.0	12,000
26	27.44	41,150	0.325	487	7,000	8.346	12,500
27	29.56	44,350	0.324	487	7,250	8.685	13,050
28	31.76	47,650	0.324	486	7,500	9.018	13,550
29	34.29	51,400	0.326	489	7,750	9.327	14,000
30	36.8	55,200	0.327	491	8,000	9.617	14,400
Average			0.330	495	(552)		

TABLE VI—1½-TON TRUCK

Dead Weight Pf on front Wheel 1,350 Lb.
Dead Weight Pr on Rear Wheel 1,750 Lb.

1 Length c. to c. of Supports	2 Values of K (M = KPr)	3 Maximum Mom. M Foot-Lb.	4 Values of Z (W = ZPr)	5 Equivalent Uniform Load W Lb. per Lin. Ft.	6 Maximum Shear Vm Lb.	7 Values of E (R = EPr)	8 Maximum Beam Concentrations R Lb.
Ft.							
15	9.04	15,800	0.321	562	4,900	4.7	8,200
16	10.29	18,000	0.322	563	5,250	5.031	8,800
17	11.80	20,700	0.327	572	5,550	5.324	9,300
18	13.30	23,300	0.328	575	5,850	5.583	9,800
19	14.78	25,850	0.328	573	6,050	5.87	10,300
20	16.29	28,500	0.326	570	6,300	6.175	10,800
21	17.79	31,100	0.323	565	6,550	6.5	11,400
22	19.29	33,750	0.319	558	6,800	6.818	11,900
23	20.85	36,500	0.315	552	7,150	7.152	12,500
24	22.57	39,500	0.314	549	7,450	7.437	13,000
25	24.41	42,700	0.312	547	7,700	7.72	13,500
26	26.48	46,350	0.313	548	7,950	8.0	14,000
27	28.47	49,800	0.312	547	8,150	8.37	14,650
28	30.45	53,300	0.311	544	8,450	8.66	15,150
29	32.70	57,200	0.311	544	8,750	8.983	15,600
30	34.94	61,150	0.311	544	9,050	9.283	16,250
Average			0.318	557	(625)		

TABLE VII—3½-TON TRUCK

Dead Weight Pf on Front Wheel 2,000 Lb.
Dead Weight Pr on Rear Wheel 2,900 Lb.

1 Length c. to c. Supports	2 Values of K (M = KPr)	3 Maximum Mom. M Foot-Lb.	4 Values of Z (W = ZPr)	5 Equivalent Uniform Load W Lb. per Lin. Ft.	6 Maximum Shear Vm Lb.	7 Values of E (R = EPr)	8 Maximum Beam Concentrations R Lb.
15	7.97	23,100	0.283	820	7,150	4.0	11,600
16	8.97	26,000	0.28	812	7,450	4.312	12,500
17	10.00	29,000	0.277	803	7,850	4.588	13,300
18	11.26	32,650	0.278	806	8,200	4.889	14,200
19	12.53	36,350	0.278	806	8,700	5.158	14,950
20	14.08	40,800	0.281	815	9,100	5.4	15,640
21	15.6	45,250	0.283	820	9,450	5.643	16,350
22	17.0	49,300	0.281	815	9,900	5.886	17,050
23	18.57	53,850	0.280	812	10,200	6.109	17,700
24	20.0	58,000	0.278	806	10,550	6.437	18,650
25	21.56	62,500	0.276	800	10,950	6.72	19,500
26	23.0	66,700	0.272	789	11,300	6.981	20,250
27	25.2	73,100	0.277	803	11,800	7.26	21,050
28	26.45	76,700	0.27	783	12,250	7.5	21,750
29	28.51	82,700	0.271	786	12,600	7.759	22,500
30	30.73	89,100	0.273	792	12,950	8.0	25,200
Average			0.2775	804	(896)		

TABLE VIII—5-TON TRUCK

Dead Weight Pf on Front Wheel 2,150 Lb.
Dead Weight Pr on Rear Wheel 3,750 Lb.

1 Length c. to c. of Supports	2 Values of K (M = KPr)	3 Maximum Mom. M Foot-Lb.	4 Values of Z (W = ZPr)	5 Equivalent Uniform Load W Lb. per Lin. Ft.	6 Maximum Shear Vm Lb.	7 Values of E (R = EPr)	8 Maximum Beam Concentrations R Lb.
15	7.6	28,500	0.27	1,013	9,000	3.8	14,250
16	8.56	32,100	0.267	1,003	9,400	4.0	15,000
17	9.53	35,700	0.264	990	10,100	4.235	15,900
18	10.55	39,550	0.26	977	10,200	4.556	17,100
19	11.84	44,400	0.262	983	10,600	4.842	18,150
20	13.04	48,900	0.261	978	11,250	5.1	19,125
21	14.57	54,600	0.264	990	11,800	5.333	20,000
22	16.07	60,250	0.265	996	12,300	5.545	20,800
23	17.57	65,900	0.266	997	12,700	5.783	21,700
24	19.06	71,500	0.265	993	13,100	6.0	22,500
25	20.56	77,100	0.263	986	13,500	6.28	23,550
26	22.25	83,400	0.263	986	14,000	6.534	24,500
27	23.57	88,400	0.259	970	14,450	6.813	25,550
28	25.00	93,750	0.255	957	15,000	7.071	26,500
29	26.82	100,600	0.255	957	15,800	7.31	27,400
30	28.48	106,800	0.253	949	16,000	7.533	28,250
Average			0.262	983	(1,115)		

(NOTE: Value of Γ_{m} at foot of column 6 is the average load perlin.ft. of beam to produce max. end shear.)

TABLE IX. EQUIVALENT UNIT LIVE-LOADS (LB./SQ.FT.) FOR BEAMS AND GIRDERS

Span	5		5½		6		6½		7		7½		8	
Capacity, Tons	*Wm*	*Ws*	*Wm*	*Ws*	*Wm*	*Ws*	*Wm*	*Ws*	*Wm*	*Ws*	*Wm*	*Ws*	*Wm*	*Ws*
1	99	110	90	100	83	92	78	87	74	83	71	79	67	75
1½	111	125	101	114	93	104	91	102	88	99	86	96	83	93
2	127	143	116	130	106	119	98	110	96	108	93	105	91	102
2½	143	161	130	146	119	134	110	124	107	120	103	116	100	112
3	139	155	126	141	116	129	107	119	104	116	101	113	98	109
3½	161	179	146	163	134	149	124	138	120	134	117	130	113	126
4	172	191	156	174	143	159	133	148	129	143	125	139	121	134
5	197	223	179	203	164	186	151	171	146	166	141	160	135	153
6	199	226	181	205	166	188	153	173	148	168	143	162	138	157

Wm for bending moment. *Ws* for shear.

parallel sides, the stress produced is distributed over a width, parallel to these two sides, equal approximately to twice the distance between supports. In other words, if the span of the slab is called S, the deflection at a distance S on either side of the load is practically zero, indicating that the effect of the load extends only over a distance of $2S$. The stress immediately under the load is greatest, and at a distance equal to S, measured on either side of the load, it becomes practically zero. The "effective width" is the width over which the concentrated load may be considered as uniformly distributed. This width, it was found, is changed very little by the percentage of reinforcement in the case of concrete, and is apparently independent of the magnitude of the concentrated load. It varies but slightly with the thickness of the slab.

Prof. Morris deduced the following equation for the effective width: $e = 0.6S + 1.7$ ft. This equation is applicable where the total slab width exceeds $1\frac{1}{2}S$ plus 4 ft. and was derived for use in highway bridge floor design. Mr. Slater suggested the equation $e = 0.8S + T$ for a load at the center and $e = 0.53S + T$ for two loads at the third-points, T being the width of the load, or in practice the tire width. From later tests, Goldbeck established a relation between the total slab width and the effective width from which he drew a curve

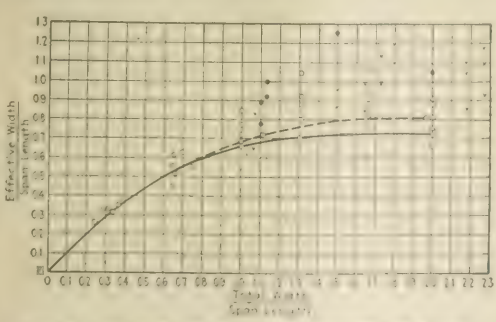


FIG. 3. CHANGE OF EFFECTIVE WIDTH OF SLAB WITH TOTAL WIDTH

shown in Fig. 3 by the full line. The diagram shows the plotted ratios obtained from the tests at hand; the writer would use, for floor slabs, the values indicated by the dash line in Fig. 3 and tabulated in Table XI. When the total slab width is equal to or more than twice the span lengths, the effective width e is approximately $0.8S$, and the formulas for rectangular beams may then be applied to the design of floor slabs by substituting $0.8S$ for the actual beam width b. Continuity of the slab does not change the effective width to any extent, merely changing the beam formula to be used.

In a building where the floor system is composed of beams and girders, excluding the long-span type of concrete construction, the length of the floor beams is usually greater than twice the span length. The equation $e = 0.8S + T$ can be applied in general to the design of the floor. The rear wheel loads are the ones to be used with the rear axle at right angles to the floor beams. The governing condition, in this case, is the maximum bending moment in the slab or arch. To illustrate the application of this equation, suppose the span length is 5 ft. and the floor is to support 1-ton trucks. Assuming each wheel load as extending over a length of 6 in. parallel to the supports, due to the flattening of the tire; $e = 0.8 \times 5 + 0.5 = 4.5$ ft. Each load of 1,500 lb. is to be considered uniformly spread over 4.5 ft. in the above direction. When e exceeds the distances between wheels shown in Column 3, Fig. I, these latter lengths must be used.

TABLE X. EQUIVALENT UNIT LIVE-LOADS (LB./SQ.FT.) FOR FLOOR SLABS

Truck Capacity, Tons	Span Ft. 4½	5	5½	6	6½	7	7½	8
1	225	185	155	145	135	125	115	105
1½	260	215	190	170	150	140	130	120
2	305	250	215	190	175	165	150	140
2½	345	290	240	215	190	180	170	160
3	335	285	245	220	190	175	165	155
3½	385	325	275	255	225	200	190	180
4	415	350	300	270	240	215	205	195
5	500	425	365	325	285	260	230	220
6	505	430	370	330	290	265	235	225

Suppose, now, it is desired to use an equivalent uniform load per square foot of span length in place of the above concentrated load. Three cases, then, present themselves: floor slab with both ends supported, floor slab with both ends fixed (continuous slab), and floor slab with one end fixed and the other supported. Comparison of the bending moments from concentrated loads with those from equivalent uniformly distributed loads for these three cases, will show that practically the same unit load W_a for each capacity truck and span may be used in the three cases for application in the customary formulas for uniform loading. Table X shows the values W_a for floor slabs for spans 4 ft. 6 in. to 8 ft.

TABLE XI. RELATION BETWEEN SLAB RATIOS

Total Width / Span Length	Effective Width / Span Length	Total Width / Span Length	Effective Width / Span Length
0.1	0.1	1.1	0.7
0.2	0.2	1.2	0.73
0.3	0.28	1.3	0.75
0.4	0.37	1.4	0.77
0.5	0.44	1.5	0.79
0.6	0.5	1.6	0.8
0.7	0.55	1.7	0.8
0.8	0.6	1.8	0.8
0.9	0.63	1.9	0.8
1.0	0.68	2.0	0.8

For general use the writer suggests the following live loads per square foot for the *beams* and *girders*: 1-ton trucks, 100 lb.; 1½-ton trucks, 115 lb.; 2-ton trucks, 125 lb.; 2½ and 3-ton trucks, 150 lb.; 3½ and 4-ton trucks, 175 lb.; 5 and 6-ton trucks, 225 lb. For the *floor slab*, these loads should be increased 50 per cent. For storage of trucks of mixed capacities, 125 lb., for 1- to 3-ton trucks and 200 lb. for the others are recommended, these loads also to be increased 50 per cent for the floor slab.

Sewage Screen and Pump Station at Pleasantville, N. J.

New Type of Rotary-Drum Fine Screens—Chlorination—Automatically Controlled Electric Drive for Both Screens and Pumps

By W. DeWitt Vosbury
Of Remington & Vosbury, Consulting Engineers, Camden, N. J.

IN designing works to treat the domestic sewage from the City of Pleasantville, N. J., fine screening followed by chlorination was adopted as the best solution of a difficult problem. The screens are of a new type and both screens and pumps are electrically driven, with automatic control.

Pleasantville is located on the edge of the mainland, approximately five miles from and due west of Atlantic City. Between the two cities there lies a tidal flat or meadow, dotted with ponds and transversed by a network of small, winding streams. The ground upon which the city is built averages but a few feet above the meadows.



VIEW OF ONE OF THE TWO FINE SCREENS AT PLEASANTVILLE SEWAGE-WORKS

A large tidal stream known as Beach Thorofare, and located on the opposite side of the meadows, immediately adjacent to Atlantic City, offered the only effluent point. This outlet was finally selected, although its adoption meant that all sewerage would have to be pumped a distance of some three and a quarter miles.

The depth of the sewer outlet below the surface of the marsh precluded the use of tanks in treating the sewage at that point, as, for obvious reasons, it would have been necessary to pump both to and from them. Furthermore, they could not have been placed at the terminus of the force main referred to above, as the location was inaccessible. The logical solution of this problem, and the one adopted, was the use of fine screens, followed by pumping, as owing to the limited space required by screens they could be placed at an elevation to receive the sewage by gravity.

The station consists of a rectangular building, superimposed upon a cylindrical shell, 30 ft. in internal diameter and 17 ft. deep. There are two floors. The first or motor floor is in reality a gallery which extends from the main entrance around three sides of the building to a stairway leading to the floor below. The second or screen floor is on a level with the outlet of the outfall sewer. With the exception of the dry well or pump pit, all of the space below this floor is used for the storage of screened sewage.

As the sewage enters the station, it flows through an open channel to the entrance of the chambers containing the fine screens, located on either side. After passing through the screens, the sewage returns to a point opposite the main channel, where it passes through an orifice opening into the storage well below. From the latter it is pumped to the outfall sewer.

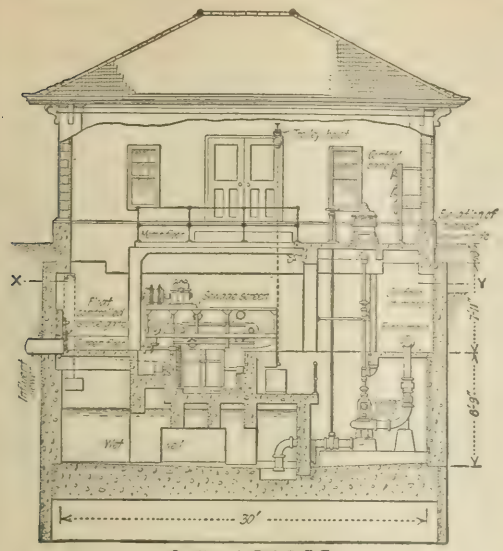
The mechanical equipment of the station consists of two motor-driven, centrifugal pumps, two fine screening units, auxiliary control and safety devices.

The pumps were built by the Buffalo Pump Co. and have a normal rated capacity of 1,000 gal. per minute. They are of the single-stage, bottom-suction, vertical-shaft type, with special sewage impellers. Experience gained by the writer in operating a number of sewage pumping stations has shown that frequent cleaning of the impellers is an essential of efficiency. For this reason each pump is provided with two openings, one in the shell and the other in the suction bend beneath. The cover plates for these openings are held in place by hand screws, which permit rapid removal and replacement. The pumps are driven by 20-hp. motors, mounted on the ground floor above. Besides the usual thrust bearings, built into the motors and pumps, a third thrust bearing, mounted beneath the motor floor, is used to support the dead weight of each vertical shaft.

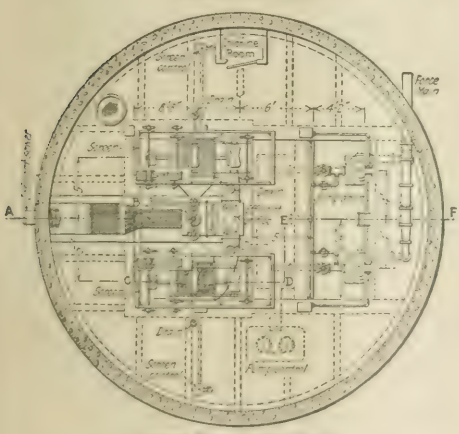
In determining the type of fine screen to be used, several points were carefully considered. The presence of mud, quicksand and large quantities of underground water made advisable the cylindrical form of the sub-surface structure and its construction by means of the open caisson method. The diameter of the shell, which was limited by cost and by the circular shape of the floor, restricted the space available for the screens to the minimum and, in turn, made the floor space they required an important feature. In addition, the station was designed to operate automatically, or at least without constant attendance. This meant that, besides being capable of producing a reasonable degree of clarification, the screens must be both rugged in construction and thoroughly reliable in operation. After a series of rigid tests, a new type of sewage screen, recently developed by the Link Belt Co., was adopted.

This screen is of the rotary drum type, with an ingenious mechanism for the removal of the solids collected. The screen proper consists of a cylinder or drum which revolves, partly submerged, in a concrete chamber at a circumferential speed of about 4 ft. per minute. The sewage enters from the outside and leaves the cylinder from the inside at one end.

The cleaning apparatus consists of four brushes which travel in a straight line, at a speed of approximately 38 ft. per minute, across the top of the revolving drum and parallel to its longitudinal axis. In addition to their motion of translation, the brushes also revolve about their own axis in such manner as to sweep the screenings in the direction of their path of travel into a chute, through which they fall to receptacles below. Removal of the solids in the sewage which do not adhere to the surface of the drum as it revolves out of the water is effected by a number of mechanically actuated sludge plates that project beyond the face of the drum, while rotating beneath the surface of the water, but which disappear as they are about to come in contact with the brushes.



Section A-B-C-D-E-F



Screen Floor, Section X-Y

PLAN AND SECTION OF PUMP AND SCREEN STATION

Each machine has a capacity of 1.5 m.g.d. and is driven by a 2-hp. variable-speed motor, although but approximately 1-hp. is actually consumed when operating under normal load.

These screens afford the means for an accurate comparison of two radically different types of screening surface. This difference consists in the fact that the drum of the one screen is covered with manganese bronze plates having $\frac{1}{8}$ x 2-in. slots on $\frac{1}{8}$ x 2½-in. centers, running parallel to the axis of the drum and in the direction of the travel of the brushes. The screening surface of the other machine is composed of stiff, phosphor bronze wires, mounted on a bronze frame, with $\frac{1}{32}$-in. openings or slots between.

The design of the latter type of screen followed a suggestion from the writer after a study of brush action in connection with various lengths of slots. In studying this action it was noted that the bristles of a brush in contact with the plate and when approaching a slot were slightly bent, and that as the slot was encountered, each bristle straightened out and entered with a downward motion. Although this motion was slight, the tendency at first was to push the finer particles which had collected over the opening actually through instead of along the surface and in advance of the brush. This action is, of course, repeated for every slot in succession as it is traversed by the brush, with a loss in efficiency proportional to the number of slots. It, therefore, followed that with but one long slot and one entry, the action of the bristles in pushing the solid matter through the opening would be reduced to a minimum. In addition, it was thought that by using parallel wires to form the slots, the clear openings between could be reduced to at least $\frac{1}{32}$ in. or possibly smaller without danger of clogging. This, in connection with a reduction in the number of entries to one, indicated an increase in efficiency over a screen with slotted plates. Simultaneous field tests run upon the two screens, one of which has slotted plates as already described, show the correctness of this assumption. Interesting data pertaining to these and other tests to follow will be published in a later article.

Automatic Operation

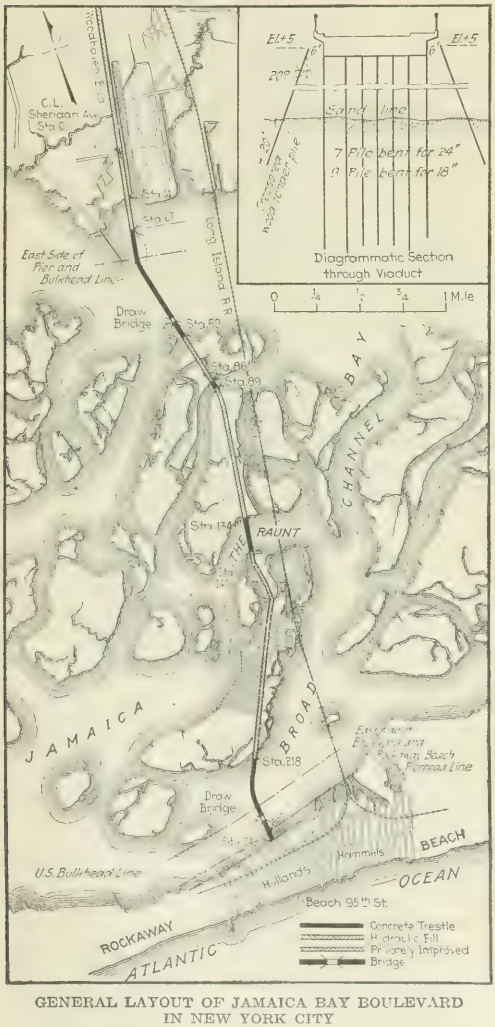
It is necessary to keep the screens in operation only during such times as the flow of sewage into the station is sufficiently heavy to require constant removal of solids from the surface of the screens to prevent clogging. For this reason, constant operation is not required. Like the pumps, the starting and stopping is controlled by floats. The permissible variation in the level of the sewage in the screen chamber is less than 4-in., however, which is not sufficient for direct operation of the float switches. This limitation has been overcome by placing each float in a separate well, formed by a section of flanged pipe supported by and on the top level with the screen floor. When, due to clogging, the water surrounding the screen reaches a level 2-in. above normal, it overflows a small weir, passes through a connecting pipe and fills the float chamber. This causes the float to rise, which in turn starts the screen motor, thus causing the drum and brushes to operate. After one or two revolutions the screen is cleaned and the water returns to normal level. The flow through the pipe leading to the well stops and the contents of the latter then drains out through an orifice in the bottom of smaller capacity than the inlet weir. When the well is about empty, the float shuts off the current and operation of the screen ceases, to be resumed only when clogging occurs again. Repetition of this cycle depends upon the volume of sewage flowing into the station. During part of the day, only, is constant operation required.

The flow of sewage into the station is controlled by a sluice gate, mounted on the wall at the entrance point of the main sewer. Under normal conditions the gate is raised and held in position by a float-actuated, trigger mechanism. If, however, through failure of the pumps to operate, the sludge in the storage reservoir beneath rises to a point where there is danger of flooding the station, the trigger holding the gate in position is tripped, the latter drops and the flow is shut off. Installation of this device has already been justified by failure of the power at night, during absence of the attendant.

Special Concrete Specified for Jamaica Bay Viaduct

Five-Mile Boulevard 52 Ft. Wide to Cross Ocean Bay in New York City Has Nearly 9,000 Ft. of Concrete Trestle, for Which 3,000-Lb. Concrete of Extra Density Will Be Required

CONTRACTS have been let by the city of New York for the construction of a low grade viaduct crossing Jamaica Bay from the mainland at the foot of Woodhaven Boulevard to Rockaway Beach on the Atlantic Ocean front. The total length of the viaduct will be 23,505 ft., of which 8,785 ft. is in reinforced-concrete trestle with two lift bridges and 14,720 ft. in earth fill, behind bulkheads for a small part. The trestle is



GENERAL LAYOUT OF JAMAICA BAY BOULEVARD IN NEW YORK CITY

52 ft. wide and is designed for street car and motor travel. As the concrete is exposed to sea water, special precautions in the way of extra density and high strength are being required of the contractor by the city.

The map above shows the layout of the bridge from which it will be seen that the viaduct, the trestle, and earth-fill section succeed each other across the bay depending upon the location of the islands which are very numerous here. Where the islands are at approximately low water level, a fill is used. In the open water, which has rarely a depth of over 6 ft. at present at low tide, the concrete trestle is used. The elevation of the viaduct is from 9 to 31 ft. above mean high water giving a 12-ft. clearance at the small-boat channel and a 4½-ft. clearance elsewhere. Where the deep channels occur are drawbridges, which have a clearance of 24 ft. when closed.

The city is contracting for that section of the fill between Sta. 89 + 34 and 134 + 48, but that part of the fill between Sta. 145 + 74 and the trestle at the Rockaway Beach end of the viaduct is being provided by private interests following the design, however, of the city. Through the construction of the viaduct the distance from the Borough of Manhattan to the Rockaway peninsula will be shortened by about 10 miles, and from the Borough of Brooklyn by about 6.5 miles.

After the design for the viaduct and for the trestle structure were prepared the city called in as consulting engineer Prof. William H. Burr, of New York, to make a critical examination of the plans, particularly in view of the sea-water exposure. The plans as approved and slightly revised by Prof. Burr are being used in the construction. General details of typical sections are shown in the accompanying drawings.

The typical trestle is a reinforced-concrete structure providing a 36-ft. roadway, one 12-ft. sidewalk, and one 4-ft. sidewalk, making a total width of 52 ft., carried on a seven-pile bent of 24-in. reinforced-concrete piles, with girder spans of 24 ft. grouped together in threes so that there is an expansion joint every 72 ft. Prof. Burr rejected alternate designs of creosoted piles on account of the teredo danger after the treatment had been dispersed by time, and also rejected 18-in. reinforced-concrete piles carrying a 24-ft. span and 4-ft. 6-in. concrete cylinders carrying 40-ft. spans. On account of the shortness of the spans, the closeness of the spacing of the piles, and the short distance between the sand line and the floor-beams, it was not thought necessary to use any crossbracing other than that furnished by the floorbeams themselves.

As shown in the details, the trestle structure itself is quite simple. It consists of 24-in. piles which are to be precast and reinforced as shown, reinforcement extending up into the floor-beams. The piles are spaced on 6-ft. 7½-in. centers and stringers are in line above each pile. The floor itself is a reinforced-concrete slab cast integral with the beams and stringers. Provision is made under the wide sidewalk slab for carrying conduits, etc. Expansion joints, as noted, occur every 72 ft. according to the design shown. The railing is a solid section spanning between 12-ft. posts.

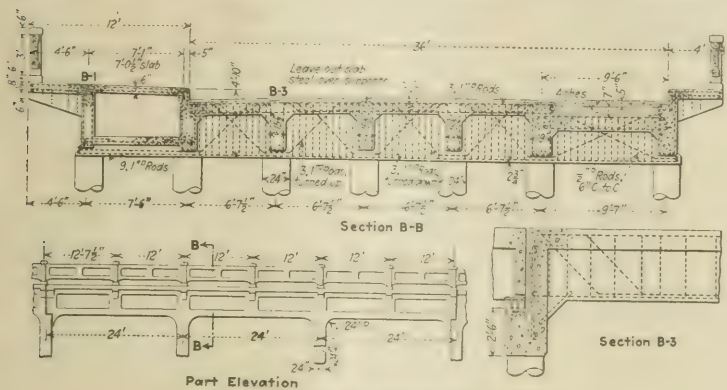
As noted in one of the drawings, the piles are protected by a timber sheathing in accordance with recommendations by Prof. Burr.

The sea-water danger is disposed of as follows in Prof. Burr's report:

There is serious question whether reinforced-concrete piles, either between high and low water, or above or below

that zone, can be constructed so as to be successfully resistant to sea water. Many statements can be found in engineering literature in which it is alleged that neither plain nor reinforced concrete can successfully withstand exposure to sea water for any material length of time. Wherever such instances of deterioration of concrete in sea water are alleged, it is generally found that the deterioration is due either to poor concrete due to insufficient cement in the mixture or to bad aggregates or insufficient mixing, or some other defect of material or treatment which may be, and should be, controlled.

Prof. Burr then continues and refers to a number of successful reinforced-concrete sea-water structures. He seems particularly impressed with the Aberthaw tests of concrete prisms in Boston Harbor, and on the strength



CROSS-SECTION OF THE CONCRETE VIADUCT

of those tests and of the work done in Halifax Harbor for the Intercolonial Ry. He recommends that the alumina content in the portland cement should not be greater than 6 per cent. His further recommendations are as follows:

In view of the extensive successful use of concrete in sea water work, as cited in this report, which has been confirmed by my own experience in similar constructions located at various points on the Atlantic Coast, from New York City north to Portland, Me., it is my recommendation that reinforced-concrete piles be used for this construction, the mixture of concrete for such piles to be equivalent to one cement, one sand and two broken stone, i.e., that the engineer responsible for this construction make investigations with approximately such proportions of mixture for the purpose of determining the most dense mixture possible with the aggregates available in the New York market. For such an investigation the sand may range in size from the finest product of a crusher up to grains with maximum dimensions of ¼ in. while the coarse aggregate may range from ¼ in. up to a maximum size of 1 in. A small percentage of the finest product of the crusher is permissible in the production of the most dense concrete possible.

The amount of water to be used in the mixture will depend somewhat upon the character of the mixture of cement and aggregates and should also be determined by actual tests. Preferably it should be "wet" but not too wet or sloppy. Obviously when the concrete is poured into the forms for the piles, it should be thoroughly agitated or "rodded" so as to secure an intimate bond between the concrete and the reinforcing steel and at the same time completely fill every part of the mold. The agitation or "rodding" should be done under the supervision of an engineer in a complete manner, not only for the purpose of thoroughly incorporating the materials but also to secure the greatest possible density. As indicated in the specifications, the piles should be hardened, or "seasoned" for at least sixty days before being driven.

Although experience shows that a rich, dense mixture of concrete is in itself effectively resistant to any disintegration or deterioration due to freezing and thawing, or to other destructive sea-water influences, it is, in my judgment, prudent to sheath each pile from 3 ft. above mean high water to 2 ft. below mean low water with a 3-in. thickness of timber rigidly secured to the pile. In placing this timber sheathing a heavy asphaltic preparation should be used as a coating to fill any thin openings which might otherwise occur between the sheathing and the concrete of the piles.

This sheathing with its asphaltic lining will not only prevent immediate contact of water with the face of the concrete between high and low tide but it will also guard the protected parts of the pile from any ordinary abrasion such as that due to floating ice, logs or similar debris. If any of the piles should, in spite of such protection, suffer abrasion under extraordinary circumstances, that abrasion can readily be repaired by the use of the cement gun now so commonly employed, or even by other means.

In order to give effective protection to the reinforcing steel from corrosion it is my recommendation that the exterior surface of such steel should be placed at not less than 3 in. from the exterior surface of the pile.

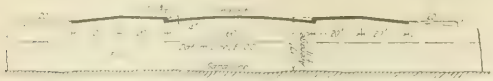
In order to secure the greatest possible supporting frictional area on the exterior surfaces of the piles, I recommend that the cross section be made rectangular but with the corners rounded with a radius of not less than 1½ in. nor more than 2 in. This rounded corner is not needed throughout the depth of penetration of the pile and may be omitted if desired for that part of its length, but it should certainly be used from the top of the pile down to the elevation where pentration begins.

It is my recommendation that the concrete mixture for the longitudinal and transverse beams, or girders, for the roadway should be the same as for the piles, as at many points their exposure during storms will be such as to subject them to heavy spraying. The roadway slabs or plates, however, are distinctly more protected. It is my further recommendation, therefore, that the mixture for these roadway slabs be equivalent to 1 cement, 1 sand, and 3 broken stone, the exact proportions to be determined by actual trial so as to produce the greatest density possible with the prescribed mixture.

It should be insistently observed that in the design and construction of a work of this character with reinforced-concrete members exposed to sea water with a considerable range of tide, the materials to be used should be thoroughly inspected in order to secure the best of their kind for the work contemplated and that the processes of their fabrication should be of the most effective character to accomplish the desired results. Again, through the whole operation of fabrication and putting in place of all parts of the structure, no measure calculated to produce the best results in this field of work should be omitted or even modified in such a way as to reduce the enduring quality of the final work.

All of the recommendations made by Prof. Burr are embodied in the design and in the specifications. Some special features of the specifications in regard to strength and density, however, are of peculiar interest and novelty. The clauses of the specifications in respect to the concrete are as follows:

It is intended to obtain a concrete mixture of the maximum density possible and the contractor should use only the best grade of materials of most uniform kinds

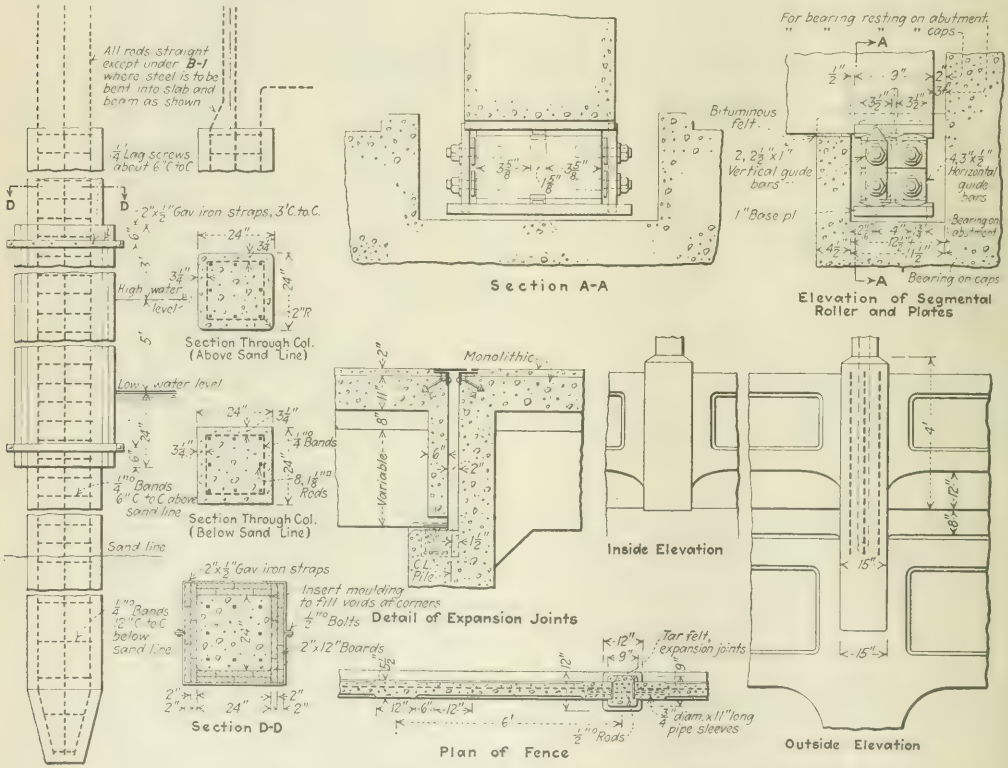


TYPICAL CROSS-SECTION OF EARTH FILL PART OF JAMAICA BAY BOULEVARD

and exercise great care in mixing the materials so that this maximum density and strength are obtained. The minimum requirements for cement are given below, [They are practically the standard specifications except that the alumina content shall not be greater than 6 per cent.—Ed.] but bidders are cautioned that a more finely ground cement than described is at least desirable to obtain the required density and strength of the cement. . . . The sand shall be composed of grains of clean, sharp quartz not softer than hard limestone; it shall be moderately coarse, preferably made up of grains of varying size not exceeding

Concrete Proportions—Reinforced concrete in piles and in the beams and girders shall be mixed in the proportion of 1 part cement, 1 part sand, and 2 parts trap rock or North Shore Long Island gravel. Concrete in abutments and deck of the trestle shall be mixed in the proportion of 1 part cement, 1 part sand, and 3 parts trap rock or gravel. However, should the tests which are to be made as outlined below fail to develop the required strength and density, the proportions of sand and stone may be varied until a mixture is obtained which gives the desired results. In no case shall the proportion of the aggregate be more than 3 or 4, respectively.

It is understood and agreed that the contractor shall make, at his own expense, such tests as are necessary to obtain a mixture of cement, sand and stone which will have a least compressive strength of 3,000 lb. per square inch of cross-sectional area and at the same time a maximum density, the tests to be made on blocks of concrete cast in a cylindrical mold 8 in. in diameter and 16 in. long and



DETAILS OF CONCRETE VIADUCT OF JAMAICA BAY BOULEVARD

⅛ in., producing a mass with low percentage of voids. It shall not contain any loam, mica, scales, silt, or other objectionable organic matter, nor any clay or organic matter. It must be so graded that when mixed with a coarse aggregate the required density is obtained.

The coarse aggregate shall be approved trap rock, broken into roughly cubical or pyramidal fragments, or North Shore Long Island gravel. It must pass through a screen with circular openings 1½ in. in diameter and shall be retained on a screen with openings ⅜ in. in diameter. It shall be clean and sound and so graded that, when mixed with the proper proportion of sand, as described, the resultant mixture will have less than 16 per cent voids. The engineer will provide such determination of the aggregate as will reduce the voids to a satisfactory minimum.

seasoned one day in moist air and 27 days in damp sand.

The contractor understands and agrees that he is to make the grading and compressive tests at his own expense, far enough in advance of beginning the construction of abutments and casting of the trestle or piles, that he can submit a certified report to the engineer in charge of such tests, including sieve sizes of sand and stone, proportions of cement, sand and stone, quantity of water used, and compressive strength of cylindrical blocks, and not delay its completion. He also understands that he is to furnish at his own expense a sufficient volume of graded materials he intends to use in the concrete mixture, together with the proper quantity of cement, submit the said materials to the engineer in charge far enough in advance of beginning work to enable said engineer to submit the materials to the

laboratory, to make the necessary sieve mixture, etc., to check the test report.

There follows then a tabulation which is reproduced herewith and the following notations:

TABLE OF TYPICAL TESTS
SPECIAL CONCRETE SPECIFIED FOR VIADUCT

Mix	Fineness Modulus	Weight of Mineral Aggregate Cu.Ft.	Slump of Fresh Concrete In.	Water Cement Ratio by Volume	Weight of Concrete per Cu.Ft. at 28 Days, Lb.	Compressive Strength Lb. per Sq. In.
1:1½:2½	5.7	126.5	7½	0.65	155.3	3,432
..	..	.....	7	0.65	153.0	3,209
..	...	.....	7½	0.65	154 4	3,178
Average	...	.....	7 7 24	0.65	154 2	3,280
1:1:3	...	.....	8½	0 66	159 1	3,610
.	6 4	128.5	8	0.56	159 6	3,412
..	..	.. ..	8½	0.56	152 9	3,353
Average	...	.....	8¼	0.59	157 2	3,460

The accompanying table shows the results of tests made with concrete mixtures made up of 1 part cement, 1½ parts sand, 2½ parts stone, and also 1 part cement, 1 part sand, and 3 parts stone. These results are given only to show in a general way what combination of water and of fine and coarse aggregate possessing the indicated quality may give the desired result and refer to the above cited mixtures of 1:1½:2½ and 1:1:3 only and not the mixtures of 1:1:2.

At least six cylindrical blocks as herein described and furnished by the contractor shall comply with the compressive and grading tests herein described, and the quantity of graded material submitted to the engineer in charge for investigation by laboratory must be enough for at least six cylindrical blocks that will pass the prescribed tests.

The contractor agrees that he will not begin the casting of piles or columns or the pouring of concrete on any part of the structure until he has received from the engineer in charge the approval of reports of tests of respective materials to be used in this work. . . .

The contractor expressly guarantees the sufficiency of the plans and specifications, to produce the results called for by the specifications.

SPECIFICATIONS COVERING CONCRETE

These blocks after being seasoned as described will be submitted to a crushing test and must not fall below a crushing strength of 3,000 lb. per square inch in cross-sectional area or any part of the work in which the concrete from which the samples were taken has been used will be rejected. The engineer in charge shall determine when such samples shall be taken. The concrete, except in precast piles, will be paid for per cubic yard and placed at the bid price, which price shall include the cost of testing materials, building and removal of forms and falsework and all work incidental thereto:

The precast piles will be paid for per lineal foot in place, which price shall include steel reinforcement, concrete forms, and all labor incident thereto. . . .

For the purpose of determining the proportions of the materials for concrete each bag of cement will be considered as containing 0.9 of a cubic foot. The other ingredients shall be measured by an approved method.

Only clean, fresh water shall be used for mixing the concrete. The amount of water to be used for mixing concrete, giving the specified strength and density, shall be determined by tests to be made under the supervision of the engineer.

After the amount of water has been obtained in this manner the average slump from three cylinders of dimensions stated hereafter shall be ascertained and the amount of water used thereafter shall be such that the slump from cylinders be the same as obtained above. Slump tests shall be made at least once a day before starting work or whenever new material is brought to the work or after change of atmospheric conditions.

An approved apparatus giving positive control for measuring water shall be used and shall be part of the mixer equipment. It must be so designed as to admit the full predetermined quantity of water for each batch in fully discharge into the mixer in not more than 30 sec. after the charging skip reaches the tap.

All concrete shall be mixed in approved mechanical batch mixers so constructed and operated that the ingredients of the concrete may be accurately measured and thoroughly mixed. The mixing of each batch shall be continued for at least 1½ minutes after all materials including water are in the drum or 2 min. if deemed necessary. The number of revolutions of the machine shall be 16 per minute and no variation from this shall be permitted. The drums shall be watertight and provided with a batch meter. No hand-mixed concrete will be permitted.

Concrete shall be deposited from wheelbarrows or other approved appliances in as nearly a continuous operation as is practicable, and shall be rodded and spaded with suitable tools to expel air bubbles to produce a dense and compact mass. It is essential that the spading and rodding be continued long enough especially near the forms so that the surface of the concrete shall be covered with a smooth and impermeable layer of fine aggregate and cement.

The Jamaica Bay Boulevard is being built by the City of New York under the general direction of Maurice E. Connolly, president of the Borough of Queens. The borough engineering bureaus have made the necessary surveys for location and design. The location surveys were made by the Topographical Bureau under the direction of engineer in charge, Charles U. Powell. The original design was made by the Bureau of Engineering Construction, which bureau will also be in responsible charge of the construction. In that bureau Carl T. Steiner has had responsible charge of preparing the designs and in that he has been assisted by B. W. Homans.

After completion the boulevard will be turned over to the Bureau of Highways for maintenance, and the engineering work incident to maintaining the project will be in charge of Fred Shepherd.

The design had to be approved by the Board of Estimate and Apportionment through Arthur S. Tuttle, chief engineer, who is responsible for the approved design of reinforced-concrete piles to the extent of the 3-in. concrete cover over the reinforcing metal; the original design had 2-inch cover.

Contract for the entire structure has been let to Smith, Hauser & MacIsaac, Inc., New York City, for a lump sum of $2,863,280.14.

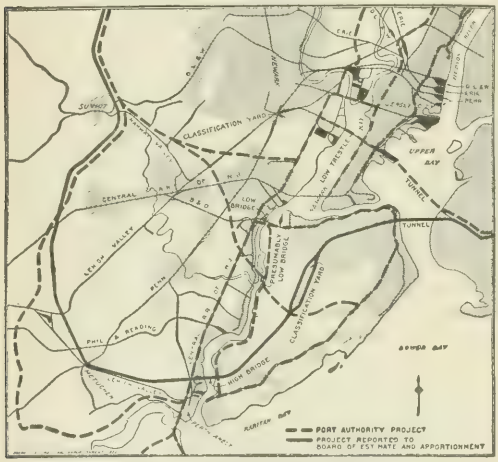
Unemployment in Foreign Countries

According to recent estimates contained in the *Monthly Labor Review*, unemployment in foreign countries is about as follows: Great Britain, 1,484,829 unemployed, representing 12 per cent of all persons insured against unemployment; Germany, 1,250,000 unemployed, representing 2.2 per cent of trade union members; France, 17,970 persons on the live register of employment exchanges, and 18,831 persons in receipt of unemployment benefits from departmental and municipal unemployment funds; Belgium, 147,232, or 21 per cent of those entitled to relief from the unemployment fund, were either out of work or on part time; Italy, 388,744 unemployed; Switzerland, 66,646 totally unemployed and about the same number on short time; Holland, 72,000 on live unemployed; Norway, 15.9 per cent of members of trade unions unemployed; Sweden, 27 per cent of trade union members unemployed; Czechoslovakia, 33,500 unemployed; and Canada, 8.7 per cent of members of the trade unions unemployed.

City vs. Bi-State Plans for Port of New York

Col. Wilgus Outlines Two Schemes and Gives Reasons Why Technical Features of Narrows Tunnel Plan Are Superior

IN A progress report to the Board of Estimate and Apportionment of the City of New York of the city's special committee on the Narrows Tunnel, Col. W. J. Wilgus, consulting engineer to the committee, submits a brief outlining the difference between the city's scheme for developing the port and that of the "comprehensive plan" of the Port of New York authority, now before the legislatures of New York and New Jersey for adop-



FAC-SIMILE OF MAP IN CITY'S REPORT SHOWING TWO PORT PLANS

tion. The following abstract is from that section of the brief headed "The Narrows Tunnel Preferable to the Port Authority Plan." The accompanying map is a facsimile of the one in the report, which is dated Jan. 23, 1922.

Underlying principles must be adopted as guides to a wise decision for the public good. Among them the ones that are believed to have special force [in any plan for improving cross-harbor transportation at New York.—Editor.] are:

1. Fixed charges should be the minimum consistent with the accomplishment of the desired purpose: (a) through avoidance of costly duplicate routes, (b) through utilization of the city's credit for borrowing funds at a low rate of interest, and (c) through the establishment of the route in such manner as to make possible important savings in cost of construction through joint action with other public enterprises.

2. Tonnage to and from Staten Island, Long Island and New England should be routed around rather than through areas in New Jersey that are now or may in the future become congested by reason of their own local freight and passenger development, as for instance between the Orange Mountain range and the waterfront.

3. Crossings of rail and water traffic should be separated through the use of tunnels or high level bridges, so that one will not interfere with the other.

4. Use of temporary mainline structures should be avoided on account of fire hazard and cost of maintenance.

5. Gradients on steam operated new lines should be at least as light as on the railroads with which they are to connect.

6. The classification of freight cars and their suitable consolidation in trains should be provided for in a modern economically planned clearing yard into which all lines will feed, such yard to be so located as to minimize the territory that necessarily must be electrically operated at the start.

7. The portion of the route to be placed in tunnels should be minimized not only because of their cost but also by reason of the unremunerative non-traffic producing character of the territory so traversed.

8. The route should be so placed as to induce the flow of life giving traffic where it will do the most good and the least injury to the communities affected.

Having these principles in mind we may next examine in detail the qualities of the rival plans, that of the city known as the Narrows tunnel plan, and that proposed by the Port Authority.

The Narrows Tunnel Plan

The Narrows tunnel route, as laid out by the writer [Col. W. J. Wilgus] some ten years ago and placed by him at the disposal of the city, has its source in the north at its connection with the West Shore R.R. at Haworth, N. J., and passes thence in a westerly direction to the high land in the rear of Paterson; thence southerly along the rural valley of the Passaic River to a piercing of the Orange Mountains near Summit; thence continuing southerly and easterly through Scotch Plains, South Plainfield and Metuchen to a high level crossing of Arthur Kill between the bluffs that border that waterway in the vicinity of Perth Amboy, N. J., and Tottenville, Staten Island; thence on an easy incline through the midst of the Borough of Richmond to a modern "hump" clearing yard at which cars from many origins may be classified and consolidated into full-sized trains for varying destinations; and thence beneath the Narrows to a connection with the Long Island R.R. and proposed Brooklyn marginal railway in Bay Ridge, Brooklyn, beyond which access to existing and proposed marginal railways, port developments and other local facilities in the boroughs of Brooklyn, Queens, The Bronx and Manhattan; as well as direct connections to New England, is proposed via the New York Connecting R.R. and sundry connections.

The character of construction is proposed to be modern in every respect. On the steam operated section, which is the portion lying west of the proposed yard in Richmond, the maximum gradients are 8 ft. per mile against eastbound and 16 ft. per mile against westbound traffic in New Jersey, while within the limits of the city they descend with the eastbound movement and have a rise of 21 ft. per mile against westbound traffic.

East of the yard, where the intended electric operation makes steep rates of grade unobjectionable, the ruling gradient is 2 per cent in both directions, this being the rate in successful use at other important electric installations in tunnels and elsewhere. Lighter gradients would involve greatly increased expenditures with incommensurate returns in the way of lessened operated costs.

A double-track main line is contemplated, free from grade crossings of every kind, with suitable provision for later expansion to four main tracks when warranted by increase of traffic.

Special attention is paid to the needs of Staten Island. An industrial line is planned along the easterly bank of Arthur Kill, on the opposite side of which, in New Jersey, there is an object lesson in the beneficial effects of adequate railroad facilities. Above all, a direct connection is made with the north shore of the island, on which already exist great ocean piers and warehouses, notably those of the American Dock Co., the Pouch Terminal and the $25,000,000 development of the city itself.

Just where the division line should lie between the portion of this system that should be constructed by the railroads or other outside interests and the portion that should be constructed by the city is a matter for negotiation to determine.

It is hoped that the railroads, through joint action, will organize a Metropolitan Terminal Railroad Association, somewhat similar to the one that has proven to be so successful at St. Louis, under the auspices of which the belt railway may be constructed in New Jersey and at

other places to be agreed upon, and the city's part of the route and certain existing railroad lines may be leased, all with a view to unfied operation at actual cost, in the interest of both the railroads and the public.

By planning in this manner all the principles above set forth are duly recognized. The proposed route involves no duplicate crossings of the bay, it avails itself of the city's credit and it lies where adjoining public facilities may be created with mutual savings of several million dollars, as for instance, through the placing of rapid transit tubes in the same trench across the Narrows and through the placing of a vehicular roadway on the Arthur Kill viaduct, as a means of shortening the journey of automobiles many miles between New York and the New Jersey seacoast resorts. It avoids the congested regions of New Jersey, an item of the greatest importance to the future growth of both states and to the nation, from the standpoint of protection in time of war. It crosses waterways above their heads of navigation in New Jersey, and with its anticipated burden of upwards of 20,000,000 tons annually it passes high over or beneath harbor channels, thereby obviating grade crossings of water and rail traffic, as would be the case if drawbridges were required. Its gradients on the steam operated part of the route, where this question is of moment, are very moderate. Its yard on Staten Island, being of ample length for tandem hump operation, serves all the purposes of economical classification and consolidation and makes unnecessary an extension of electric operation into the existing yards of the trunk lines. Its entire length is available for the industrial development of adjoining territory, except the comparatively short distance in tunnel beneath the heights of northern Staten Island, over the Arthur Kill and under the Narrows. It offers means of trunk line passenger entry to the populous portions of the metropolis, which so far have been neglected in that respect. It does no injury to the New Jersey communities in diverting from their midst New York's cross-water traffic, but on the contrary benefits them by removing a cause for growing congestion. Finally, in turning the arterial flow of New York's commerce through Staten Island, it will change that potentially rich borough from a vermiform appendix to a healthy and prosperous section of Greater New York. Statements have appeared that the project is "impracticable"; that the intent of the law is that the tunnel shall be treated as "an interborough or local improvement" and shall not invade the fields reserved to the bi-state port organization; that it will not stand the test of an economic analysis; that either new costly "break-up" yards will be required at the point of intersection of the proposed belt line with the connecting roads, or expensive "back-haul" of traffic will be required from the existing break-up yards to such points of intersection; and that the outer belt line is a round-about route in contrast with one that would cross the entire width of Upper Bay to the north of the Narrows.

Plan Not Impracticable

Regarding the charge of impracticability, the impression has been given in the press that this lies in the inability of the tunnel to handle both freight and *rapid transit* passenger traffic. This has never been claimed by the city's engineers. What they do claim is that the project is entirely practicable for doing just what the law says it shall do, namely, carry both freight and passengers. The Detroit River tunnel of the Michigan Central R.R. has been doing this successfully for some ten years, and it has been done for some thirty years through the Sarnia tunnel of the Grand Trunk Ry. There is no good reason why it should not be done here, until the time may come in the future when growth of traffic may warrant the laying of additional self-supporting tubes. As to rapid transit passenger service, it has been expected that tubes therefor would be laid alongside those intended to be created under the present law, and the published plans of the city have so indicated.

The charge that the Narrows tunnel project is intended to be a local improvement only is refuted in the act itself.

As to the charge, attributed in the press to the bi-state port organization, that the Narrows tunnel project is uneconomic, no figures have been produced to substantiate it. If it is true of this admittedly necessary and authorized connection between Brooklyn and Staten Island, then it is true in a much greater degree if applied to the dual crossing of the Upper Bay by the tunnel of the Port Authority and the one ordered by the Legislature to be built by the city. Fortunately for the future of the port and for the city—it is not true.

Break-Up Yards Unnecessary

As to the break-up yard statement, a few examples [not given here.—Editor] of yardless junctions will best illustrate its incorrectness. What is the reason then that trains for points east of New York Harbor cannot be made up at divisional yards to the west and diverted over the proposed belt railway of the new clearing yard on Staten Island, where classification and consolidation would enable the traffic to continue in suitably composed trains for various designations on Staten Island, Long Island, The Bronx, Manhattan and New England. It is done elsewhere and it can be done here. Of course there will be fragmentary train lots that will be set off on sidings at the connections and moved thence in "pick-ups" in the usual way, and there will be a comparatively small volume of back-haul freight moving between the Jersey inner zone and eastern points, but these in no manner affect the main question, namely, the feasibility of operating the Narrows tunnel route, coupled with the outer belt railway, without the need for creating extensive new break-up yards at intersections with the connection lines.

As to the alleged round-about nature of the Narrows tunnel route as compared with the Port Authority plan, it is true that the most northerly of the trunk lines, the West Shore R.R., has an excess haul of some 41 miles and that the northerly group of roads as a whole has an added haul of 31.3 miles. However, *per contra*, the one of the southerly group which carries approximately one-half of the entire tonnage of both groups, the Pennsylvania R.R., has a four mile shorter haul than the Port Authority plan, and the entire southerly group, carrying 80 per cent of the tonnage of both groups, has a lesser haul to the extent of 2.7 miles. Taking the traffic of both groups as a whole the average haul by the Port Authority plan is approximately 28 miles and by the Narrows tunnel plan about 33 miles, a difference in favor of the former of 5 miles, or say 18 per cent. At first glance this added haul may seem objectionable, but on reflection it will be realized that a circuitous route is not necessarily less desirable than a direct one if over-balancing advantages are thereby gained. Many illustrations could be given of the creation of round-about lines on which the added cost incident to longer train haul is far more than offset by outstanding advantages similar to those to be gained in this case, namely (a) escape from losses of time and money in passing through yards and congested regions on the existing routes and escape from other violations of the aforesaid fundamental principles of design, including congestion at the proposed bottle-neck at Greenville, and (b) reaping of vast future benefits through access to new traffic producing regions. It is to be expected in this case that the interests of all the roads will be pooled through a terminal association for joint operation, so that no one road will be penalized for its disabilities. The greatest good for the greatest number is the underlying thought of the city's proposition.

If the points as here outlined are well taken, as is believed to be the case, it is apparent that the Narrows tunnel plan accords with the principles that have been laid down as essential to a proper solution of the problem, and that it is free from the [illegible] against it from anonymous sources in the press.

In many, if not most respects, the Port Authority plan, [illegible] the manner of linking together the two sides of the harbor and the promptness with which the construction of the outer belt line shall be undertaken.

The outer belt line of the Port Authority follows [illegible]

Narrows tunnel route very closely between North Paterson and Summit, but differs therefrom very materially at the northerly and southerly ends. At the former point it diverges in a northeasterly direction to a terminus at Piermont on the Hudson River. At the south, near Summit, it splits in three directions, one branch passing south to New Brunswick and Perth Amboy where neglected Staten Island is left in all its loneliness across Arthur Kill, another branch passing as a spur beneath Arthur Kill to Staten Island, and the third or main branch joining the so-called middle belt line, over which connection is had with the Lehigh Valley—Pennsylvania R.R. low-level drawbridge and trestle across Newark Bay, and thence by a tunnel beneath what is practically the widest portion of Upper Bay from Greenville to junctions in Bay Ridge, Brooklyn, similar to those proposed in the Narrows tunnel plan.

For immediate construction it is proposed to link the trunk line roads together by means of a so-called inner belt line along the Hackensack Meadows and easterly shore of Newark Bay, which, together with the above mentioned middle belt line and Newark Bay trestle, will bring the traffic of all of the roads from their existing break-up yards to the proposed Greenville-Brooklyn tunnel. Staten Island, pending the construction of the outer belt line at some uncertain date, is to be served by the existing heavily burdened Baltimore & Ohio R.R. stub line on which there is a single track drawbridge kept normally open for the unfettered passage of the Arthur Kill water traffic estimated at 30,000,000 tons annually.

Port Authority Plan Faults

A study of these routes quickly shows that they are not planned in accordance with the aforesaid principles.

First, fixed charges necessarily will be high (a) because the expensive tunnel crossing the Upper Bay will duplicate the cross-bay tunnel at the Narrows which the State has directed the city of New York to build (b) because annual interest charges for this public enterprise, of course paid in the first instance by the shipper and eventually by the ultimate consumer, will be higher by reason of the need for borrowing money directly through bankers at high rates with the usual commissions and discounts rather than through the city with its splendid credit, and (c) because the leaving of Staten Island on one side of the main route robs the project of the savings that would result (1) from the building of the proposed Staten Island-Brooklyn rapid transit tubes in the same trench used for the cross-harbor tunnel, and (2) from the utilization of the crossing of Arthur Kill for both railroad and vehicular traffic.

Second, the anticipated tonnage, far exceeding 20,000,000 tons per annum, will pass through regions in New Jersey now congested with some 75,000,000 tons of rail traffic annually as well as the passenger service of nine trunk lines, and promising to become increasingly so as time goes on, not only through the natural growth of long-haul traffic but also through intensive local passenger and freight growth, neighboring great port developments, and the proposed transshipment of Manhattan freight in the very region in which this inner belt line is proposed to run.

Third, both the main route via Greenville and the B. & O. spur to Staten Island pass over navigable waterways by means of drawbridges, which will embarrass and therefore cause delay and increased cost of operation to both rail and water traffic. Newark Bay waterborne tonnage is large, now reported to cause some 13,000 yearly openings of the drawbridge, with the surety of great increases as the plans of the Port Authority for the deepening of the Newark Bay, Passaic and Hackensack river channels to Newark, Passaic, Paterson and other places are carried out. It is well to quote from page 345 of the 1920 report of the bi-state organization, in its reference to the L.V.-P. R.R. crossing, "Here also tunnels should be built rather than bridges. The Commission assumes that any crossing of the bay as a part of the exterior belt line system will be by tunnel." Also at page 30 of the same report the bi-state organization states "The Commission would further urge . . . that the Federal Government co-operate with the local authorities in providing 30 ft. entrance channels to Jamaica Bay and Newark Bay, and deep water channels within those bays. . . . The bridges over Newark Bay should be replaced, if feasible, by tunnels . . . ."

Thirty-foot channels are not alone intended for light draft craft. On top of all this, further embarrassment is to be expected from the concentration of all of the close-harbor rail traffic at the very point where greatly increased rail movement is to be expected in connection with the Lehigh Valley R.R. new Claremont terminal, the new Port of Newark, the new Droyer's Point water terminal in Jersey City, and other projects which cluster about the place where the proposed "inner belt line" is to join the L.V.-P. R.R. trestle and the tunnel to Brooklyn.

Certainly the former plan of the bi-state organization in this regard was preferable to the later one, which now contemplates drawbridge crossings of these two waterways already having a volume of traffic several times that of the Panama Canal.

Fourth, the intended use of the Newark Bay trestle, unless it is to be replaced with a costly permanent structure, invites the same disaster that in the past has cut traffic in two for a long period due to a fire.

Clearing Yard Necessary

Fifth, the westbound ruling gradient on the outer belt line is understood to be 32 ft. per mile, in contrast with much lower rates on the Narrows tunnel route.

Sixth, no provision appears to have been made for a clearing yard, unless it is intended to build one at Greenville or utilize that of the P. R.R. If none is intended, then there is no provision for consolidating partial train loads going from various origins to various destinations, with resultant costly operation in running light trains or else gross delays and congestion due to holding cars for full train loads, either of which is inadmissible. Moreover, in this case electric operation through the tunnel will have to be extended for long distances to the existing break-up yards of the various railroads, and into such yards, many of which are unadapted to so doing without radical changes. If a yard is intended at Greenville, then the short distance available for yard purposes between the tunnel summit and the place where the lines branch to the north and west forbids a modern yard layout and high cost of operation and congestion are sure to ensue.

Seventh, the portions of the route that are carried on trestle or in tunnels, including the Upper Bay and Newark Bay crossings and the future crossing under Arthur Kill to Staten Island, aggregate with approaches some 18 or 20 miles, which, of course, are unadapted to local industrial development.

Eighth, the route leaves on one side of the main current of traffic the great county and borough of Richmond, with its existing deep-water ocean piers, having an anticipated tonnage of 21,000,000 annually, and the potentially important waterfront along the east bank of Arthur Kill, thereby depriving that promising part of New York of the great benefits that result from an arterial flow of main line traffic through the midst of a community.

No detail maps, profiles or estimates of cost of construction or operation or revenue have been made public by the Port Authority, and, therefore, the student of their plan is in more or less of a fog. Based on what has been published and with what are believed to be reasonable assumptions of what has so far been withheld from the public, it would appear that the Port Authority plan, so far as connections are concerned between the railroads in New Jersey and the boroughs of New York City, is gravely at fault in not having been based on fundamentals which are vital to the effective solving of New York City's cross-bay transportation problem.

It has been shown that the Narrows tunnel plan is grounded on the principles that must have full recognition, if New York City is to profit to the full from an enterprise of such moment; and that the Port Authority plan, in failing to give them recognition will perpetuate handicaps which both sides of the harbor are seeking to eliminate.

After all, the point at issue is not whether the Narrows tunnel or the Port Authority's plan shall be selected, because it is generally recognized that the former in any event should be built. It then becomes a question whether (1) the Narrows tunnel with its outer belt line in New Jersey, or (2) the Narrows tunnel exclusive of the outer belt line *plus* the Port Authority's cross-bay tunnel, inner belt line and Staten Island spur, shall be the adopted plan. In the former case a self contained system, in full accord with the principles heretofore mentioned, is obtained at a cost of say $85,000,000. In the other case the outer belt line portion of the City's plan is rejected in favor of a duplicate tunnel and inner connections in New Jersey, and the total cost of the plan as a whole, with its many objectionable features, becomes say $120,000,000, this figure embracing the unescapable Narrows tunnel terminating in Staten Island and the cross-bay tunnel, connections and improvement of existing facilities in New Jersey as to which it has been necessary to hazard a guess in the absence of any published estimates by the Port Authority. It will thus be seen that so far as can now be judged from available data the city's plan promises a saving of say $35,000,000, coupled with observance of sound principles of design.

There can be but one conclusion and that is in favor of the building of the Narrows tunnel as directed by the Legislature and in conjunction with it the railroad connections which are necessary for its self-support.

Railways Reject Narrows Tunnel Port Plan

IN a letter to Mayor Hylan, of New York City, on Jan. 30, Samuel Rea, president of the Pennsylvania R.R., states that the committee of executives of the railways entering New York "have regretfully but necessarily reached the conclusion that the Staten Island-Narrows Tunnel route could not in the public interest, and in the interest of the railroads carrying the traffic of the public, be adopted or used by them." To this opinion are subscribed the names of all the railways, except that "the president of the Baltimore & Ohio R.R. Co. prefers that his company be not recorded at this time either for or against any plan under consideration."

The letter is accompanied by a lengthy report by the engineering committee of the railways which analyzes the traffic possibilities of the new route and finds them much below those expected by the city and the costs of the proposed plan much greater than by the present method of trans-bay freight handling.

As a deduction from this report the railway executives say "the trunk lines would not be justified in participating in the assumption of the carrying charges for such a large work, including the tunnel under the Narrows, which, in their judgment, is not now, nor in the near future, required for the volume of traffic moving; second, that the approaches to such a tunnel by way of Perth Amboy, and a large bridge over the Arthur Kill, thence traversing Staten Island and tunneling under the Narrows, would entirely change the operation of a majority of the trunk lines whose Long Island and New England traffic would be expected to go through such a tunnel. The Lehigh Valley, Pennsylvania and Jersey Central all have their terminal yards well up towards the New York harbor front on the Jersey side and are constantly expanding the same, and the Long Island and New England traffic [illegible] by water over to Bay Ridge, and the facilities for such movement are ample for the present volume of business and for a considerable increase thereof, and when the traffic demands, and can carry the cost of, direct rail connection, it has been generally conceded that a tunnel on the existing water route, that is to say, from the vicinity of Greenville to Bay Ridge, seems to be the most direct and would seem to accommodate said traffic better and more economically than any other tunnel location so far considered; the cost of a tunnel and connections on that route would be less, and the operation and amortization costs would be much below comparable figures for the Staten Island-Narrows Tunnel route."

Dorr-Peck Activated-Sludge Process Has Been Given Up

AFTER trial of the Dorr-Peck modification of the activated-sludge process at three different test plants, The Dorr Co., of New York City, has concluded that the process does not meet the expectations to which it gave rise and has decided to carry the tests no further. The company's own account of the aims and tests of the process and its conclusion to discontinue work on the process follow:

The Dorr-Peck process was designed to give a greater air economy than had been obtained with other types of activated-sludge units and at the same time accomplish the aeration and sedimentation of the sludge in one unit, It was first tried out on a small scale on municipal sewage at Mt. Vernon, N. Y. [See *Engineering News-Record*, Sept. 9, 1920, p. 490.] The results obtained were encouraging and the air consumption was reduced to about one half that commonly used in rectangular aeration tanks. The original design of the plant was modified during the experiments and it was recognized that at best it was somewhat of a makeshift plant which had not been operated on the normal fluctuation in flows in municipal sewage. Whether or not the low air consumption obtained with a constant flow would be maintained with a fluctuating flow was not determined at Mt. Vernon, and facilities were not available for experimenting with the dehydration of the sludge produced.

The Mt. Vernon test plant was visited by several sanitary engineers and the concensus of opinion was that the results obtained were sufficently encouraging to do further testing with a well designed plant. Arrangements were made for continuing the experiments at Urbana, Ill., in co-operation with the Illinois State Water Survey. The Urbana plant was rated at 100,000 gal. a day and was operated during most of 1921.

After making laboratory tests it was decided to install a Dorr-Peck plant of 25,000 gal. a day capacity at the Argo works of the Corn Products Refining Co. This unit was operated on strong industrial sewage for several months in 1921 and was arranged to work in parallel with the usual type of aerator, followed by a Dorr sewage clarifier for sludge sedimentation.

The Dorr-Peck plants at Urbana and Argo have not given the expected economies and efficiencies and the Dorr Co. has decided to give up any further work with this process.

Pleasing Highway Bridge Design

The matter of aesthetics in highway bridge design has received much more attention of late than ever before and the time is here when the plan of every bridge designed by the state highway commission will receive careful consideration from this point of view. The necessity for good appearance is greater in a permanent structure than in a structure of temporary nature. Permanence ceases to be a virtue where an ugly structure is concerned.—*From Quarterly Bull., Jan. 1, 1922, of A. E. Hunt, state highway engineer of Wisconsin.*

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Conflicting Convention Dates

Sir—Replying to your letter Jan. 7, addressed to Gen. Marshall, and attaching copy of editorial note which appeared in your issue of Dec. 15, p. 963. The Chamber of Commerce of the U. S. A., through its fabricated production department, has for the past few months been compiling a list of the convention dates of all associations and societies in the United States of which they have a record. It seems to us that this compilation will be of material assistance to all associations in arranging their dates so that they will not conflict with other important meetings. It might even be well for *Engineering News-Record* to call attention through its columns to the existence of this list for the benefit of other associations and societies.

It might be of interest to you to know that our by-laws require the holding of our annual meeting during the first quarter of the year, so that we are limited to some extent in that direction, and it has become our policy to hold our meeting the latter part of January after our members have closed their books for the year and before the construction season has opened up.

We have had in mind for some time a plan which would bring together in some manner the annual meetings of the more prominent associations in the construction industry. You can readily realize the difficulties in carrying through such a plan, but again your columns might be of assistance in this direction, and by so doing you would be of assistance in "co-ordinating" all important society and association convention dates.

G. W. BUCHHOLZ,
Washington, D. C. General Secretary, The Associated
Jan. 30. General Contractors of America.

Army Engineers' Early Training

Sir—It is to be feared that your editorial on "Army Engineers' Early Training" in *Engineering News-Record* of Jan. 19, p. 93, may convey a false impression as to West Point and its place in the scheme of military education. The curriculum at West Point is designed to instruct the student in subjects underlying the profession of arms by land. Although commissioned in various branches of the army immediately after completing the course, the military schooling of the graduates is by no means ended, and they are sent to special service schools to qualify them for their duties. West Point is thus, in a sense, a secondary school. It lays an excellent foundation, but it does not pretend to fully fit its graduates for service in the engineers, artillery, cavalry, infantry, or other branches.

If no one in civil life regards West Point as an engineering school, the same may be said of persons in the military establishment. If such opinion ever obtained, it was only in the early days of the institution. In the beginning, the Corps of Engineers and the Academy were one and the same, for the Organizing Act of March 6, 1802, authorized the President to establish a Corps of Engineers, and provided that "the said Corps, when so organized, shall be stationed at West Point in the State of New York, and shall constitute a military acadamy." Moreover, until about 1824—when Rensselaer Polytechnic Institute was established—West Point was the only institution in the United States giving any training in engineering subjects. In 1866 the connection between the Corps of Engineers and the Academy was served, and control of the latter was vested in any officer whom the Secretary of War might elect to serve as superintendent.

Throughout the history of the Academy, only a few graduates from each class have been assigned to the Corps of Engineers, and during the first few years of commissioned service they have always been deemed to be under instruction. During this period of tutelage their work has been performed under the supervision of older officers, and has been so conducted as to further the engineering education and experience of these young assistants.

To facilitate the instruction of the officers newly commissioned in the Corps of Engineers, an Army Engineering School was established immediately after the Civil War. It has been in existence ever since, with the exception of a few brief interruptions caused by the Spanish-American War, the Mexican Border troubles, and the World War. This school is now located at Camp A. A. Humphreys, Virginia, and during and immediately after the World War it conducted instruction in civil, mechanical and electrical engineering subjects, under methods which received the commendation of a number of prominent educators and engineers. Many of the instructors were officers commissioned from civil life for the emergency. The methods evolved have recently been put into practice at several civilian colleges.

However, for reasons indicated in the last annual report of the Chief of Engineers, it has been decided to send young officers to good civilian technical schools for instruction in engineering subjects. Whatever may be the defects of the West Point course, it has been such as to permit these officers, detailed as students at civil schools, to receive the degree of B.S., C.E., with one year in residence, though such year has included some weeks of summer instruction necessary to bridge the gap between the West Point course and the schedule for the senior year at these civil schools. The Engineer School at Camp A. A. Humphreys now conducts instruction in subjects more directly connected with the military service, and in certain subjects of a technical nature pertaining to the duties of the Corps of Engineers not covered by courses at civil schools.

At the present time, three officers of the Corps of Engineers are attached to three important railway systems, and are engaged in detailed study of railway operating. One officer is also on duty with the Transit Commission of New York City. While it is not expected that they will qualify as operators, they will learn some of the problems connected with railway management, and their experience—limited though it be—will prove of value in time of war.

Contact with engineers in civil life is also had through the engineer units of the Reserve Officers' Training Corps at various colleges where young officers of the Corps of Engineers are serving as instructors, and so come into intimate association with students who later will take up the practice of engineering.

It may interest your readers to note that at the present time the Corps of Engineers has an authorized strength of approximately 710, including officers serving with the General Staff, National Guard, Organized Reserves, and on other duties not directly under the jurisdiction of the Chief of Engineers. The Corps actually consists of only 509 officers, of whom 181 have been commissioned directly from civil life, and have never attended the Military Academy. Of the Academy graduates, 85 have also attended civil technical schools subsequent to their entry into the Corps of Engineers, and have received, or will receive the degree of B.S., C.E., for their work. The authorized strength of the Corps has been increased from 248 to about 710, within a period of six years, or approximately 186 per cent. In consequence, only 37 per cent of the officers have had more than five years' commissioned service, and only 56 per cent have had more than four years of such service.

Washington, D. C. G. A. YOUNGBERG,
Feb. 2. Lieutenant-Colonel, Corps of Engineers.

Wisconsin's Highways Classified

Classification of the state trunk highway system of Wisconsin, as required by the laws of 1921, has been completed. Of the total mileage of the system, amounting to 7,412, about 1,200 miles are designated as Class A highways (on which a gross load of 12 tons may be carried) and the remainder Class B roads (on which the gross load is limited to 7 tons).

NEWS OF THE WEEK

New York, February 9, 1922



NEW CLUB HOUSE OF THE SEATTLE ENGINEERS' CLUB

Seattle Engineers Occupy New Club House

The Seattle Engineers Club, on Jan. 1 moved its headquarters from the Arctic Club Building to the College Club Building on the corner of Sixth Ave. and Seneca St. A photograph of the new home of the organization is reproduced herewith.

The building, formerly occupied by the College Club of Seattle, is 60 x 120-ft., of brick construction, located within a few blocks of the heart of the business shopping and theater sections of the city. The structure is modern in every respect, containing lounge, library, card, billiard, dining and committee rooms and 22 bed rooms. The club's membership includes more than 200 civil, electrical, mechanical, chemical and mining engineers.

Texas Freight Rates Lowered

The Railroad Commission of Texas has reduced freight rates on sand, gravel and crushed stone when these materials are to be used on road work and the freight is paid either by the county or the state. The minimum carload is specified as 10 per cent over the marked capacity of the car. The new rates are 15 per cent higher than those in effect Aug. 25, 1920 as published in Item 1750 of Texas Lines Tariff No. 2-E. This reduction, effective between all points in Texas on the principal lines, applies only to state and county work and not to municipal improvements.

Federated Engineers Appoint New Committees

The Federated American Engineering Societies has appointed a new committee on registration of engineers. The personnel of the committee is as follows: A. S. Dwight, chairman, New York; Gardiner S. Williams, Ann Arbor, and Philip N. Moore, St. Louis.

A new federal water-power committee also has been named. John H. Finney, of Washington, is the chairman, the other members being Calbert Townley, New York; G. S. Williams, Ann Arbor; Gano Dunn, New York, and A. P. Davis, Washington.

Levee District Bond Bids Called

Bids for $250,000 5 per cent bonds of the fifth Louisiana Levee District will be opened January 20, at Tallulah, La., by the board of commissioners of the parish.

$60,000,000 *Water Supply For Boston District Advised*

As noted in last week's issue, page 209, an additional water supply of 200 m.g.d. from the flood flows of the Ware, Swift and Miller rivers, at a cost of $60,000,000 is recommended for the Boston Metropolitan Water District and the City of Worcester, Mass., by the Joint Board consisting of the State Department of Health and the Metropolitan District Commission in its report submitted to the Massachusetts Legislature on Jan. 28. Supplementary details are given herewith:

The complete project, as planned, includes a 410 billion gallon reservoir on the Swift River at Enfield and a long gravity tunnel, but for immediate construction all that is recommended is a diverting dam on the Ware River at Coldbrook and a 13-ft. tunnel 12 miles long therefrom to the Wachusett reservoir, with provision for pumping water for Worcester from either the tunnel or the Wachusett reservoir, all at an estimated cost of $12,000,000. The diverting dam would provide a supply of 33 m.g.d. but this part of the aqueduct would have a capacity of 500 m.g.d.

A minority report by James A. Bailey, chairman of the Metropolitan District Commission, contends that by continuing the meter extension policy now in force and by filtering the poor supplies the existing sources of supply will be sufficient for the Metropolitan District. X. H. Goodenough, chief engineer of the Department of Health, was chief engineer of the Joint Board, and its chairman was Dr. Lucius R. Kelley, commissioner of health. After the death of F. B. Stearns on Dec. 1, 1919, J. Waldo Smith, chief engineer of the Board of Water Supply, New York City, was consulting engineer of the Joint Board. Further details of the report will be given in a later issue.

Idaho Engineers Meet With Architects

Three Organizations in Joint Session—Irrigation is Leading Topic of Discussion at Rupert

Three organizations of technical men in Idaho, the Idaho Society of Architects, the Idaho Chapter of the American Association of Engineers and the Idaho Irrigation Congress, met in joint session Jan. 16-21, at Rupert. The architects took charge of the first day's meetings, the A. A. E. chapter sessions began the second day, and the real joint sessions were held on the fourth day.

Relation of architecture to engineering, city planning, the state building code, the unemployment situation, utilities valuation, government regulation of railroads, mining engineering methods and a review of the value and extent of the phosphate resources of Idaho were outstanding topics of discussion at the A. A. E. meetings. The annual address of the president, Lee R. Cooke, recommended somewhat more stringent provisions in Idaho's license law for engineers. Resolutions were passed instructing the delegates to the annual convention of A. A. E. at Salt Lake City to work for a reduction in dues.

Irrigation Bills Endorsed

The Irrigation Congress endorsed bills in Congress which contemplate the loan of money to the reclamation fund. It also urged companies contracting for water from the American Falls reservoir to make payments as rapidly as possible so as to convince the Reclamation officials of their good faith.

In his annual address the president of the Irrigation Congress, G. Clyde Baldwin, touched upon the present financial depression which seems to be particularly in evidence throughout agricultural communities and pointed out some of the dangers of any false economy in the maintenance and operation of irrigation projects.

J. C. Wheelon, manager, Twin Falls Canal Co., described a method of cleaning moss and silt from canals with disk harrows. (See *Engineering News-Record*, Aug. 12, 1920, p. 319). Discussion of the paper indicated that the method had many advantages and was coming into more general use.

A paper on "Ditch Riders and Their Duties," by G. A. Remington, manager, Nampa-Meridian Irrigation District, preceded a general discussion of the compensation of irrigation employees for 1922 which emphasized the fact that while loyalty and efficient service cannot be strictly measured by the wages paid, [illegible] should not be reduced below certain more or less well defined limits if efficient service is to be maintained. Salaries range from $85, with no perquisites, to $175 with allowances for [illegible] and board [illegible].

The plans of the proposed Grande Ecore Bridge [illegible]

License Bill in North Carolina

An engineer license bill has been introduced in the North Carolina General Assembly. It provides for an examination of both engineers and surveyors by a board of five members and the granting of licenses to properly qualified persons who register with the board within one year after the ratification of the act.

Raise Funds for Bust of Eads

At its meeting Jan. 18, the Board of Direction of the American Society of Civil Engineers authorized the raising, by popular subscription, of funds for a bust of the late Buchanan Eads to be placed in the Hall of Fame of New York University. Capt. Eads is the only engineer honored by a place in the Hall of Fame, and the board is requesting from members of the American Society of Civil Engineers contributions of from $1 to $5 as a tribute to the memory of this engineer.

Among Capt. Eads' notable engineering works were the building of the Mississippi River bridge at St. Louis and the maintenance of a channel through the South Pass of the Mississippi River.

Idaho Engineers Meet

(*Concluded from p. 253*)

lined in an address by H. W. Dietz, supervising engineer, U. S. Indian Service, Salt Lake City, Utah. Irrigation project cost-keeping was discussed by Barry Dibble, project manager, Minidoka project, U. S. Reclamation Service.

A paper on the "Capacities of Soils for Irrigation Water," by Prof. O. W. Israelson of the Utah Agricultural College, described the results of numerous laboratory experiments.

Underground Irrigation Water

O. E. Meinzer, chief, underground water division, water resources branch, U. S. Geological Survey, Washington, D. C., presented a comprehensive paper on "Underground Water for Irrigation in Idaho." He described the possibilities of securing yields adequate for irrigation use either by pumping or through artesian wells from the tertiary lake beds, basalt and alluvial deposits existing throughout southern Idaho. Advance census statistics were presented which showed that the average cost of irrigation systems supplied by pumping from wells in 1919 was about $46 per acre with an average annual operation and maintenance cost of $10.07 per acre, wheras the average cost of systems using flowing wells was about $37 per acre with an average annual opueration and maintenance cost of $2.77 per acre. In describing the springs which enter Snake River between Milner and King Hill, Idaho, it was stated that their combined total flow was more than sufficient to supply all the cities of more than 100,000 population in the United States.

Officers elected to head the A. A. E. are as follows: President, E. E. Moberly; vice-presidents, J. E. Wilson and S. T. Baer; secretary-treasurer, E. F. Ayers, Boise. For the Irrigation Congress the following were elected: President, J. E. Badley; vice-presidents, John O. Pincock and J. C. Porterfield; secretary-treasurer, G. C. Remington, Nampa.

New York Firm Gets Contract for Brazil Exposition Building

The contract for the construction of the exposition building to house the exhibits of the United States at the Brazilian exposition, to be held in September, has been awarded to Dwight P. Robinson & Co., New York City. Representatives of the company and Frank L. Packard, architect, of Columbus, Ohio, who will design the building, have sailed for Brazil. Dwight P. Robinson & Co. also has government contracts in northeastern Brazil.

Joins Staff of "Engineering News-Record"

Willard Chevalier, an engineer with long experience in work in and near New York City, formerly general manager of the American Bitumastic Enamels Co. and during the war lieutenant colonel of the 11th Engineers, has joined the staff of *Engineering News-Record* as associate editor.

Col. Chevalier was graduated from the civil engineering course of the Brooklyn Polytechnic Institute and then entered the service of Arbuckle Bros. as assistant to the general superintendent in the mechanical department. Later he became draftsman for the Consolidated Telegraph & Electrical Subway Co. of New York City and subsequently occupied the positions of field inspector and of chief draftsman. His next engagement was as assistant engineer with the Public Service Commission on both the design and construction of the rapid transit subways. In 1912 he became field office manager for the Atlantic Gulf & Pacific Co. on its contract for the construction of the Champlain Section of the New York State Barge Canal, and when that company took in hand the development and promotion of its Mill Basin industrial property on Jamaica Bay, he was transferred to that work.

Served with 11th Engineers

In 1916, as a result of his promotional experience on the Mill Basin project, he determined to enter sales work and became sales manager of the American Bitumastic Enamels Co., but he had hardly got into the work when war broke out. He promptly entered military service and was made captain in the 11th Engineers, of which William Barclay Parsons, the well-known New York consulting engineer, was colonel. He served with that regiment throughout its experience in France, was promoted to the lieutenant-colonelcy of the regiment and returned to the United States in April, 1919.

He at once became general manager of the Enamels Company, resigning that position in October of last year to engage in advertising and public relations work as a member of the Brearley Service Organization.

Col. Chevalier has always taken a very active interest in engineering society work and is now, as the culmination of many years of activity on behalf of the organization, president of the Brooklyn Engineers' Club. He is an associate member of the American Society of Civil Engineers and a member of the Society of American Military Engineers. He has constantly maintained an interest in the work of his Alma Mater and is a past-president of the Polytechnic Alumni Association.

City Manager Bill Introduced in New Jersey Legislature

A bill authorizing the municipalities of New Jersey to adopt the city-manager plan, has been introduced in the State Legislature. Such bills have been introduced and failed of passage for several years in succession. New Jersey is one of only a dozen states in the union that has no city managers but a large number of its municipalities have adopted the plain commission plan.

Indiana Governor Urges Road Building to Aid Unemployment

Governor McCray, of Indiana, as a result of a recent call by representatives of the Central Labor Union regarding the finding of employment for unskilled laborers, has written a letter to Lawrence Lyons, director of the state highway commission, suggesting that the commission start immediately whatever construction work is consistent with good judgment in order that the unemployment situation may be relieved.

Construction Budget for Power Company Is $22,534,000

The Southern California Edison Co. has announced that in its 1922 construction program $22,534,000 will be spent on water-power projects and the extension of the transmission system. This is the largest annual construction budget ever appropriated by the company and is in addition to the $17,500,000 which is to be used during the year for operating expenses, wages, supplies, interest, etc. The construction budget includes $10,951,000 for water power plants proper; $3,333,000 for 220,000-volt transmission lines; $8,124,615 for extensions to distribution lines and substations; and $125,385 for subsidiary companies.

The funds are to be secured by the sale of bonds. Practically all the additional water power is to be generated by plants on Big Creek and the San Joaquin River, where the company has for years been working on a comprehensive program, adding something to the system each year.

To Build Dam and Tunnel

The 1922 program includes work on a 125-ft. dam just below Big Creek power house No. 8, a 5-mile tunnel thence to power house No. 3, which is to have six generating units operating under a head of 855 ft. and developing a total of 200,000 hp. Work on the 13.6-mile tunnel between Florence and Huntington Lakes, which was started in 1920, will be continued this year, the allotment for this season being $1,900,000.

The company now operates a 150,000-volt transmission line 240 miles long, from Big Creek to Los Angeles. This year this line is to be changed over to 220,000 volts, which will be adopted as standard for other high-tension lines to be added to the system. In the ultimate development proposed for the Big Creek-San Joaquin chain of plants a total of six 220,000-volt transmission lines will be required. It is now estimated that by the use of 220,000 volts instead of 150,000 volts the ultimate savings in transmission-line investment will total $30,000,000.

Illinois Society Talks of Modern Surveying

Aerial Mapping Discussed—Other Subjects Included Research and Drainage Prizes Awarded

Surveying, formerly a prominent subject at local engineering meetings, came to the front again at the annual meeting of the Illinois Society of Engineers, held at Decatur, Ill., on Jan. 24 to 26. But it was represented by distinctly modern phases rather than by the once familiar talks on lost corners and the locations of boundary lines. Aerial photography and mapping as a commercial proposition and a sequel to war developments was the subject of a paper by R. C. Diggins, of the Diggins Aviation Co. An analysis of the errors in a transit-tape traverse was given by W. H. Rayner, University of Illinois.

Education in surveying was dealt with in two papers. A new system at Purdue University, described by G. E. Lommel, provides a general course in plane surveying, followed by special separate courses for students in civil, mechanical and electrical engineering, that for the two last dealing largely with building layouts. The University of Michigan, according to T. J. Mitchell, has established a separate diploma department in geodesy and surveying, since it appears that the proper schooling of the surveyor requires more time than that allotted to surveying in the regular engineering course. The dual aspect of surveying, as an independent profession and as a basic part of engineering, was brought out in a brisk discussion following these papers, it being contended that land and property surveying is essentially distinct from engineering survey work.

Sanitary Districts

Sanitary districts, their purpose, organization and plans, were the subject of four papers, two of which dealt with the matter in general. The Indianapolis and Decatur districts were described by J. A. Craven and W. C. Field, respectively. Provision for storm-water runoff in city sewers is a local problem and must be solved in view of the records and experiences of local floods. This was a conclusion presented by C. B. Burdick, Chicago, who pointed out that while correct application of theory is necessary, the greater weight must be given to local records.

Highway research was the subject of an address by Dr. W. K. Hatt, director of the Advisory Board on Highway Research. Road construction is only one element, the general problem being the economics of highway transport. As the engineer has improved and developed railway transportation, so now he has the same field and opportunity in regard to highway transportation. Experimental road work was described by C. A. Hogentogler, highway engineer of the U. S. Bureau of Public Roads, and by H. F. Clemer, testing engineer of the Illinois Highway Department. The former expressed the conclusion that reinforcement is a necessity in concrete roads, but just what is the best form and arrangement of such reinforcement has not been determined. The Illinois highway situation and prospects were reviewed by F. S. Sheets, state superintendent of highways.

That engineers were of greater constructive assistance than lawyers in drafting a revised drainage law, was stated by F. B. Leonard, attorney, in an address on "Legal Aspects of Drainage in Illinois." A review of progress in land reclamation by drainage was given by Prof. G. W. Pickets, University of Illinois. The economic, transportation and construction features of the Illinois barge waterway were given in a paper by M. G. Barnes, chief engineer, which was read by Mr. Cornish, assistant chief engineer of the waterway.

Prizes

Prizes of $25 each were awarded to two of the six papers entered in a competition: "Analysis of Errors in Chaining," by W. H. Rayner, and "Overflow Chambers for Intercepting Sewers," by W. T. McClenahan.

Robert Isham Randolph, Chicago, was elected president, and H. E. Babbitt, Urbana, vice-president of the society. Resolutions passed included: (1) All registered engineers and surveyors, from whatever state, should be permitted to practice in Illinois; (2) a new registration law should be drafted; (3) approval of the recent appointment of an assistant as State Superintendent of (5) revision of the state drainage laws; and (6) endorsement of a diploma department of geodesy and surveying, as established at the University of Michigan.

El Paso Sells $1,850,000 Bonds for Public Improvements

The city of El Paso, Texas, has issued and sold to Stern Bros. & Co., of Kansas City, $1,850,000 in bonds, the money to be expended in public improvements as follows: $500,000, water works; $500,000, school buildings and additions; $250,000, sewer lines; $125,000, sewage disposal plant; $125,000, drainage (storm sewers); $125,000, paving street intersections; $90,000, street grading and extension; $100,000, park extension; $10,000, addition to public library. The water works improvements call for two reservoirs, one of 12,000,000 and the other, 2,600,000 gal. capacity. W. C. Stewart is city engineer.

Development of Canton, China Assured by Contracts Let

Municipal improvements in Canton, China, which have so far included the demolition of the wall encircling the city and building in its place a modern well-paved boulevard, have recently been augmented, according to "Commerce Reports" for Jan. 16, by contracts for several million dollars' worth of terminal facilities. Plans are being drawn for dredging the Pearl River so as to permit ocean steamers, which now come within 20 miles of Canton, to tie up at the city wharfs.

Permit Sought for New 81-Mile Railway in Washington

The Wenatchee Southern Railway Co., Wenatchee, Wash., has filed with the Interstate Commerce Commission, application for permission to construct 81 miles of new railroad main line in the Wenatchee-Kennewick fruit region. The proposed new line will serve the rich apple and fruit districts of Eastern Washington.

What the Colorado River Conference Will Do

Secretary Hoover, Chief of Engineers and Head of Reclamation Service Outline Federal View of Problem

The Colorado River Commission, which met in Washington on Jan. 26, organized in three divisions so that the three major problems may be studied simultaneously. One sub-committee composed of W. F. McClure, of Arizona and F. S. Emerson, of Wyoming, will report on the volume of water available with storage, and the volume available without storage. A second sub-committee made up of W. S. Norviel, of Arizona, Col. J. G. Scrugham, of Nevada, and R. E. Caldwell, of Utah, will study the water requirements of the various states. S. B. Davis, of New Mexico, and D. E. Carpenter, of Colorado, comprise the third division. Since these latter two commissioners are lawyers, they were assigned the legal questions involved, which includes a study of the obligations of the United States under the treaty with Mexico as to the Colorado River.

Hoover's Opening Address

In opening the conference, Secretary Hoover said in part:

"This commission has been established primarily to consider and if possible to agree upon a compact between the seven states of the Colorado Basin, providing for an equitable division of the water supply of the Colorado River and its tributaries amongst the seven states. Such a compact is subject to ratification by Congress and the Legislatures of the various states.

"The problem is not as simple as might appear on the surface for while there is possibly ample water in the river for all purposes if adequate storage be undertaken, there is not a sufficient supply of water to meet all claims unless there is some definite program of water conservation. The commission will, therefore, inevitably be driven into the consideration of a program looking further than the immediate legalistic relationship of the states if it is to find a solution to the problem.

"The federal government is interested through its control of navigation, through protection of its treaty obligations, through development of national irrigation projects and through virtual control of power development depending upon the use of public lands.

"This conference is unique in its attempt to determine states' rights over so large an area by amiable agreement. Indeed it has wider proportions than this in its realization of common interest, need of joint consideration, etc., in order that the greatest possible benefits may be derived for the whole of our people from one of the most precious possessions of our country."

A. P. Davis, director of the U. S. Reclamation Service, told the commission that he has no doubt that there is enough water in the Colorado to irrigate all the lands in the basin and still leave enough for the power plants that can be utilized. He pointed out that three-fourths of the water in the Colorado comes from the Green and the Grand Rivers, and that the other tributaries will need their waters locally. He urged that no further burdens be placed on the tributaries. He pointed

$2,500,000 Addition to San Diego Water Supply Advised

Immediate construction of a 116-ft. gravity type masonry dam to store 29 billion gallons of water on the San Diego River at Mission Gorge, 12 miles above San Diego, a filtration plant, and a conduit to the city, are advised by H. N. Savage, city hydraulic engineer of San Diego, Cal., in a report submitted to the city council and water commissioners of that city on Jan. 14. The estimated cost of the project is $2,500,000. Mr. Savage proposes that the dam be built for future raising to such a height as to provide a storage capacity of 95 billion gallons, which would give a net safe daily yield of 12.5 m.g.d. (in place of 5 m.g.d. for the 116-ft. dam) and bring the total cost of the project to $5,250,000. The drainage area of the proposed reservoir is 387 sq. miles, compared with 192 sq. miles for a reservoir at El Capitan, 30 miles up the San Diego River from San Diego, which site was investigated by Mr. Savage.

Colorado River Conference

(*Concluded from p. 255*)

out that mining and other industries in the upper basin are dependent upon the production of food supplies. He made it clear that he does not concede that it is necessary to insure enough water for that part of the basin which lies in Mexico, but he said that question is simplified by the fact that the Mexican area will have all the water it needs.

As to power, Mr. Davis pointed out that it is a mistake to believe that the development of irrigation in the upper basin will not limit the power available below, although he pointed out that the development of power in the upper basin will not interfere with the use of the water below. He cited as one of the great difficulties of the great development, the handling of the salt in connection with storage in the lower river.

O. C. Merrill, executive secretary of the Federal Power Commission, pointed out that applications already are on file covering 4,500,000 hp. of the 6,000,000 hp. which can be developed on the Colorado River. He stated that the Federal Power Commission has suspended all action awaiting the recommendations of the Colorado River Commission. He said that he is perfectly willing to concede that power should be subordinated to irrigation and flood control. He said that the river is capable of producing more power than can be used for generations to come but that reservoirs should be so located as to provide for the gradual expansion of power developments.

Maj.-Gen. Lansing H. Beach, chief of engineers of the Army, said that it is the policy of the Corps of Engineers to interpret proposed restrictions in the interest of navigation, according to a rule of reason. He pointed out that the Supreme Court has ruled that a stream is navigable where navigation has existed or may exist and that the development of the motor boat is resulting in a very material increase in the navigation on rivers. The impression created by his talk, however, was that there would be no interference with the development of the river by the injection of technicalities based on navigation claims.

To Mine Rock Asphalt in Arkansas

An effort is being made to resume operations on the Pike County, Ark., rock asphalt deposits for road work. The high price of cement is aiding the project. A number of years ago this asphalt was extensively mined and some of the best of Little Rock's older streets are paved with the material.

Mining Engineers to Meet

The American Institute of Mining and Metallurgical Engineers will hold its annual meeting at the Engineering Societies Building, New York, Feb. 20-23. In addition to the three-day technical program there will be a number of excursions and a reception and banquet. William Y. Westervelt is chairman of the committee on arrangements.

New York City 80,000 Apartments Short, Committee States

A preliminary report to the New York Legislature by the Joint Committee on Housing, headed by Senator Charles C. Lockwood, states that there is a shortage of 80,000 apartments or housing for 400,000 people in New York City. The shortage of houses that formerly rented at $4 to $11 a room is greater than before the war, the report states.

The committee expresses the opinion that the housing shortage is a menace to health and life. It recommends an amendment to the State Insurance Act that would permit life insurance companies operating in the State to invest up to 10 per cent of their assets as of Dec. 31, 1921, in purchase of land in any first-class city of the State and the erection thereon of apartment houses, tenements and other dwellings, not including hotels, the privilege to terminate on April 30, 1924. As a safeguard against high rentals, a bill already introduced in the Legislature provides that properties improved under its terms shall not be recognized as assets of the insurance companies unless when their construction is begun their "rental value is estimated at $9 a room or less."

It is reported that the Metropolitan Life Insurance Co. has expressed a willingness to invest $100,000,000 in New York City housing, if the proposed legislation is passed, and that in 1921 it loaned $68,000,000 for housing in that city. It is also reported that architects and builders have offered their services and supply men in various lines have offered materials at cost plus all expense, and that labor organizations have expressed a willingness to permit their members to work overtime without any charge for the excess hours, with the understanding that they were given the option of renting 25 per cent of the apartments they helped build.

In estimating the feasibility of providing apartments at $9 and $11 a room allowance is made for the State legislation exempting new housing accommodations from taxation for some ten years, it being assumed that this exemption, which soon expires, will be extended. It is also expected that construction will be carried on by whole city blocks under the best methods available for efficiency and economy.

Washington's Civil Engineers Vote for Federation

By a unanimous vote the Washington Section of the American Society of Civil Engineers, Feb. 3, voiced its desire to become affiliated with the Federated American Engineering Societies. The action was taken in the presence of John R. Freeman, president of the American Society of Civil Engineers, who indicated informally that he was much pleased with the action taken. The motion to join the federation was made by Gen. W. H. Bixby, formerly Chief of Engineers, U. S. Army. The vote followed statements by Arthur P. Davis and L. W. Wallace summing up the federation's accomplishments and giving an outline of its plans.

Freeman Speaks

Mr. Freeman delivered the address of the evening. With the aid of lantern slides he reviewed some of his experiences on the Yellow River in China. He pointed out the more important reasons why flood control on the Yellow River is one of the greatest engineering problems in the world. Incidental to his address, he expressed the opinion that river hydraulics is a much neglected branch of the civil engineering profession. Carefully developed scientific facts with regard to flood control and the handling of river problems generally are not available. He explained how a search of the principal technical libraries of the country revealed that such literature as exists on the subject is largely an expression of opinion. This search revealed that most of the opinions expressed were contradicted by those of engineers of equal standing. Mr. Freeman recommended the establishment of a laboratory at which flood control and other river studies could be pursued.

Consider $20,000,000 Building Program at Yale

James Gamble Rogers, supervising architect of Yale University, New Haven, Conn., at a conference Jan. 23 with city officials, outlined a building program for Yale which may involve the amount of $20,000,000 in new buildings for the university during the next five years.

Plan Flood Prevention Works for Peru, Ind.

The Peru, Ind., flood commission has submitted to the state conservation department plans and specifications for the building of earth and concrete levies, the raising of bridges and the building of ditches to protect the city of Peru from a repetition of the losses caused by the Wabash River flood in 1913. The plans of the flood commission have been submitted to M. J. Stinchfield, assistant state engineer, for inspection, and will later be examined by Dean A. Potter, of the engineering department of Purdue University. Members of the flood commission are R. A. Edwards, W. S. Mercier and Charles L. Vance. The commission was accompanied on its visit to the state conservation department by its engineer, T. N. Jackson, of St. Louis. No estimate was made in the specifications of the cost of the proposed improvements.

Narrows Siphon Submarine Pipe Line Broken by Dredge

One of the three spuds of the dredge "Toledo," which was operating off Tompkinsville, Staten Island, New York City, Feb. 2, on work for the N. Y. Department of Docks, is believed to have been responsible for the breaking of the 36-in. cast iron submarine pipe line, known as the Narrows siphon, which delivers the Catskill water supply under New York Harbor from Brooklyn to the Borough of Richmond. The laying of the Narrows siphon, described in *Engineering Record*, Dec. 19, 1914, p. 656, was a most unusual engineering operation, involving the use of §-in. 36-in. pipe, in 12-ft. lengths, equipped with a special type of flexible joint and laid by means of a 180-ft. curved structural steel cradle with one end attached to a scow and the other reaching to the bottom of a dredged trench in which the pipe line was laid and covered over with a minimum fill of 10 ft.

The depth of water at the point where the accident occurred was 40 ft. The normal daily flow carried by the submarine pipe line was 15,000,000 gal., but after the break occurred this flow increased to 28,000,000 gal., indicating, according to W. W. Brush, deputy chief engineer, Department of Water Supply, Gas and Electricity, that the pipe had not merely been cracked but that a large piece of the line had been broken out and washed away. After the accident occurred the flow at the Staten Island end of the line was completely cut off.

Break Located

Compressed air was turned into the pipe line to locate the break by means of the bubbles arising and divers were sent down by the Merritt & Chapman Wrecking Co., which has been engaged to make the repairs, for an inspection of the line, but at this writing the muddy condition of the water made it impossible to appraise the damage done.

Examinations show that there is a 10-ft. cover of mud over the pipe line. This material is now being removed by means of a bucket and by pumping. Forty thousand circulars have been distributed to Staten Island school children with instructions to take them home to their parents, calling upon members of households to reduce water consumption to the minimum.

Several local pumping stations, securing their supply from wells, have been put in service and are delivering about 12,000,000 gal. daily to the Silver Lake reservoir, which has a capacity of 400,000,000 gal. The normal consumption for Staten Island is 19,000,000 gal. per day, which, in the opinion of Department of Water Supply officials, can be easily cut to 16,000,000 gal. a day without inconvenience to householders. By pumping 12,000,000 gal. a day into the reservoir from the wells and using 4,000,000 gal. a day of the water stored in the Silver Lake reservoir, it will be possible to supply the needs of the borough for at least 100 days.

Details of the break and the probable method of repair are not yet available, although it is probable that a special steel sleeve will be employed to replace the broken section of pipe.

Fire Damages Falsework of New Bridge at Minneapolis

Fire, which will cause about a month's delay and $10,000 damage, occurred Jan. 27 in the falsework supporting the arch centering of the center span of the Franklin Ave. bridge, Minneapolis. An overheated salamander, which was being used to prevent freezing of freshly placed concrete, was the cause of the fire. About 400 cu.yd. of concrete fell into the river when the supporting centering gave way. The existing steel truss bridge, which is being used for construction as well as traffic, was damaged slightly by heat, but will be repaired.

As described in *Engineering News-Record* of Feb. 12, 1920, p. 335, the bridge will contain a 400-ft. span, said to be the longest concrete arch ever built. It was designed by the late F. W. Cappelen.

Vehicle Tunnel Bids Postponed

Receipt of bids for the construction of the Hudson River vehicular tunnel, comprising twin tubes of cast iron 29 ft., 6 in. in diameter, scheduled for Feb. 7, has been postponed to 3 p.m. Feb. 15. It is understood that the delay is occasioned by the difficulties which a number of prospective bidders have experienced in getting surety companies to furnish the bonds called for in the contract. For the entire work the underwriting involves a sum of $4,000,000.

Richards President of Lehigh

Charles Russ Richards, dean of the college of engineering and director of the experimental engineering department of the University of Illinois, has been elected president of Lehigh University at a meeting today of the board of trustees. Dean Richards succeeds Dr. Henry S. Drinker, who retired more than a year ago.

Mr. Richards is 51 years old and was graduated from Purdue University in 1890. After graduation he became an instructor in mechanical engineering in the Colorado Agricultural College, where he remained until 1911, when he went to the University of Nebraska. Since 1917 he has been connected with the University of Illinois.

Kansas City Engineers' Club Aids Water-Works Campaign

The Engineers' Club of Kansas City, Mo., has appointed the following committee to co-operate with the bi-partisan water commission in winning public support for the $11,000,000 bond issue for water-works improvements: Robert E. McDonnell, John Prince, Charles S. Foreman, Ernest E. Howard, Ernest B. Black, Eric W. Bacharach and Hart Cummins. Bonds for this amount and purposes were voted down last November, at the same time that the proposal for establishing the commission was carried. An ordinance for re-submitting the $11,000,000 bond issue to the people on April 4 has been introduced in the city council.

Affiliation Proposed for Boston Technical Societies

Plans have been developed for the creation of an affiliation of technical societies in Boston, Mass., and a prospectus outlining the general scope and the objects of the organization, together with a proposed constitution and by-laws, have been distributed by the organizers of the movement comprising the Boston Society of Civil Engineers, the New England Water Works Association, the Plant Engineers Club, the local sections of the national societies of civil, mechanical, electrical, mining, and heating and ventilating engineers, and the local chapter of the American Association of Engineers. The movement is similar to action recently taken in Philadelphia, Detroit, Cleveland, Chicago, and other large centers.

Such a general organization as is planned, the prospectus points out, will eliminate the present duplication of effort on the part of individual engineering societies and will give opportunity for concerted action on questions which concern technical men either in public or professional life. The affiliation, according to the plans of its proponents, would consist of local technical organizations and would not be made up of individual memberships. The government of the organization would be vested in a council consisting of two representatives from each member organization, the council to have jurisdiction over joint matters.

It is proposed to have the council appoint standing committees as follows: Program, Public Affairs, Finance, Welfare, Employment, and Library. The project could be financed by an assessment of $3 annual per member of each of the affiliated sections.

Slag Association Elects Officers

At the recent animal meeting of the directors of the National Slag Association in Cleveland the following officers wer elected for the present year: L. A. Beeghly, Youngstown, Ohio. president; C. E. Ireland, Birmingham, Ala., vice-president; and H. J. Love, Cleveland, secretary-treasurer.

Urge State To Build Cement Plant in Arkansas

At the annual meeting Jan. 28, of the Arkansas Chapter, American Association of Engineers, a resolution was passed urging the Governor of Arkansas to investigate the feasibility of establishing a cement plant in southwest Arkansas, to be operated by convicts. The action results from a belief that cement manufacturers have kept the price of cement up to such exorbitant figures that both public and private work is held up. Road-building especially is said to be suffering from these conditions.

About 25 years ago a vertical cement mill was built in southwest Arkansas, but with the perfection of the horizontal mill and the consequent reduction in costs of production, the old concern soon ceased to operate. In Little River and Sevier counties abundant material for cement manufacture exists and fuel is cheap and easily obtainable. With the establishment of such a plant it is believed a great reduction could be made in Arkansas road and bridge costs.

Summon Cement Companies to Explain Indiana Road Bids

Representatives of five cement companies have been summoned to appear before Governor McCray of Indiana, Attorney General U. S. Lesh and members of the state highway commission to explain alleged collusion in connection with bids on cement for road construction. A compilation of the bids shows that a number of companies submitted bids which were practically identical on work involving more than $500,000. The same situation exists in regard to some smaller bids. The Governor said he had placed the matter in the hands of Attorney General Lesh to determine whether any legal action should be taken by the state.

The cement companies which have been summoned to appear before the Governor and other state officials are the Atlas, Universal, Indiana, Wabash, and Lehigh.

Bids were also submitted to the commission by a number of other companies, but an examination of the proposals offered by them was satisfactory to the commission, according to officials. The cement companies which have not been asked to appear before the state officials include the Louisville, Sandusky and Kosmos.

Cooper Seeks Power Permit on Columbia River

Col. Hugh L. Cooper has applied to the Federal Power Commission for a preliminary permit covering the important Grande Coulee site on the Columbia River in the State of Washington. This project is covered in the Columbia Basin report issued by the State of Washington. *(Engineering News-Record,* Nov. 11, 1920, p. 944 and July 14, 1921, p. 83.) In that report it is stated that a dam 180 ft. high could be erected at the Grande Coulee site. The Federal Power Commission, using the existing records of the flow of the Columbia River, figures that such a dam would permit of the development of 430,000 hp. Since the principal use of the power would be for irrigation purposes, it is believed that on a pumping-load basis it would be possible to install 1,000,000 hp.

Louisiana Highway Commission Personnel Announced

Formal announcement has been made by Governor John M. Parker of the appointment of William T. Peterman, of St. Mary's parish, La., as president of the newly-created state highway commission. This is the appointment which was forecast some weeks ago in the *Engineering News-Record.* Associated with Mr. Peterman will be Arthur Taylor, of New Orleans, and Duncan Buil, of Royville, Richland parish, La., the two other members of the commission just appointed.

The commissioners will serve for overlapping terms of two, four and six years. No announcement has yet been made of the term of service, though rumor has it Commissioner Peterman will be named for the six-year term, Commissioner Taylor for the four-year term, and Commissioner Buil for the two-year term. All three of the commissioners are experienced in highway construction and engineering. Mr. Buil is the present state highway engineer.

St. Louis Continues Hog Feeding But Plans Incineration

What is hoped may prove to be a temporary contract for a continuation of garbage disposal by feeding to hogs pending the construction of incinerators has been let by the city of St. Louis. The contract, which is to begin Feb. 15, 1922, and run for a year, has been awarded to John F. Klein and Meyer Katz, the city to pay $1.60 per ton for the removal and final disposal of the garbage. The city will deliver the garbage on barges at the municipal dock. The contractors expect to sell the garbage to farmers for hog feeding at points down the river. The city is not obligated to pay anything to the contractors for any garbage that it may dispose of by incineration or otherwise during the year, provided the city gives the contractors thirty days' notice of its intention to make such a change. Under the contract expiring Feb. 14 the city was delivering the garbage to a hog feeder who was paid $2.30 a ton for disposal and who bid $2.40 per ton for the ensuing year of which $1.80 was for freight. A city ordinance has been passed which provides for the construction of two incinerator plants costing about $140,000. The incinerators are to have capacities of 70 to 80 tons in 14 hours, temperatures of about 1,700 deg. and stacks some 125 ft. high. Two more incinerators are planned for later construction. The amount of garbage for disposal ranges from 60 tons in winter to 350 tons in summer. Clinton H. Fisk is director of the Department of Streets and Sewers of St. Louis.

Hoisting of Lumber for Buildings Must Be Done Inside

An amendment to the building laws of New York has been passed and the bill signed by Governor Miller whereby only timber and lumber must be hoisted within a building in excess of five stories in height. The former law was construed to mean that in the construction of buildings five or more stories in height no construction material could be hoisted outside the building. The amendment to the law was caused through the restriction against the handling of steel girders and other heavy framing members.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; Annual Convention, Cleveland, Ohio, Feb. 13-16.
AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago; Annual Convention, Chicago, March 14-16.
AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, Philadelphia, May 15-19.

The Engineers Club of Kansas City held its annual meeting Jan. 27. Dr. A. H. Cordier delivered an illustrated lecture on "Hunting Birds with a Camera," followed by a talk on "The Lure of the Northwest" by Frank Branch Riley of Oregon. Announcement of officers elected for 1922 will be made later.

The Seattle Engineers' Club held its annual dinner and election of officers Jan. 13. Officers for 1922 are: President, Stuart Mannell, vice-president, Chester F. Lee; secretary, Lyman T. Banks and treasurer, Amos Slater.

The Iowa Engineering Society at its annual meeting Jan. 10 to 13, inclusive, in Sioux City, elected the following officers: President, R. W. Crum; vice-president, Karl C. Kastberg; directors, J. H. Dunlap and C. S. Nichols; secretary-treasurer, L. A. Canfield, Des Moines.

PERSONAL NOTES

HARRY L. WILSON and GEORGE E. JOHNSTON civil engineers, have opened an engineering and contracting office in Appleton, Wis.

SAMUEL YOUNG has been appointed chief engineer of the Board of Commissioners of the Port of New Orleans, La. Mr. Young held this position from August 1913, to May 1915, but for the past few years he has been construction engineer for the United Gas and Electric Corporation and for the American Cities Co. on the rebuilding of the power plant of the Little Rock Railway and Electric Co.

REX C. STARR, construction engineer for the San Joaquin Light & Power Corporation has been named chief engineer for the Merced Irrigation District. He will retain his position with the power company.

R. F. RAGLAND, formerly assistant engineer in charge of road maintenance and construction in Yellowstone National Park, is now connected with the state highway commission of Montana.

O. B. BESTOR, assistant to the manager of the department of transportation and communication of the Chamber of Commerce of the United States, has been appointed principal locating engineer for the North Carolina State Highway Commission.

GEORGE E. WOODS has been appointed chief engineer of the Consolidated Gas Co., N. Y., succeeding the late William H. Bradley.

THOMAS H. WIGGIN, formerly principal designing engineer of the Catskill aqueduct for the Board of Water Supply of New York City, has opened an office in New York City for the practice of engineering. His most recent work has been in China, where he served as acting chief engineer of the Grand Canal Improvement Board, returning in 1921, after the completion of the preliminary survey work. During the war Mr. Wiggin, with rank of captain, major and lieutenant colonel, was in charge of the water supply section of the Division of Construction and Forestry of the A. E. F.

O. B. LACKEY, for four years supervising engineer of the Southern Railway System with headquarters at Washington, D. C., has been made city manager of Morganton, N. C.

WILLIAM ORD, for a number of years manager of the paving department of the Lakewood Engineering Co.,

has resigned. Mr. Ord is well known to highway engineers as an expert in concrete paving equipment, plant layout and methods, having installed most of the large outfits furnished by the Lakewood Co. during the last three years.

CHARLES H. LEE, formerly a member of the California state water commission and chief of the division of water rights under the department of public works, has resumed private practice as a consulting engineer in San Francisco.

CHARLES B. WATSON, formerly architectural engineer of the Union Pacific Ry., has joined the Charles L. Pillsburg Co., engineers, St. Paul and Minneapolis, and will have charge of the company's railway engineering work.

GEORGE E. WOODS, heretofore assistant chief engineer and engineer of manufacture of the Consolidated Gas Co., New York, has been made chief engineer, succeeding William Bradley, whose death was noted in these columns recently. Mr. Woods has been with the Consolidated Gas Co. since 1901. Before this he was chief engineer of the Standard Gas Light Co.

WILLIAM CULLEN MORRIS, engineer of construction of the Consolidated Gas Co., New York, has been named assistant chief engineer and engineer of construction. Mr. Morris was successively engineer of the New Amsterdam Gas Co., in charge of the Ravenswood works of that company, assistant engineer of manufacture of the Consolidated Gas Co., and, since 1907, engineer of construction. He is a graduate of Stevens Institute of Technology. In his service as engineer of construction he has had charge of all the development work of the company's main plant, the Astoria plant, which first became an active project in 1902 and started operation in 1906. He has also directed the engineering and construction work of the company's office building, completed in 1914, and the difficult Astoria tunnel completed 1917.

OBITUARY

HARRY FROST, superintendent of the waterworks department of Akron, Ohio, died Jan. 27. He was graduated from the University of Michigan, class of 1908. Before he went to Akron he was an engineer for the Detroit, Mich., water board and chief engineer of the Park and Boulevard Commission.

SIR WILLIAM MATTHEWS, past-president of the Institution of Civil Engineers, England, died Jan. 8 at his home in Hampstead. He was born in 1844 in the Borough of Penzance and engaged in surveying and contracting there until 1864, when he received an appointment to the firm of Sir John Coode, engineer, engaged in harbor, dock, river and estuary work. Twenty-two years later he was made a member of the firm, and remained in active partnership until 1917 when failing health forced him to retire. The firm occupied the position of consulting engineers for harbors and docks to the Crown agents for the colonies and Sir William's duties took him to Ceylon, Hong Kong, Gibralter and Singapore. The firm was also employed by the Admiralty and the Board of Trade, having built the naval harbor at Dover and commercial harbors at Colombo, Cape Town, Folkstone, Peterhead and other ports.

THOMAS P. JOHNSTON, 42 years old, assistant chief construction engineer for the Louisville & Nashville R.R. died suddenly on Jan. 4 at his home in Louisville. He served as a first lieutenant in the Engineers during the World War.

GEORGE W. JACKSON, engineer and contractor, died of pneumonia at his home in Chicago, Feb. 5. After graduation from Purdue University he worked for a number of structual steel firms. About 1904 he organized the Jackson & Corbett Bridge & Steel Works, doing a general contracting business. He supervised the construction of a large part of the freight tunnel system under the downtown business section of Chicago. As a general contractor he built some of the largest water supply tunnels for Chicago, tunnels for telephone and telegraph cables under the Chicago River and the Strickler tunnel in Colorado. He served in a consulting capacity on many of the Great Lakes tunnels built during the last 25 years. At the time of his death he was preparing plans and estimates for a passenger subway system for the city.

EQUIPMENT AND MATERIALS

Device for Proportioning Concrete By Weight

Concrete is proportioned by weighing the aggregates and cement by an apparatus developed by the Lakewood Engineering Co., of Cleveland, O., and recently given practical trial on the Sherman Island hydro electric development on the Hudson River. The proportioner is a steel panel of ¼-in. plate so constructed that it can be framed into any standard bin. At the bottom of the panel are three openings fitted with bin gates. A center gate, 18 x 12 in., is for stone and 12 x 12-in. gates at each side are for sand and cement.

On a shaft extending the width of the plate are three cams, one operating each gate. These cams are adjustable so that they may trip their respective latches when the proper balance is obtained. Keyed to this shaft are bell-cranks forming the scale beams. Three pans of sufficient size to take care of the counterweight necessary for weighing the sand, stone and cement, ride on a vertical shaft. The bottom pan is for stone the middle pan for cement and the top for sand. The ratio between the weight in the pans and the weight of the material in the auxiliary hopper is one to five.

To measure a batch the stone gate is opened and as the weight of the stone in the auxiliary hopper balances the weight in the bottom pan, the pan rises and a cam on the horizontal shaft automatically closes the gate on the stone bin. The cement gate is then opened. When the combined weight of the stone and cement in the auxiliary hopper balances the weight of the two lower pans, the pans rise and a second cam closes the gate. The same cycle takes place in operating the sand gat except that the weight of the material in the auxiliary hopper must counterbalance the weight of the material in all three pans. The batch is then complete and is dumped into the mixer.

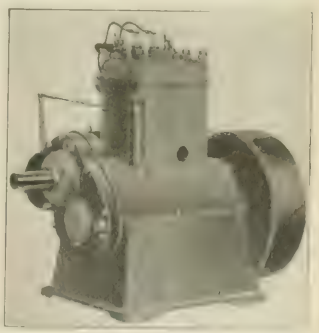


As the material leaves the auxiliary hopper the pans automatically drop to their original positions and the Proportioner is then ready for another batch. So accurately can materials be measured that the error per 1-yd. batch will rarely exceed 50 lbs.

The Lakewood Engineering Co., is manufacturing the proportioner under the patents of Nathan C. Johnson, of Hool & Johnson, New York City.

Small, Two-Cylinder Gas Engine

The Le Roi Co., of Milwaukee, announces a new gasoline engine devoloping from 4 to 8 hp. It is the vertical type, four cycle, and two cylinder with



a 3¼-in. bore and a 4¼-in. stroke. A novel feature is that the drive may be taken off at three different points, either the front or the rear at engine speed or, if slower speed is desired, the drive is taken off of the camshaft at one-half engine speed. The engine, completely equipped with all accessories including fuel tank, radiator, fan and fan belt and fully enclosed, weighs 325 lb. Without accessories and enclosing equipment the engine weighs 26 lb.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Judge Landis Refuses to Resign As Building Trade Arbitrator

The outstanding feature of the Chicago building trade situation for the past week was the determin tion of Judge Landis not to resign as arbitrator of the building trade disputes. He was asked to do so by petition from eighteen unions. If he would relieve them of further negotiations they contended that the unions could make new agreements amicably with individual contractors. On the other hand renewed pledges of full support of Judge Landis and his award have been given by the two contractors' organizations.

In accordance with a clause in the award on or before Feb. 1 the umpire was to fix the rates to control from May 31 for a period of one year. The contractors have announced that the existing scales would not be attacked, but some of the unions which accepted the award have submitted data and arguments for an increase in the scale.

Trend of Business

Finance—Outstanding investment bonds strong in face of new large loans pending. European exchange firm; sterling $4.38⅛; German mark 0.49½ cent.

Bankruptcies in January broke all records, Bradstreet's reporting 2,705, which exceeded the former record of December, 1921, by 278, or 11.4 per cent, and that for January, 1915, following the outbreak of the war, by 13.7 per cent.

F. W. Woolworth Co. earned $20.04 a share in 1921. Net profits per dollar of sales were 9.34 cents, which is reported best yield since 1917.

Car Surplus for the week ending Jan. 23 was 396,192 (159,109 box, 183,999 coal, 53,084 miscellaneous), which was 43,790 cars fewer than in the preceding week. Revenue freight loaded totaled 738,275 cars, or 17,398 above the total for the previous week.

Unemployment in January showed no real improvement, according to the U. S. Employment Service.

Textiles—General market uneven. Wage-cutting in the cotton goods industry has caused uncertainty. Retail business light.

Bids Desired on Big Jobs

Among the projects on which bids are either asked or will soon be called in Construction News, pp. 51-61, are the following:

A tunnel and shafts for Interstate Vehicular Tunnel between New York and Jersey City, $25,000,000.

A high school for Columbus, $1,000,000.

A store building for Richmond, Va., $1,000,000.

An office building for New York City, $1,000,000.

A sewer project for Lakewood, Ohio, $654,000.

A bank and office building for New Orleans, $1,000,000.

An office and loft building for Detroit, $1,000,000.

Materials—Production and Stocks

Production Light and Stocks Sufficient for Small Demand—Stocks in 12 Cities

ment—The production of finished portland cement in the United States in December, 1921, was approximately 6,559,000 bbl. As compared with the production in November, 8,921,000 bbl., this represents a decrease of 2,362,000. A seasonal decline was to be expected, and though the production in December, 1921, was less than in December, 1920, it was about 14 per cent more than the average for December, 1917 to 1921.

The shipments in December, following the usual trend, showed a decrease from November. The shipments in December, 3,697,000 bbl., was over 9 per cent greater than that in December, 1920, but was slightly below the average for December during the last five years.

About 11,938,000 bbl. of finished cement were in the hands of the manufacturers at the end of 1921, as compared with 8,941,046 bbl. at the end of 1920. This total exceeded the average stocks in hand at the ends of the years 1917 to 1921 by over 27 per cent. From April until October stocks of finished cement decreased steadily, but in November and December they increased.

Brick—Latest data from the Common Brick Manufacturers' Association are dated Jan. 1, and are as follows:

Dist. No.	Including States of	No. of Firms Reporting	Plants Closed Down	Burned Brick on Hand	Orders on Books	Price per Thousand at Brickyard	Price per Thousand at Brickyard Dec. 1, 1921
1.	N. Y., New England	8	6	16,443,000	2,768,000	$12.00@ $20.00	$13.00@ $20.00
2.	Pa., N. J., Md., D. C., Delaware	12	7	27,830,000	18,643,000	12.00@ 16.00	12.50@ 16.00
3.	Va., N. C., S. C., Ga., Florida	10	7	11,752,000	5,366,000	6.50@ 18.00	6.50@ 18.00
4.	Mich., Ohio, W. Va.	7	6	8,955,000	1,800,000	12.00@ 15.00	12.00@ 15.00
5.	Ill., Ind., Wis.	28	10	172,582,000	110,056,000	10.00@ 17.00	11.00@ 17.00
6.	Ky., Tenn., Miss., Ala., Ark., La.	13	9	10,057,000	1,731,000	10.00@ 15.00	10.00@ 15.00
7.	N. and S. Dak., Minn., Neb., Ia., Kan., Mo.	9	7	5,336,000	104,000	10.00@ 17.00	11.00@ 17.00
8.	Okla., Tex., N. M.	7	4	5,138,000	1,131,000	8.00@ 14.00	8.00@ 14.00
9.	Wash., Ore., Mont., Wyo., Ida., Utah, Colo.	8	6	2,407,000	1,100,000	11.50@ 17.50	11.50@ 17.50
10.	Calif., Ariz., Nev.	3	.	6,096,000	5,960,000	14.50@ 15.00	14.50@ 15.00
Total		105	62	266,596,000	148,659,000		

The report of Ralph P. Stoddard, secretary-manager of the association, showed that the number of common-brick plants in the United States capable of immediate operation has shrunk to about 1,200. The Geological Survey in 1900 reported 6,400 brick plants in operation. The reduction of plants has come about largely through the failure of small operators who were not familiar with cost of production or not capable of successful merchandising. The second most important influence is the consolidation of plants into larger corporations, usually resulting in the abandonment of some inefficient yards. The common-brick business of the future is to be done by those concerns who conform to these tendencies of highest plant efficiency and strictly business-like merchandising. The common-brick industry is emerging from a "mud-mixing" business and taking its place beside other industries which believe in organization, standardization and efficiency. Details brought out by the current reports show that the season is having its effect on many plants, and the number closed is greater than since last spring.

In December 53,494,000 brick were produced, and almost exactly the same number were shipped from the plants, leaving the stock on hand only slightly reduced from the month previous. The orders on the books on Jan. 1 were not quite so heavy as the month before, due no doubt to seasonal conditions. Production had practically ceased in New York and New England on account of the weather, but a few plants were running in the fourth, seventh and ninth districts. Stocks on hand in all sections of the country were generally less than a year ago. There has been little change in price.

Steel—The annual production rate of steel ingots for January is estimated at about 22,000,000 gross tons. Demand has shown no improvement since October, 1921, and warehouse stocks though only fair are sufficient. The tendency is evident throughout the country to refrain from piling up large stocks of steel shipped in under existing high transportation charges. Large individual tonnages remain noticeably absent in current buying. Mill operations for the entire industry appear slighty under 50 per cent of capacity.

Lumber movements for the month ending Jan. 28, 1922, as announced by the National Lumber Manufacturers' Association show a total of 644,139,151 ft. cut; 598,449,169 ft. shipped and orders for 619,905,902 ft. Production stood at about 15.5 per cent; shipments 30 per cent and orders 22 per cent below normal for the month. Figures were received from all members, averaging 367 mills reporting weekly to the Association.

Orders, shipments and production according to the American Wholesale Lumber Association reports from various associations, were approximately at the same level for the week ending Jan. 21. Southern pine leads in demand,

receiving in the last four weeks 10 per cent more business than the West Coast.

Rail business, which has been strong due to rate reductions, shows a slight falling off, while export business is unchanged. About 11 weeks of unshipped export business on the Coast will remain unmoved until April 1. Western pine orders are far ahead of production but still much below normal. North Carolina pine demand is about half of the normal.

Stocks in Twelve Cities

New York—Common brick in hands of dealers and producers in city amount to about 45 barge loads. Brick from Connecticut and northern New York State are being shipped in by rail, water-ways having been rendered non-navigable by ice. Lumber stocks continue large enough to complete deliveries on quantities of yellow pine as large as 300 M. ft. in 9 or 10 days within the Metropolitan District. Hollow partition tile stocks kept comparatively low owing to quick delivery facilities from limited supply from local mills with 24 hr. deliveries. Small stocks of hollow tile are kept in city; deliveries take from 4 to 5 days after receipt of orders. Lumber stocks low with small demand.

Philadelphia—Sewer pipe dealers in this district preparing for a resumption of business from a month to six weeks earlier than last year. Brick demand small at present but yards are working to accumulate sufficient stock for the spring rush. Lumber stocks ample.

Chicago—About 50 cars of lime on sidings, both lump and hydrated. Deliveries on cement, common brick and sewer pipe on the job, within city limits, in a few hours. Large stocks of lumber on hand.

San Francisco—Deliveries on road oils and asphalt in 2 to 3 days. About 4,000 bbl. of lime and 8,000 bbl. of cement on hand. Stocks of two cement corporations, probably aggregating 350,000 bbl., at nearby mills. Lumber stocks amounting to 40,000,000 ft. Going out fast and coming in at the same

About 15,000 tons of structural steel on hand; 24 hr. deliveries. Stock conditions unchanged during the month.

CONDITIONS OF MATERIALS STOCKS IN IMPORTANT CENTERS

Stocks on hand in approximate figures, example: (cement, San Francisco, 8,000 bbl.); time required for delivery of carload lots to city job, example: (cement, Birmingham, 1 to 2 days); and stocks on hand in general terms, example: (sewer pipe, Los Angeles, plenty.)

	New York	Denver	Detroit	Minneapolis	Philadelphia	Chicago	San Francisco	Birmingham	Los Angeles
Sewer pipe	Ample Immediate deliveries	Immediate del. plant in city	Local stock small		Ample	Immediate deliveries	Good; del. 2 to 3 days	Supply large; plant in city	Plenty Del. 24 hr.
Cement	60,000 bbl. Prompt deliveries	10,000 bbl.	75,000 bbl. Nearby mills	4,000 bbl. Mill del. one day		Del. few hrs.	8,000 bbl. Mill stocks large	800 bbl. Mill del. 1 to 2 days	Large
Lime (common)	Ample	4,000 bu. Del Missouri lime 10 day to 2 weeks.	20 cars Ohio mills	Plenty 24 hr. del	Light	25 cars	4,000 bbl.		Sufficient
Lime (hydrated)	Ample	Colorado one week	20 cars	Plenty	Light	25 cars	Del. 2 to 3 days		Sufficient
Common brick	200,000,000 at most	6,000,000	Ample Local brick yards	4,000,000	Yards working to replenish stock for Spring	Immediate deliveries	Small. Del. 7 to 10 days	Supply unlimited; local kilns	Large. Del 24 hr.
Hollow tile	From factory to job, 48 hr.		Small Deliveries slow	Small Del. 4 or 5 days	Sufficient	Large	Fair; Del. 2 to 3 days	Plenty	Ample Del. 24 hr.
Lumber	Can complete del. on 300 M. ft. in 9 or 10 days	16,000 M. ft.	10,000 M. ft	44,000 M. ft.	Sufficient	Large	40,000 M. ft. Arrival 5,000 M. ft. per day	Large mills within 200 miles	No jame Fir del. 48 hr

plants within 26 miles of city. Dealers' stocks of sand, gravel, and crushed stone are sufficient to meet all demands.

Denver—Conditions of stocks but slightly changed since last month. About 10 cars of asphalt on sidings as against 5 cars one month ago. Cement stocks about 10,000 bbl. At least 6,000,000 bricks on hand. Immediate deliveries on sewer pipe from plant within the city limits.

Detroit—Plenty of sewer pipe on hand for immediate demands. Not much call for pipe from local stocks in yards. About 75,000 bbl. of cement in stock within the city, and nearby mills to draw from. Lime, both lump and hydrated, shipped from Ohio mills as needed; about 20 cars on sidings at present. Some local contractors maintain brick yards and make their own brick for large contract jobs. Ample supply on hand for all local work. Hollow-tile stocks very small and several days necessary for deliveries from factories. Lumber stocks decreasing slightly. Average monthly stock now about 10,000,000 ft.

Minneapolis—From 3,000 to 4,000 bbl. of cement in local warehouses with unlimited supplies available from nearby mills; shipments on 24 hr. notice. Brick stock is low, running from 3,500,000 to 4,000,000 but can be replenished from yards in district. Lime plentiful; unrate; 5,000,000 ft. having arrived in one day during the latter part of January.

Birmingham—Stock of track supplies small at the present time, but supply of cast iron pipe unlimited at local foundries. Sewer pipe also manufactured locally. Sand shipped in from southern part of state; not more than 10 carloads on hand but deliveries can be made in 1 to 3 days. Crushed slag produced in Birmingham and reinforcing bars rolled at Bessemer, Ala. About 500 bbl. of cement in warehouses but deliveries in carload lots can be made from Leeds, Ala., inside of two days. Brick kilns within city limits; supply unlimited. Plenty of hollow tile and large lumber mills within 200 miles.

Los Angeles—All building materials on hand in sufficiently large quantities to meet all present demands with the exceptions of paving stone and wood blocks, for which there is no market. Deliveries in 24 to 48 hr.

Cincinnati—About 8,000 ft. of sewer pipe and 8,000 bbl. of cement in stock. Small gravel pits shut down; paving stone and wood-blocks obtained on order only.

Seattle—Lumber shipments to California and the Orient unusually heavy; supply equal to the demand.

Montreal—Large stocks of lumber; mill deliveries from 1 to 2 weeks.

North Carolina Plans $20,000,000 Road Program for 1922

The North Carolina State Highway Commission met recently and decided upon a program for 1922 providing for the letting to contract of not less than 1,000 miles of highway construction. Of this amount 400 miles will be of a hard-surface type, consisting of plain concrete, reinforced concrete, and asphaltic types on concrete bases, and 600 miles will be of sand-clay, top-soil or gravel. Most of these 600 miles will be surfaced during 1923. It is estimated that the cost of the 1922 work will be in the neighborhood of $20,000,000.

The highway commission is busy reorganizing its engineering staff, which is under the direction of Charles M. Upham, state highway engineer, to handle the 1922 program. A material survey of the state is being made in the effort to locate sufficient deposits of highway building materials. Provision is being made for increased capacity for testing materials and in addition to the main laboratory the commission is erecting a two-story brick building at its mechanical plant. The most modern road-material testing equipment is to be installed.

Besides the program of 1922, the commission already has under contract some $18,000,000 worth of new work comprising about 1,100 miles.

Cost of Gravel Roads in Indiana County Low

The cost of constructing several roads in Wayne county, Ind., is $213 a mile, while the average cost of constructing roads of this kind in Indiana is $1,200 a mile, says a report of W. O. Jones, county highway superintendent. To aid in the economical construction and maintenance of the road system the county has its own gravel-digging machinery, and last year cut 20,000 cu.yd. at an average cost of 15 cents a yard. The report shows $31,537 in the road fund, which means that the road levy will be cut from 14 cents to 9 cents in 1922, county officials say. Last year the department spent $94,017.

Fall Road Contracts in North Carolina Total $3,000,000

During November, the North Carolina State Highway Commission let eighteen highway contracts for which it received 343 bids. The contracts provide for the construction of 130 miles of road to cost, exclusive of usual additional engineering and contingency fees, approximately $3,000,000. Of that mileage, 90 miles are to be hard surface. The average per mile cost of the hard surface road was $30,654. This included clearing, grading, draining, small reinforced concrete bridges and culverts, as well as paving. Road widths were 16 and 18 ft.

The remaining 40 miles were of sand-clay or gravel construction and cost an average of $4,330 per mile.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of February 2; the next, on March 2.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$2.63	$3.50	$4.00	$2.63	$2.91	$3.50	$3.10	—$3.36	$4.00
Structural rivets, 100 lb	3.50	5.00	5.50	3.43	3.90	4.25	4.50	4.00	6.50
Reinforcing bars, ¾ in. and larger, 100 lb	2.53	3.20	3.50	—2.53	2.81	3.42½	2.75	—3.26	2.75
Steel pipe, black, 2½ to 6 in. lap, discount	61%	57.65%	45%	57%	61.9–5%	44%	53.7%	53%	35.10
Cast-iron pipe, 6in. and over, ton	47.30@48.30	45.00	48.30	—40.60@42.60	—46.00	52.00	50.00	44.00	60.00
Concreting Material:									
Cement without bags, bbl	—2.20@2.30	2.55	—2.40	1.97	2.24	2.90	—2.73	2.94	3.10
Gravel, ¾ in., cu.yd	1.75	1.85	2.00	2.00	1.50	2.50	2.25	1.50	1.50
Sand, cu.yd	1.00	1.25	2.00	2.00	.50	1.10	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd	1.75@1.85	2.00	2.93	1.60	2.25	3.50	2.25	3.00	2.10
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	49.00	+37.00	34 00	+44.00	38.00	50.00	32.00	+20.00	.....
Lime, finishing, hydrated, ton	—15.80@16.80	19.00	25.00	18.00	29.00	—24.00	22.00	27.00	26.00
Lime common, lump, per bbl	—2.75@3.48	1.50	2.75	1.40	1.40	—2.70	1.75	2.75	11.00
Common brick, delivered, 1,000	+20.40	—8.50	—11.00	11.00	15.00	14.00	15.50	14.00	16.00
Hollow building tile, 4x12x12, block	Not used	.0675	.13	.0821	.0752	.08	....	.10	.08
Hollow partition tile 4x12x12, block	.11120	.0675	.13	.0657	....	.10	—.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal	+.79	+.85	.93	+.84	+.91	+.95	+.89	.86	.82
Common Labor:									
Common labor, union, hour	—.60	.35	.....	.72½	.40	.50@.55	.62½	.50@.60	...
Common labor, non-union, hour	.....	.20	.35@.45	.35@.40	.40	.35@.40	.45@.56¼	.50	.20@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations are delivered except tiles, which are "on trucks." Common lump lime per 280-lb. net; both lump and hydrated quoted f.o.b. cars New York. Sand gravel and crushed stone are quoted alongside dock. Cement and steel pipe delivered to contractors on job. Gravel ready mixed $2 per cu.yd.

Chicago quotes hydrated lime in 50-lb. bags; common lump line per 180-lb. net.

Minneapolis quotes on fir instead of pine. Brick and hollow tile delivered. Cement on cars. Gravel, sand and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized.

Denver quotes cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to contractors in yards at San Francisco. Lumber price is for No. 1 fir, common.

Seattle quotes on Douglas fir instead of pine. Common lump lime per 180-lb. net.

Montreal quotes sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 95.6 cents). Bag change is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net.

Changes Since Last Week

Structural shapes are quoted in Seattle warehouses at $3.36 as against $3.60 and reinforcing bars at $3.26 as compared with $3.75 per 100 lb. last week. Although the Pittsburgh mill price of $1.50 on steel shapes and reinforcing bars continues to prevail, it is applicable to increasingly smaller tonnages. Quotations as low as $1.40 per 100 lb. on reinforcing bars have been effected on sufficiently large orders. Mill shipments, New York on shapes and bars are quoted at $1.83@$1.88 per 100 lb. Reduction of $1.80 per ton on cast iron pipe in Minneapolis.

Long leaf yellow pine, base size, quoted in Atlanta at $37 as against $35 per M. ft. b.m., and Douglas fir in Seattle at $29 as compared with $19, one week ago. We quote Colorado lime in Denver warehouses at $24 per ton for hydrated finishing and $2.70 per bbl. (180-lb. net) for common lump. Missouri lime, however, is quoted in Denver at $28 per ton for the hydrated and $2.85 per bbl. for the common lump. The change in price is due to manufacturers' reductions to dealers.

Rising prices of flaxseed are reflected in advances ranging from 2c. to 7c. on raw linseed oil throughout the country. New York reports a rise of 2c., Atlanta 5c., Chicago 4c., Minneapolis 7c., Denver 2c., and San Francisco 6c. per gal. in 5 bbl. lots.

Common brick quoted in Dallas at $11 as against $12.65 and in Atlanta at $8.50 as compared with $9 per 1,000, one week ago. Brick conditions in the North, particularly in New York, are quite different from those prevailing in the Southern states. Ice-bound waterways, causing brick shortage, have produced price advances in New York as against the price declines in the South.

Reports from Oakland, Cal., state that a large amount of residence building has been started in the Bay districts, but that no improvement in the unemployment situation is in sight. Seattle, however, reports gradual improvement in the unemployment situation; street and road work and residence construction materially increased as well as a general improvement in volume of business. Lumber demand, both domestic and foreign, is growing stronger and the upward price trend persists. Mills and logging camps reported operating under full crews.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, President

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren, Editor

Volume 88 — NEW YORK, FEBRUARY 16, 1922 — Number 7

A Job for Every Citizen

LAST week we commented in these pages on the results of the Arms Conference. The evolving of the treaties, though, is only a preliminary step. The final one, the essential one, for the United States is to have them confirmed by the Senate. If the Senate rejects the treaties we shall lose for a generation, at the very least, the confidence and respect of the world. We shall have no influence in world affairs. Might will again take the ascendency in international relations. This cannot be allowed to happen. It is a solemn duty of every citizen who believes that the results at Washington are good to bring his influence to bear upon his senators. We called the conference. If the results are good—and the *News-Record* believes that they are—we must back it by acceptance of its conclusions.

Chlorination and Synura

EVIDENCE that chlorination may be an aid in controlling tastes and odors in public water supplies is afforded by the recent experience of New York city, reviewed by Mr. Brush elsewhere in this issue. It was found that while the normal amount of chlorine for reduction of bacteria increased the bad taste caused by Synura—much as chlorine at Milwaukee and elsewhere brought out tastes due to pollution by coal-tar wastes—an *excess* of chlorine reduced taste. Further observations on this and other taste and odor-producing organisms, both in New York city's reservoirs and in other water supplies, may be needed to show how generally reliance may be placed on excess chlorine in those sudden outbursts of tastes and odors which now and then challenge the water engineer and biologist. Meanwhile the studies by Mr. Brush and Dr. Hale deserve careful attention.

Rolled Base for Brick Roads

ECONOMIES in brick-road construction are indicated by the conclusions reached by the U. S. Bureau of Public Roads as a result of an investigation of "rolled-base" types in Ohio. This form involves the use of a base consisting of gravel, crushed stone or slag, with a cushion, 1 to 2 in. thick, of sand or screenings. The two principal advantages of the rolled base are its lower cost, as compared with a concrete foundation, and the opportunities it offers for the use of local materials. The latter consideration, particularly in view of the existing high freight rates, is in line with the policies advocated at all recent meetings of roadbuilding organizations. Most of the rolled-base construction examined in Ohio, as described on p. 273 of this issue, had a thickness of 6 in., but where traffic conditions warrant, compacted bases 8 to 10 in. thick are recommended as suitable for all routes except trunk-line highways subjected to very heavy traffic. There has been evidenced on the part of both engineers and contractors a desire to bring down highway-construction costs. The more extended use of the rolled-base type, if properly placed, compacted and located where soil and drainage conditions are favorable, offers a means of accomplishing this result in the case of the type of surfacing under consideration. Such a pavement, of course, does not possess the rigidity of the concrete-base types, and consequently an asphaltic joint filler is to be preferred to cement grout.

Wood and Steel Conduits

PROGRESS in the design and economics of water-supply pipe lines is shown by the practice of the Butte Water Co. Satisfactory experience with wood-stave pipe up to a head of 250 ft., for portions of a pipe line completed in 1900, led the engineer-manager of the company, as related by him in this issue, to use wood for heads up to 300 ft. in duplicating the line. By this means, the amount of wood-stave pipe in some 27 miles of conduit was increased from 74 per cent in the first to 81½ per cent in the second line, besides permitting a change in location that saved nearly a mile in the length of the new conduit. Another feature of the second conduit was the use of lap-welded steel pipe for heads from 300 to 841 ft., with welded circumferential joints. These are some, but by no means all, of the points of interest in Mr. Carroll's notable article.

Fitting the Highway Organization To Its Task

MANY of the younger highway departments of southern and western states have this winter the responsible task of organizing for their first season of intensive construction. Generous bond issues have given them millions of dollars where previously they have had hundreds of thousands, and the people who have provided the money are demanding that it shall be speedily converted into improved roads. The situation presents the danger that the work of organizing for this expenditure will take the obvious direction of increased forces instead of that of increased capacity which comes from logical division of labor, centralized planning to co-ordinate effort, educational supervision, a skilled personnel trained in teamwork and, above all, a high organization morale.

Efficient organization is necessary if quantity production of high-class improved roads is to be economically secured. The older road-building states of the east and the north have learned this by long experience. Their highway departments are successful in the direct proportion that they have become smooth-working organizations for conducting a continuing business. Number of employees, or high individual skill, will not give success unless the other qualifications of good business organization exist. These are elementary principles, but they require to be emphasized because the indications are already clear that they will not prevail in a numbe

of states which are organizing to carry out extensive highway-construction programs this year, unless the state executives and their highway commissions review their present plans and make radical alterations.

Correction requires first the definite decision not to undertake construction more rapidly than the department forces are trained to plan and supervise it. With the people clamoring for roads this calls for determination and diplomacy. Criticism will most certainly develop and its danger must be checkmated. Here the national engineering societies and the associated general contractors through their local sections and state chapters can be of help. The construction industry has more to gain by establishing highway improvement as a continuing business than by any immediate increase in mileage.

Publicity Run Wild

ON MONDAY, following the Saturday night collapse of the Knickerbocker Theater in Washington, no one in Chicago could have had accurate information regarding the design of the building, the character of the designers and builders, or the cause of the failure. And yet on that day the Public Information Service of the American Association of Engineers issued to the press a bulletin headed "Comment: Knickerbocker Theater Collapse. Licensing Engineers and Architects Protects Public From Building Disasters," and containing the following sentences:

"The failure of the roof of this theater was due to a heavy snow load, but since no other large roofs in Washington failed from this cause the disaster was evidently due to either faulty design or construction, which would not have existed had licensed engineers or architects supervised the work. . . . The movement for the enactment of adequate licensing laws for the protection of the public from the activities of dabblers and quacks who formerly had only to hang out a shingle in order to qualify for business, has been actively supported by the American Association of Engineers, an organization of 24,000 professional engineers. It is to the credit of professional engineers that they are seeking to purge the profession of incompetence and protect the public from engineers-for-a-day."

This is the publicity instinct run wild. To support their licensing propaganda those responsible for the bulletin did not hesitate, while uninformed regarding facts, to place their interpretation on the accident. Surely such action does not add to the reputation of engineers for balanced judgment. We realize that the A. A. E., as such, cannot be held responsible for this expression, unless it be for failure to check those whose judgment is shown to warrant distrust. Unfortunately, though, the newspapers and the public will take the press bulletin as representative of the matured judgment of the association.

Faith in Licensing

THERE is comment elsewhere in these columns on the precipitate haste with which the American Association of Engineers—or, rather, some one apparently empowered to use the association's name—rushed into print regarding the Knickerbocker Theater collapse. There is an additional point in the publicity bulletin to which we wish to call attention, namely, the simple faith with which its author regards registration of engineers as a full and sufficient preventive of future structural failures. "The disaster," says the bulletin, "was evidently due to either faulty design or construction, which would not have existed had licensed engineers or architects supervised the work."

We wish that we could share this faith in the efficacy of licensing—this cure-all character of public registration. But we can't. We are too strongly impressed with the existence of incompetent medical men and lawyers, even after years of registration. Moreover, the conditions which insure or even promote competency are worse in engineering than they are in law and medicine.

In those more matured professions the practical legal validity and the effectiveness of the laws are secured by the determination of the professions to keep the ranks as pure as possible. The country medical associations and the bar associations are the real agencies of professional improvement; the laws are but valuable adjuncts in making professional discipline more effective.

In engineering, alas, we have no such thing as professional discipline. Without it licensing laws will be idle. The demand today among engineers must be for strong enforcement of ethical codes. Then will licensing laws begin to be effective.

Even at that time inspection and approval of plans will have to remain as a third safeguard of public safety.

Publicity for Trade Association Activities

A CONSTRUCTIVE service of much importance to industry has been performed by Mr. Hoover in securing from the Attorney-General a statement as to the legality of activities of trade associations. Interest centers naturally in the legitimacy of the collection and distribution of trade statistics. The indication is that such activity is not illegitimate under the conditions set by Mr. Hoover, namely, that the information be given simultaneously to consumers as well as producers.

The form in which Mr. Hoover has put his question will not be pleasing to many producers. They apparently fear to give the buyer full information regarding the functioning of the industry. The Secretary, though, holds that "information secured solely for the benefit of members and of a character that puts the membership, by reason of the information, in a position of advantage as compared with the public cannot be sanctioned by sound public policy." This is a view in which this journal heartily concurs, and which, as the readers know, it has repeatedly urged in these columns.

Of course, Mr. Hoover and Mr. Daugherty do not make the law of the land. What Mr. Daugherty has designated as not illegal as to statistical activities is obviously a course on the side of safety. The courts may hold that, provided there are no agreements on future action, distribution of statistics to members only is legal. Nevertheless, the drift of public thinking is in the direction of preventing trade associations taking advantage of the public. We believe that all of them will be in a stronger position with the public if they accept the new conditions and take the public into their confidence after the manner proposed by Mr. Hoover or by other means—obviously, directly through the press—of supplying statistics simultaneously to their members and to the buyers.

Special Theater Hazards and Safety

THE public concern about theater safety awakened by the Knickerbocker collapse may serve to produce valuable results. It is somewhat different from the typical sentiment of indignation that follows every sensational accident. Citizens and communities are in this case seeking not for a scapegoat but for unsafe conditions that may exist and their remedies. In the presence of this spirit of progress it is important that certain special factors of theater safety be recognized.

An abnormally large life hazard is involved in theater occupancy. With large audiences assembled daily and in each case the entire audience exposed jointly to an all-embracing risk, a condition is presented that has no counterpart in other types of building. It is a condition that justifies alarm—at any rate such degree of alarm as will inspire a careful study of existing theaters.

In the routine of daily life the public mind takes no notice of this special hazard. Not only the public but engineers and architects also tend to ignore it. Yet the fundamentals of their planning are (or should be) determined by it, and it is their obligation to take it into proper account. The question presented is whether the greater risk demands increased safety provision in theater construction: lower stresses, greater security of connections, and integration of structure.

Heretofore it has not been thought necessary to provide this greater safety. Implicity, the engineer as well as the layman takes the view that safety is marked off from danger by a clearly defined line, and that a safe construction is equally safe no matter how great the stake at issue. This view is in conflict with the rule applied to all other affairs of men, which exacts a special guarantee where special risk exists—even to the extent, for example, of requiring a better grade of rope for hoists than for derricks, because the life hazard is more direct in the former. Is the rule not applicable equally to the special hazard of the theater? Engineers and architects must answer the question.

An additional special hazard of theater construction must be reckoned with in answering the question. This hazard arises from the speculative character of the theater business—or perhaps from the makeup of the men engaged in it. Theater owners are not lavish in their expenditures when erecting their buildings, except on decoration and luxury items. They are satisfied with the law's strict minimum, and cases are not unknown where they urged economy on their architects and engineers even at the cost of building less safely. That the speculative builder, who has made his bad record in many a city, is a special hazard to safety, is recognized by the more severe building laws that his work has made necessary; if the theater owner is a similar source of special hazard, the argument for increasing the safety requirements on theaters is strengthened.

In bringing such questions to a focus the public alarm over the Knickerbocker accident is justified by its effect. It will justify itself still more if it will bring about a general investigation of the numberless makeshifts now doing duty as theaters—the ancient meeting halls or barns converted into "theaters" by the addition of an electric sign. Those structures, whose relation to the engineer or architect is commonly reflected in their fearful and wonderful roof constructions, represent a hazard of far greater total, we fear, than that of the theaters discussed in the preceding paragraphs. If every one of these improvised theaters in the land were now subjected to competent examination, the terrible cost of the Knickerbocker collapse would be in part, at least, repaid.

National Credits for a National Crisis

JUST NOW, while many are prone to look overseas for the answer to our economic problems, American business men might well paste in their hats the following statement by the Secretary of Commerce:

"We talk glibly of giving billions of credits to foreign countries to increase our farm exports. I wish to say with all responsibility for the statements that a billion dollars spent upon American railways will give more employment to our people, more advance to our industry, more assistance to our farmers, than twice that sum expended outside the frontiers of the United States—and there will be greater security for the investor."

In this and other recent statements Mr. Hoover has shown clearly the vital bearing of the railroad problem on that of business in general. His analysis has been incisive; his proposals, specific and clean-cut.

The fundamental necessity of the country today the Secretary considers to be the resumption of adequate maintenance, betterment and expansion of the railroads. Until they have been restored to an efficient basis private capital will not be forthcoming for new construction and new equipment. Unless both of these shall have been provided before the return of normal business, confusion and waste are bound to ensue. The roads will not be in shape to take up their share of the burden and instead of helping the productive industries will be competing with them for the necessities of industrial life. Mr. Hoover believes that unless we can have an immediate resumption of construction and of equipment expansion and betterment, the commercial community will pay treble their cost in the losses of a single season.

How, then, shall we begin? A general rate increase, he believes, is unthinkable. Neither can we fall back upon a general cut in rates to stimulate greater volume of traffic. That would mean confiscation. The Secretary believes that strict economy in operation accompanied, if necessary, by increased rates in some instances will make possible the reduction of rates on the primary commodities.

This is sound thinking.

But the greater need, the restoration of credit, Mr. Hoover would accomplish through the use of government credit; by guarantee of securities, but not by advancing government funds. A courageous program of betterments based on this substantial foundation would give relief to 500,000 to 600,000 of our unemployed, would raise the standards of living of many more and would broaden the markets of our farmers. But most of all it would enable our railroads in the days ahead to fulfill their mission as indispensable servants of prosperity.

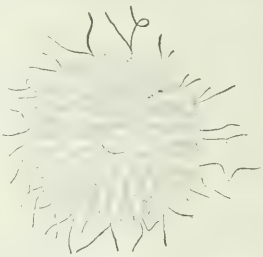
Of the many public services that have been performed by Mr. Hoover this clear-headed analysis of a critical national problem is not the least valuable. In normal times the use of government credit to aid private enterprise would be alien to the spirit of our institutions and should be discouraged. But in the face of a crisis such as that facing our railroads, arising largely from a blight on private credit, the use of national credit (without public expenditure) is a logical remedy, wholly in the public interest.

Synura and Other Organisms in Catskill Water Supply

Experience with Various Taste and Odor Producing Organisms Reviewed—Recent Trouble with Synura Controlled by Use of Copper Sulphate in Aqueduct and Reservoir and by Excess Chlorination

By William W. Brush
Deputy Chief Engineer, Department of Water Supply, Gas & Electricity, New York City

Growths of micro-organisms in the Catskill water supply, New York City, have reached such numbers from time to time since the aqueduct was put in use as to demand attention from the Department of Water Supply but until very recently the organisms have been controlled by throwing a reservoir out of use or by copper sulphate treatment without coming to the notice of consumers. Besides Synura, which caused the taste and slight odor to the prevention of which this article is primarily devoted, the predominating organisms have been Asterionella, Tabellaria and Aphanizomenon. The distribution of Synura in the recent experience was such that it could not be controlled by shutting off reservoirs but a combination of copper sulphate and excess chlorine was effective. The efficacy of excess chlorine in reducing taste is notable because at the outset the bad taste was caused by the normal chlorine dose, and it has generally been thought that chlorination strengthens a bad taste, as has been found true elsewhere, in water receiving waste coal tar products.—Editor.



SYNURA: MUCH ENLARGED
Redrawn from Whipple's "Microscopy of Drinking Water."

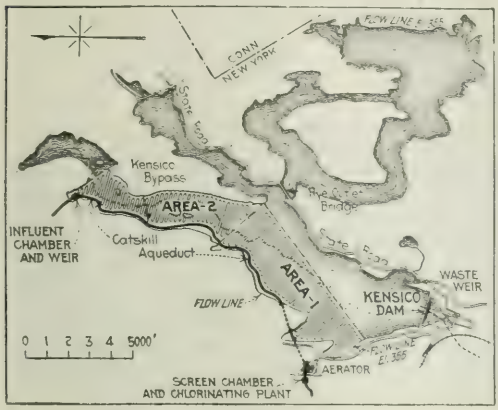
THE press of New York City has recently voiced in daily articles the unsatisfactory condition of the Catskill portion of the city's water supply due to a pronounced taste and slight odor. The taste has usually been designated as resembling a ripe cucumber, although many have designated it as "fishy," and this taste has created in the minds of the consumers a suspicion as to the purity of the water supply. The newspaper comments, the city health department, and the water department, have emphasized the harmlessness of the microscopic organisms, and their oil, which produces the taste complained of, the microscopic organisms being one of the protozoa group known as Synura. The consumer is interested in the possible effect the microscopic organisms have on his health, and in the elimination of the tastes and odors produced by the presence of these organisms, while the engineer is mainly interested in determining how the growths can be controlled and the tastes and odors removed from the water supply. The story of the microscopic organisms in the Catskill water supply system, and the unusual and successful methods of applying copper sulphate and chlorine to destroy not only these organisms but also the tastes and odors resulting therefrom, will be of interest to all water-works engineers and operators and helpful to many who have similar problems to solve. A brief outline of those features of the Catskill system which are pertinent to this subject will be given.

Outline of the Catskill System.—The Ashokan reservoir with a capacity of 130 billion gallons is the only storage reservoir on the Catskill (Esopus) watershed, and from this watershed there is an average flow of about 375 m.g.d. The reservoir is divided into two separate basins. The west basin, which furnishes about 40 per cent of the total storage capacity, receives virtually the entire stream flow, and the excess water passes over a dividing weir into the east basin, where it is stored until drawn for consumption. Water may be drawn from either basin at any desired depth, up to a maximum of 80 ft. with full reservoir. An aerator, with



KENSICO AERATOR WITH SCREEN AND CHLORINATION HOUSE ON THE LEFT
There is an aerator at the Ashokan dam also. Each aerator is equipped with some 1,600 nozzles.

some 1,600 nozzles, is located immediately below the reservoir and is operated except during the severe winter seasons. The aqueduct extends for 75 miles to the influx chamber of Kensico reservoir, and in this section



MAP SHOWING PORTION OF KENSICO RESERVOIR TREATED WITH COPPER SULPHATE

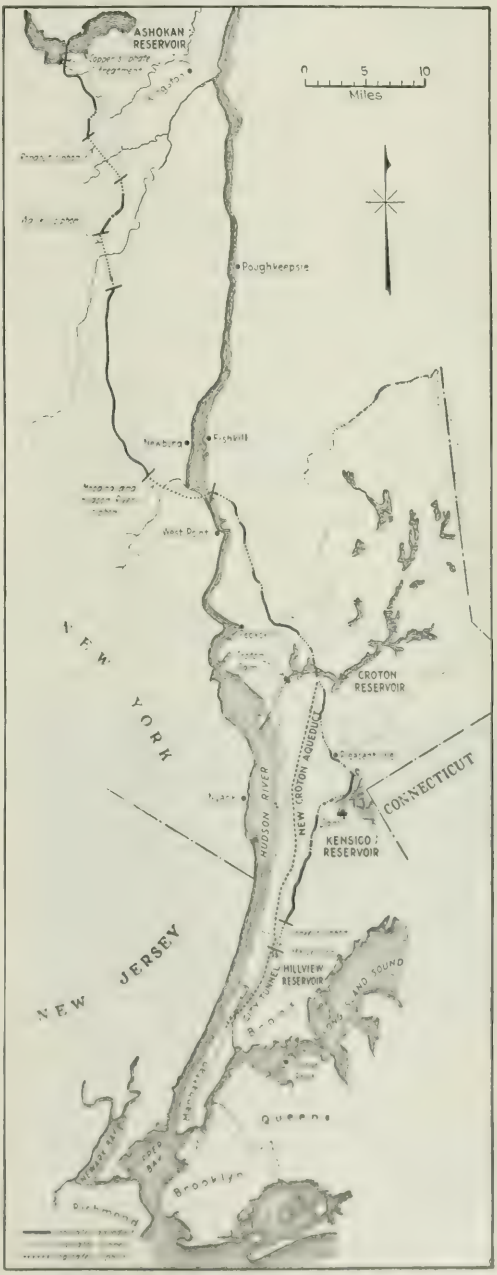
of aqueduct there are four deep pressure tunnels having an aggregate length of 15 miles, the deepest tunnel that beneath the Hudson River, being under a maximum pressure of nearly 700 lb. per square inch. On this section of aqueduct, about two miles above Kensico reservoir, is the Pleasantville treatment plant, designed for the introduction of a coagulant, if such be required. A bypass aqueduct forms a connection between the Catskill aqueduct from points respectively just above and below the influx and efflux chambers of the Kensico reservoir, the length of the bypass aqueduct being about 2½ miles.

Kensico reservoir is a storage reservoir, designed to safeguard the continuity of the supply from the Catskill system, and has an available capacity of 30 billion gallons, with a total tributary watershed of only about 20 square miles. Just below the Kensico efflux chamber is an aerator, which is similar to the Ashokan aerator, and immediately below the aerator is a screen chamber in which is located a chlorination plant of the solution-feed type. The aqueduct from Kensico to Hillview reservoir is 14 miles in length, the lower 3½ miles being a pressure section, but the pressure in this section is only about 60 pounds.

Hillview reservoir is a distribution basin 35 ft. in depth and contains 900 million gallons. From this reservoir the city tunnel extends for 17 miles through the Bronx and Manhattan to Brooklyn, with a connection approximately every mile between the distribution system and tunnel. The average pressure in this tunnel is over 100 lb., with a maximum of 400 pounds.

The Catskill system supplies 400 m.g.d. out of the 685 m.g. delivered from the municipal sources. This system was placed in operation in 1917. The Catskill water had been considered an unusually satisfactory one, due to its clearness, pleasant taste and softness.

Microscopic Organisms in the Catskill Supply.—Previous to the present trouble with Synura, the consumer did not know that microscopic growths frequently developed in large numbers in this supply, and that they had been excluded from the water delivered to the consumer by changing the draft from the Ashokan basins, and by the application of copper sulphate either in Kensico reservoir or in the aqueduct at Pleasantville.



GENERAL PLAN OF CATSKILL AQUEDUCT AND ITS CONNECTIONS
Only the principal sluices are indicated by name.

When microscopic organisms in objectionable numbers were present in Kensico reservoir and not in Ashokan reservoir, the practice has been to use the bypass aqueduct and shut off the Kensico reservoir, thus delivering the water direct from either of the Ashokan reservoir basins to Hillview reservoir. At all times the chlorination plant at Kensico has been used. The record of the bypassing of Kensico reservoir since 1918 is as follows:

Year	Period Reservoir Was Bypassed	Predominating Organism
1919	March 8—June 12	Tabellaria
1919	July 2—Sept 20	Aphanizomenon
1920	May 14—May 22	Asterionella
1921	March 24—Apr. 16	Asterionella
1921	April 22—April 27	Asterionella

When organisms were present in one basin of the Ashokan reservoir and not in the other, the basin holding satisfactory water could be drawn on. When organisms in an objectionable number were present in both basins the flow in the aqueduct could be treated with copper sulphate at Pleasantville, and discharged into Kensico reservoir, or through the bypass. The periods during which treatment was carried on at Pleasantville were as follows:

Period of Treatment	Microscopic Organism Causing Treatment	Method of Delivery of Water
1920		
Jan. 3—Feb. 3	Asterionella	To Kensico reservoir
Feb. 27—Mar 19	Asterionella	To Kensico reservoir
May 14—May 22	Asterionella	Through Kensico bypass
May 22—June 2	Asterionella	To Kensico reservoir
June 8—June 15	Asterionella	To Kensico reservoir
Sept. 25—Oct. 7	Tabellaria	To Kensico reservoir
1921		
April 22—April 27	Asterionella	Through Kensico bypass
April 27—May 12	Asterionella	To Kensico reservoir
Dec. 30—Dec. 31	Synura	To Kensico reservoir
1922		
Jan. 1 Jan. 5	Synura	To Kensico reservoir
Jan. 5 –Jan. 8	Synura	Through Kensico bypass

Influence of Storage in Hillview Reservoir on Removal of Tastes Produced by Effect of Chlorination on Microscopic Organisms.—In February and March, 1919, various complaints were received of an unsavory taste and odor in the Catskill water, these complaints coming chiefly from the borough of Manhattan, but to a slight extent also from the boroughs of Brooklyn and Richmond. The complainants generally indicated that there was a "fishy" taste to the water, but investigation showed that this was not due to fish, although in certain sections numerous fish were found present in the water. The fishy taste was traced to a microscopic growth, Tabellaria, which was present in the water to the extent of 700 to 1,000 units per c.c. Ordinarily this number of Tabellaria would not produce a noticeable taste, and the development of the taste in this instance followed chlorination. It is believed that the action of the chlorine resulted in the breaking up of some of the organisms and the setting free of the oil contained therein. At this time the taste was eliminated by utilizing the one to two days' storage available in Hillview reservoir, this reservoir having previously been bypassed. When the Synura, under similar conditions of chlorination, caused the taste in December, Hillview reservoir, which then also was being bypassed, was put back into service with the expectation that a similar elimination of the taste in the water would follow. The anticipated result, however, was not realized.

Copper Sulphate Treatment of Kensico Reservoir and at Pleasantville.—On three occasions since November, 1919, it has been necessary to treat Kensico reservoir with copper sulphate. This was done by a motor boat travelling over the area to be treated along parallel lines about 100 ft. apart, and putting into solution sufficient copper sulphate to give to the water the proportion of copper normally considered necessary to kill the organisms then present. About three tons of copper sulphate have been used in each treatment, and the area treated was one-half the width of the reservoir from a point just above the influx chamber to a point just below the efflux chamber. This partial treatment of the reservoir has been uniformly successful in destroying the organisms, and no troublesome after-growths due to the treatment have been noted. The water coming from Ashokan has been treated in the aqueduct at Pleasantville, following the treatment of Kensico reservoir, until the organisms to be destroyed had virtually disappeared from Ashokan reservoir. At the Pleasantville plant about 400 to 600 lb. of copper sulphate were daily automatically fed into an aqueduct flow of 370 to 400 m.g.d. By using automatic feed no attendants were needed during the night shifts. The copper sulphate was discharged into a wooden container suspended in the aqueduct so that the flow of the water would dissolve the copper at the fixed rate of feed. The examination of the water in Kensico reservoir in the treated area between the influx and efflux chambers, made while the aqueduct flow was being treated, always showed that the organism was destroyed in this area. It is believed that prior to December, 1919, when Kensico reservoir was first treated, no large deep reservoir had been thus treated to destroy the microscopic organisms, although the treatment of portions of reservoirs having shallow flowage for the destruction of microscopic organisms had been successfully carried on for years past in the Croton system and elsewhere.

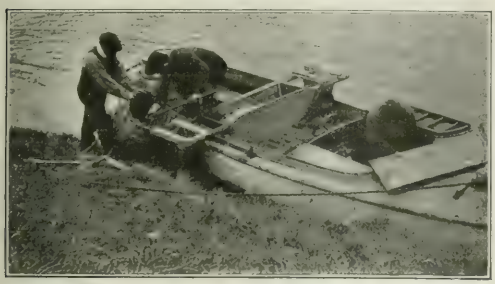
Copper Sulphate Treatment at Pleasantville with Kensico Reservoir Bypassed.—In the Spring of 1920 the simultaneous growth of Asterionella in the Ashokan and Kensico reservoirs made it necessary to bypass the aqueduct flow from Ashokan reservoir, while the Kensico reservoir was being treated with copper sulphate. In April, 1921, Asterionella again were treated by copper sulphate with the Kensico reservoir bypassed. In each case the copper sulphate was applied to the water in the Catskill aqueduct at the Pleasantville plant, and the Asterionella were destroyed, and any taste in the water eliminated in the passage of the water through the aqueduct to Hillview reservoir, and through this reservoir. The successful treatment of these organisms in this manner formed a basis for the similar treatment of the Synura, which treatment proved unsuccessful, as hereafter outlined.

One of the Lowest Forms of Life

Conditions Under Which Recent Objectionable Tastes Developed from Synura.—Synura, which is a protozoa, and therefore one of the lowest forms of animal life, was first noticed in the Ashokan reservoir in August, and varied from about 20 to 125 units up to the end of the year. It had been present in this reservoir in small numbers in 1918, 1919 and 1920, but had disappeared without causing trouble. As it was known that the oil given off by the Synura is a most penetrating and disagreeable one, the weekly microscopic examinations of the water entering Kensico reservoir, as well as the water in this reservoir, were watched to determine whether the organism was broken up and destroyed by the Ashokan aerator and the subsequent 75 miles travel through the aqueduct. This appeared to be the case, as no Synura were found, and previous experience (1918, 1919 and 1920), indicated the improbability of its de-

velopment in the reservoir. The sample of the water leaving the reservoir, used for microscopic examination, was taken just below the chlorination plant and the chlorine treatment was probably in part responsible for the Synura not being found in the samples as examined weekly.

On Dec. 8, 1921, complaints of a "fishy" taste in the water were received in Manhattan from persons residing in the area served by Catskill water. These complaints were believed to be due to stagnation, and the hydrants



MOTOR BOAT WITH COPPER SULPHATE DISTRIBUTING BAGS MOUNTED ON EACH SIDE AND STORAGE BOX BETWEEN

were blown off. On Dec. 21 and 22 several complaints were received, also of a "fishy" taste. Special examinations were made, which resulted on Dec. 29 in the location of from 60 to 100 units of Synura per c.c. in the Kensico effluent water before chlorination, but very few units after chlorination.

The Synura had not given serious trouble in the New York supply for fifteen years or more before this winter, and it was considered that about 300 units per c.c. would be necessary to give a noticeable taste or odor. It was therefore a surprise to find a distinct taste from so few units. It was found that the application of the chlorine was immediately followed by the appearance of the cucumber and bitter taste in the water, which was entirely free from such taste before chlorination. It therefore appeared that the chlorine intensified the taste produced by the organisms, and that was thought to be the explanation for so few organisms causing complaints.

When the taste was determined to be due to Synura, the ice had formed in the Kensico reservoir so that copper sulphate treatment could not be applied. The operation of the aerator at Ashokan had been stopped, due to ice, and the Synura were then going into Kensico from Ashokan. On Dec. 30 treatment with copper sulphate was started at Pleasantville, and the treated water delivered into the Kensico reservoir. The complaints became more numerous from the consumers in Manhattan and the Bronx, and on Jan. 5, as there were more Synura in the water coming from Kensico than in that from Ashokan, the Kensico reservoir was shut off and the aqueduct flow bypassed, treatment being continued at Pleasantville. The Pleasantville plant treatment was destroying the Synura, and it was believed, based on previous experience with the Tabellaria and Asterionella, that the taste of the oil would be dissipated before the treated water reached the consumer. The water travelled about six hours in the aqueduct after treatment, and then through Hillview reservoir, where the average time of passage was from one to two days. At the end of three days it was evident that the Pleasantville treatment had resulted in the water entering Hillview having a strong taste and odor, the Synura odor being plainly noticeable from the reservoir bank, and the taste was still decided when the water left the reservoir. The Catskill consumers in the Bronx, Manhattan and Brooklyn, who lived within a mile or two of the delivery tunnel, found the taste strong and very objectionable. Those living at greater distances did not get so strong a cucumber taste, but it was generally objectionable. This cucumber taste was removed by boiling the water in an open vessel for ten minutes, but such boiling did not eliminate the slightly bitter taste.

On Jan. 8 the treatment at Pleasantville was stopped, the aerator at Kensico shut down and the chlorine applied reduced from about 0.3 to 0.1 p.p.m., these changes being made to reduce temporarily, as far as possible, the destruction of the organisms and the resultant taste. A reduction in the taste of the water leaving Hillview reservoir from a strong to a faint or mild cucumber flavor followed, but as was expected, the live organisms broke up in the distribution system, causing strong taste in some locations.

Experiments to Remove the Synura Taste.—A 16-hr. test was started on Jan. 11 by applying copper sulphate at the rate of 400 lb. per day at the Ashokan screen chamber, to determine whether the oil from the Synura would be largely eliminated by the extra 75 miles of aqueduct flow.

Several years ago an unsuccessful attempt was made to kill a growth of Aphanizomenon in the Croton reservoir, by adding a solution of copper sulphate to the water in the aqueduct at Croton Lake gatehouse, and it was therefore considered that possibly the daylight might be needed to kill the microscopic organisms after the copper sulphate was introduced in the water, but this evidently is not correct. Samples of the treated



INTERIOR OF PLEASANTVILLE TREATMENT PLANT

At the center of the view is a barrel of copper sulphate, placed over a movable shutter through which any desired quantity of copper sulphate is automatically fed into the aqueduct below.

water taken at Kensico gatehouse just above the aerator showed that the Synura had been decreased from about 100 units per c.c. to about 40 units, that those remaining had lost their chlorophyl, and that the cucumber taste was decided. The cucumber odor was strong around the aerator and the taste of the water below the aerator was mild. The taste was not increased by the chlorine treatment, using 0.3 p.p.m. of chlorine. On Jan. 14, after the results of this test were determined, the application of the copper sulphate at Ashokan was resumed, and the taste of the water leaving the Hillview reservoir became

mild, and this taste was almost wholly dissipated by the time it reached many of the consumers, as it gradually reduced as the water traveled farther from the reservoir. The microscopical examination of the water leaving Hillview reservoir showed only about 5 to 10 dead Synura units.

Increase in Chlorine Dose Removes the Taste.—On Jan. 17 a test was made of the effect of an increase in the dose of chlorine on the taste of the Synura oil. To make this test the flow through the aqueduct was temporarily reduced to 160 m.g.d. and the chlorine application continued at the maximum capacity of the plant. This gave a chlorine application of about 0.73 p.p.m. and a sample taken about 1,500 ft. down stream from the point of chlorine application and tested 15 minutes after collection showed the Synura taste to be reduced and a combination Synura and chlorine taste to be present. When this higher chlorine treated water reached the uptake shaft at Hillview reservoir, about eight hours later, there was a slight chlorine taste, but the cucumber taste of the Synura had disappeared. The slight bitter taste from the Synura, which would be noticed by but few consumers, was still present. In addition to the Synura there have been about 700 units of Asterionella present, which have also been destroyed, but this number is not sufficient to give the Asterionella taste, which is also objectionable. Whether the excess chlorine oxidizes the Synura oil, or forms a tasteless compound, is not known, but whatever may be the chemical reaction the important factor for water-works operators is the removal of the taste. The duration of the experiment was not long enough to prove conclusively that the taste would be removed if more Synura units were present, but the results are certainly encouraging. Sir Alexander Houston in his 1920 annual report on the London supply, points out the possibility of removing certain tastes produced by chlorination by increasing the excess chlorine, and the writer understands that in one or two instances in this country organisms causing a disagreeable taste have been destroyed, and the taste also removed by an increased dose of chlorine. Further experiments along this line should be interesting and instructive.

Ortho-tolodin Test for Free Chlorine

Increase in Absorption of Chlorine.—Since July, 1921, the amount of chlorine applied to the Catskill and Croton waters has been based upon the additional free chlorine shown by ortho-tolodin test made on the raw water and on the treated water 30 minutes after the chlorine is applied. The standard increase in additional chlorine was fixed at 0.1 p.p.m. Up to the middle of August the Catskill water showed a low absorptive capacity for the chlorine and the excess of 0.1 was secured with a total dose of 0.22. Since then the absorption of chlorine has rapidly risen and it has been found impossible to maintain the desired excess of 0.1 of a part. During the brief test while the aqueduct flow was reduced, the absorption of chlorine was 0.45 p.p.m., or about four times the absorption last Summer. That the microscopic organisms may cause this increase is not unlikely. It would appear from the slight data available that the destruction of the Synura taste may be accomplished with a free chlorine increase of approximately the standard of 0.1 of a part.

The department has ordered an increase in chlorine feeding equipment for the Kensico plant, which, when installed, will permit 0.8 p.p.m. of chlorine to be added to the Catskill water with a 400 m.g.d. flow, and expects to have this plant ready for use soon.

Reduction in Number of Synura in Ashokan Reservoir.—On Jan. 20 the draft at Ashokan was changed from the east to the west basin, as two or three days previously there had been a rapid increase in the Synura in the east basin and a corresponding decrease in the west basin. This change reduced the number in the water, as drawn, from over 100 units per c.c. to about 10 units per c.c. There is a very slight taste in the water from this small number of Synura as it enters Hillview reservoir.

Excess Chlorine Neutralizes Synura Oil

Increase in Amount of Copper Sulphate Applied.—On Jan. 18 the amount of copper sulphate fed into the aqueduct at Ashokan was increased for eight hours to the rate of 600 lb. per day and then, for a second eight hours, to 800 lb. per day. No difference in taste could be noted when this more highly treated water reached Kensico above the chlorination plant. When the samples were taken at the uptake shaft at Hillview reservoir it was found that there was no taste in three samples taken two hours apart and representing the water treated with the copper sulphate at the rate of 800 lb. per day, or 2 lb. per million gallons. The chlorine treatment was at the rate of 0.3 of a part. The microscopical examination showed that the water treated at the 600-ft. rate had several intact but dead Synura colonies, while the water treated at the 800-lb. rate showed the organisms practically completely destroyed. The increase in copper sulphate apparently more promptly and thoroughly destroys the organisms, and thus fully exposes its oil to mechanical removal in the flow through the aqueduct and to the later chemical reaction with the chlorine at Kensico. The increase in the chlorine dose destroys to some extent the organisms, but its more important action appears to be a rapid neutralization of the Synura oil through a chemical process.

Treatment of the Croton Supply.—In the Croton system there is no large reservoir corresponding to Kensico reservoir, where the daily draft of Croton water could be treated by copper sulphate before being delivered into such reservoir. The only opportunity for treatment of the Croton supply is in the 26 miles of aqueduct connecting Croton Lake with Jerome Park reservoir, this latter reservoir being a distributing reservoir holding 730 million gallons, or about two days draft. If the results recently obtained with the Synura in the Catskill supply are confirmed by future treatment of microscopic growths, then it would appear that such growths developing in Croton Lake during the period when ice covers the surface could be successfully destroyed through the continuation of copper sulphate treatment of the water in the Croton aqueduct at the Croton gatehouse and the application of chlorine at the Dunwoodie chlorination plant, which is located about 3½ miles above Jerome Park reservoir.

Conclusions.—The conclusions that may reasonably be drawn from the experience with microscopic organisms in the Catskill supply are:

1. Microscopic organisms in Kensico reservoir may be effectively destroyed by treating that portion of the reservoir through which the flow usually takes place with sufficient copper sulphate to give the proper solution strength.

2. Continuous treatment of the flow in the aqueduct with copper sulphate will destroy the microscopic organisms.

3. The period of time required to remove the oil given off by the microscopic organisms varies, and with the Synura is more than two days.

4. No copper has been found in the supply as a result of copper sulphate treatment.

5. The addition of chlorine after the copper sulphate treatment did not increase the taste of the oil given off by the microscopic organisms but, on the contrary, did destroy the taste of the Synura oil when sufficient chlorine was added.

6. The addition of chlorine does destroy some of the microscopic units when these have not been previously destroyed by copper sulphate, and thus cause a release of the oil contained therein, with a resultant taste to the water. With a given microscopic organism the intensity of taste and odor imparted to the water through the addition of chlorine is dependent upon the number of units present and the amount of chlorine introduced into the water. The taste increases as the dose of chlorine is increased, until the maximum is reached, when probably the taste from the organism will decrease with further increase in the chlorine dose, although there may be a resultant excess chlorine taste.

7. A combination of copper sulphate and chlorine treatment of water high in microscopic organisms appears to be a satisfactory method of elimination of the organisms and their taste.

The writer wishes to acknowledge the excellent work done by Dr. Frank E. Hale, director of laboratories, in the water department, to whose efforts the solution of the New York City microscopic organism troubles is mainly due.

The water supply system of the city is under the Department of Water Supply, Gas and Electricity. Nicholas J. Hayes commissioner, with Merritt H. Smith chief engineer.

Since the foregoing statements were prepared we have made an experiment on chlorine treatment of the water from Kensico reservoir, delivering the water through the Bronx 48-in. pipe line and wasting it near the city line into the Bronx River. This experiment showed that there are about 50 units of Synura in the water going into the pipe line; that at a point 4½ miles below the dam we had no cucumber taste when using 0.5 p.p.m. of chlorine, and also none when using 0.7 and when using 0.75 of a part. We had a faint chlorine taste in about one-third of the samples taken 4½ miles below the dam, and only a hint of chlorine in one sample out of about a dozen taken 13 miles below the dam. This test corroborates the conclusion that excess chlorine would destroy the Synura and remove its taste, and indicates that even in a pipe line this may be accomplished without serious danger of objectionable chlorine taste.

Detroit Local Census Shows Less Population

According to a census taken by the authority of the Board of Education of Detroit, the population of the city as of June 1, 1921, was 942,373 or 51,305 less than the United States Census count as of Jan. 1, 1920. The number of unemployed males 20 or more years old on June 1, 1921, was 55,963.

Reminders for the Designer of Steel Structures

Cautions As to Corrosion, Expansion Effects, Future Extension and Rough Handling—Bracing and the Erector

By R. Fleming
American Bridge Co., New York

THE purpose of this article is to call attention to points in the design of steel structures that are sometimes neglected.

Conditions Favoring Rusting—The physical conditions surrounding a building have not always been considered. This accounts for some unfortunate choices of roof covering. For instance, ordinary black corrugated steel sheets were used for enclosing a copper refinery near the sea coast. Subject to gaseous fumes from within and unusual atmospheric conditions without, they corroded rapidly and had to be replaced in little more than a year. Galvanized sheets would have lasted longer, but not as long as the corrugated iron which was used the second time. In tropical climates corrugated iron is also to be preferred to corrugated steel but unfortunately the price usually prohibits its use.

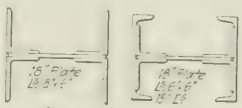


FIG. 1. STEEL-MILL COLUMN PROTECTED BY CHANNELS

Differences in temperature and humidity between inside and outside should also be considered. An engine room visited on a cold winter's morning comes to mind. The temperature in the room was 75 or 80, and the engine and floor were wet with the condensation that had dripped from the under side of the corrugated metal roof above. A metallic roof covering that has good fire-resisting qualities, that is rust- and waterproof, and that does not gather condensation on its under side, is a material greatly needed.

Neglect of Expansion—Occasionally provision for expansion and contraction has been neglected where it was needed. Greater liberties can be taken in this matter with steel buildings than with steel bridges. Roof trusses resting on walls have been used without roller bearings even for spans up to 100 ft., and in fact the writer has used them up to 120 ft. Where trusses are supported by steel columns the span may be increased almost indefinitely without attention to expansion. The 236-ft. trusses on columns 55 ft. high (illustrated in *Engineering News-Record* of May 8, 1919, p. 898) of the rolling mill of the Crucible Steel Co., have no provision for expansion and no trouble has ever been reported. Buildings and crane runways have been built 600 ft. and more long without any provision for expansion save that the ends were free to move, that is, not confined by any adjoining structure.

Little has been published on the effect of longitudinal expansion in buildings and crane runways. It is doubtful if the length of a runway that is free to expand or contract only by tipping columns should exceed 300 ft. The point needs special consideration about furnaces and where wide variations of temperature may occur.

One crane runway more than 1,000 ft. long, with girders throughout riveted together end to end, had to have expansion joints inserted the first summer of

its use. The same thing was needed in another crane runway, about 1,200 ft. long, whose girders on one side were supported by the columns of a steel-and-concrete pier shed having large doors in its side. The doors worked all right in the morning, but when the sun came up the girders expanded and drew the columns with them, so that the openings near the ends were no longer rectangular. The doors for these openings could not be closed until some time in the evening, after the girders had become cool and the openings had resumed their rectangular shape. The insertion of expansion joints proved an effective remedy.

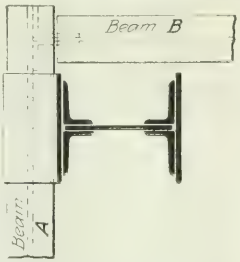
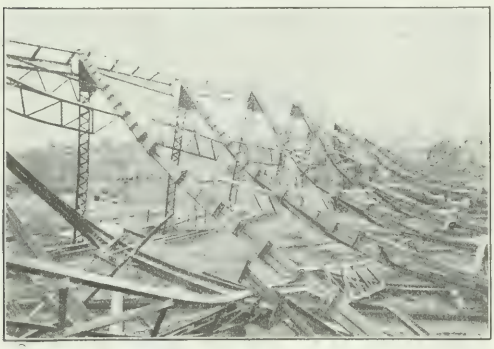


FIG. 2. CANTILEVER FRAMING IN PLACE OF COLUMN BRACKET

Future Extension—The probability of future extension is a point that should be well considered in designing a steel structure. If it is probable that in a few years more stories will be needed for an office building, the columns should be designed to carry the future loads. If it is likely that an overhead traveling crane will sometime be wanted in an industrial building, the building should be high enough and strong enough for it. Provisions such as these can be made in the original building at a small fraction of the cost of doing so later. About all that is required to provide for the future lengthening of an industrial building is that the end trusses be made as strong as the intermediates, that purlins be stopped at the center of end trusses, that connections for end framing be bolted, and that a few extra open holes be provided.

Designers have sometimes neglected the local building code, to their sorrow. In one such case—a many-storied office building—the detail drawings were finished and the work partly fabricated when the building department decided that changes should be made to conform to their code. This was done at heavy expense to the owner.

Emergency Conditions—Some parts of a structure may be subjected to rough handling, and this possibility should not be altogether neglected. A runway for a heavy crane in a steel mill is now being built. Fig. 1 shows at *A* the section of column first intended to be used. But workmen are not always careful and heavy loads from the crane are liable to strike the columns. Moreover, in this particular mill workmen have been known to strip the mold from the ingot by bringing it three or four feet from a column and then swinging it until it struck, thus jarring it loose. The column section was changed to that shown at *B*, a section preferable for all columns that are liable to be struck by crane loads or passing trucks.


FIG. 1. MILL BUILDING COLLAPSE CAUSED BY NEGLECT OF BRACING

Impact stresses—not those from moving loads as much as those from special conditions—are sometimes neglected. In designing sugar mills the stresses from vertical loads on vacuum-pan floors should be increased not less than 50 per cent for impact. The agitation of the contents of these pans when boiling is terrific. In one sugar mill the failure to make proper provision for it necessitated strengthening the structure after erection.

A heavy shell once fell from a gallery in a gunshop to a floor below and striking about midway between two beams passed through the 10-in. concrete slab, leaving a hole as if cut with a sharp knife. J. W. Ledoux in an article, "Dangerous Stresses from Falling Bodies in Floors," *Engineering News-Record*, April 29, 1920, p. 873, gives a formula for determining flange stresses in beams from falling weights. A slightly different formula is given in the Carnegie "Pocket Companion." The stresses are greater than usually supposed. For a weight of 100 lb. dropped from a height of 1 ft. on the middle of a 12-in. 31½-lb. I-beam 16 ft. long between end supports, the flange stress is 13,600 lb. per sq.in. according to the Ledoux formula and 13,025 lb. per sq.in. according to the Carnegie formula. If dropped from a height of 5 ft. the corresponding figures are 30,350 and 28,560 respectively. For a weight of 1,000 lb. dropped from a height of 1 ft. on the same 12-in. I, the flange stresses are 43,925 lb. per sq.in. according to the Ledoux and 43,330 lb. according to the Carnegie formula. It would be impracticable to design beams for possibilities of weights dropping upon them but every precaution should be taken to prevent weights from being dropped. Galleries and platforms should have guard angles. Trucks and cars should have their loads so secured that they will not fall off by any little jolt.


FIG. 3. TOWER BRACING OF ROOF

Eliminating Roughness—The causes of impact can sometimes be eliminated. A striking case is that of the ordinary highway bridge. As the bridge engineer of the Wisconsin Highway Commission says, ("Assuring Safety in Old Highway Bridges," *Engineering News-Record*, Jan. 13, 1921, p. 61), "Just so sure as a rough bridge floor will cause a large amount of shock, stressing the bridge far beyond a static load of the same weight, so will removing the cause of impact tend to relieve the bridge. . . . The approaches to any bridge can be placed in such a condition that the loads will roll upon the bridge smoothly and not, as is often the case, land on it with a bang that can be heard half a mile away." Similarly readjustment of shafting or a leveling of crane rails can often be made that will lessen vibration and impact.

Lateral Stiffness—The lateral stiffness of crane girders is a point upon which every fabricating firm has gained knowledge by costly experience. Probably every maker of traveling cranes has been obliged to strengthen the bridge girders of some crane after erection was completed. Walkways are now being made of steel and the loads thereon are heavier than formerly, thus producing a greater torsion on the carrying girder which if ignored is liable to give trouble.

Small Stresses and Secondary Effects—"Never neglect a stress because it is small," was the advice given by C. Shaler Smith to one of his office force. Before neglecting any stress some idea should be had of its nature as well as its magnitude. A long member subject to both compression and bending is often stressed to its limit and should have no additional stresses even if they are small. In many cases small stresses may safely be neglected.

Secondary Stresses

Secondary stresses brought about by eccentric loading and eccentric riveted connections should receive attention. Their effect has at times been exaggerated in books and articles; often they have been neglected in practice. They certainly should not be ignored. In the revision of an architect's design the effect of the eccentric loading on a corner column was greatly lessened by the use of the cantilever (Fig. 2); beam B, instead of being attached to a bracket on the column as shown by the architect, was framed into beam A extended. Similar devices can often be used.

Bracing—So much has been written regarding the bracing of buildings that anything more on the subject may seem superfluous. Yet adequate bracing is still lacking in many buildings. No system of bracing is complete unless wind and vibration stresses are carried to the foundations. Otherwise it is not a system but an aggregation of braces.

In planning bracing the erection of the building should be kept in view. Most erectors for buildings of any great magnitude prefer that two trusses at each end be braced together as a tower, thus enabling adjustments to be made in intermediate portions by pulling on the tower. Fig. 3 shows the roof of a building so braced.

Several years ago a building was being erected with the idea of gaining time by leaving the bracing until last. Work was proceeding rapidly until one afternoon a gust of wind struck the steel frame, causing its collapse, as shown in the view Fig. 4.

Neglect on Side of Safety—Some neglected points in structural design make for safety. The loadings prescribed in building codes and specifications are usually greater than those liable to occur, and the working stresses in common use are somewhat low. The time-honored 16,000 lb. per sq.in. for tension could safely be increased to 17,000 or 18,000, if steel fulfilled standard specifications and good workmanship was assured. In the column formula, $S = 16{,}000 - 70\,l/r$, Schneider considers the effective length l, as compared with the length L of the member between centers of connections, to be $l = L$ for both ends hinged or batting; $l = \frac{1}{2} L$ for both ends fixed; and $l = \frac{2}{3} L$ for one end fixed and the other hinged. Columns are usually figured for $l = L$, even where end connections are fixed or partly fixed by riveting—an error on the side of safety. The indefinite frictional resistance of rivets is often in excess of the shearing and bearing values used in detailing. For power-driven rivets there is little reason why rivets driven in the field should not be counted equal in strength to those driven in the shop, though specifications assign them less shearing and bearing values. Again, shearing and bearing values of rivets are calculated from their nominal diameters. The holes are reamed or punched $\frac{1}{16}$ in. larger, increasing the shearing and bearing values in accordance with the degree of accuracy with which holes match each other when pieces are assembled.

It may be inferred that the reason why some structures stand is because "factors of safety" like the foregoing help counterbalance "factors of ignorance" found elsewhere. It is better, however, to eliminate the "factors of ignorance" as far as possible and design structures for the stresses actually to be sustained.

"Rolled Base" Endorsed for Brick Road Construction

FOR brick pavement construction, "rolled base," including one or more courses of crushed stone, gravel or slag, rolled and thoroughly bound with screenings, may be used successfully even under rather unfavorable soil and drainage conditions, according to the findings of A. T. Goldbeck, chief, division of tests, and F. H. Jackson, senior assistant testing engineer, U. S. Bureau of Public Roads, in a report covering an inspection of a number of brick roads of this type in Ohio. It is pointed out that the rolled base affords an opportunity for utilizing local materials in place of a more expensive concrete base. A bedding course, 1 to 2 in. thick, of sand, stone or slag screenings is usually employed, the prevailing thickness of the base course itself being 6 in.

Like every other pavement type, the report points out, best results have been secured when conditions make possible a firm, stable foundation at all seasons of the year, such as may be obtained with a sandy soil in a gently rolling country where satisfactory natural drainage may be secured. Under these conditions the rolled-base type is apparently giving satisfactory service even under heavy traffic provided a flexible wearing surface is secured by the use of a bituminous filler. This statement would seem to be justified by the behavior of the roads in southern Ohio, especially in the vicinity of Camp Sherman, where they carried very heavy traffic during the war. The 6-in. compacted gravel or stone bases of these roads seem to be adequate.

The national road in Muskingum County is an example of the rolled-base type under rather unfavorable soil conditions. Several samples taken along the road show that the soil grades about midway between the sandy soils of Ross County and the heavy clay soils of Trumbull and Cuyahoga Counties. The excellent natural drainage afforded by the rolling country through which the road passes is probably largely responsible for the fact that no major foundation failures have occurred. There are no closed depressions or swamps to hold the water in the subgrade and thus lessen its bearing power.

In northeastern Ohio a somewhat wider range of conditions is encountered. Probably the worst combination of poor soil and poor drainage with heavy traffic was observed in Trumbull County. Here the road ran through a very flat country permitting almost

no natural drainage, while the soil was a very heavy clay. In the face of such conditions, the report states, it is remarkable that the road has held as well as it has.

In summing up the results of their study, Messrs. Goldbeck and Jackson present the following conclusions:

"The rolled-base type, provided it is properly placed and compacted, is a suitable type for brick construction where soil conditions are favorable and good natural drainage may be obtained. Under these conditions a 6-in. compacted rolled base should be adequate, provided a 2-in. sand or screenings cushion is used.

"The rolled base may be successfully used under ordinary road conditions, provided the thickness of the base is adjusted to meet the probable traffic requirements. An 8 to 10-in. compacted base with an additional 2 in. of cushion should suffice under all but trunk line highways subjected to very heavy traffic.

"Whenever a rolled base is used a bituminous rather than a grout filler should be employed in order to provide a flexible section throughout.

"In general asphalt fillers are more satisfactory than tar or tar-mastic fillers, owing to the tendency of the latter either to chip out or flow in hot weather.

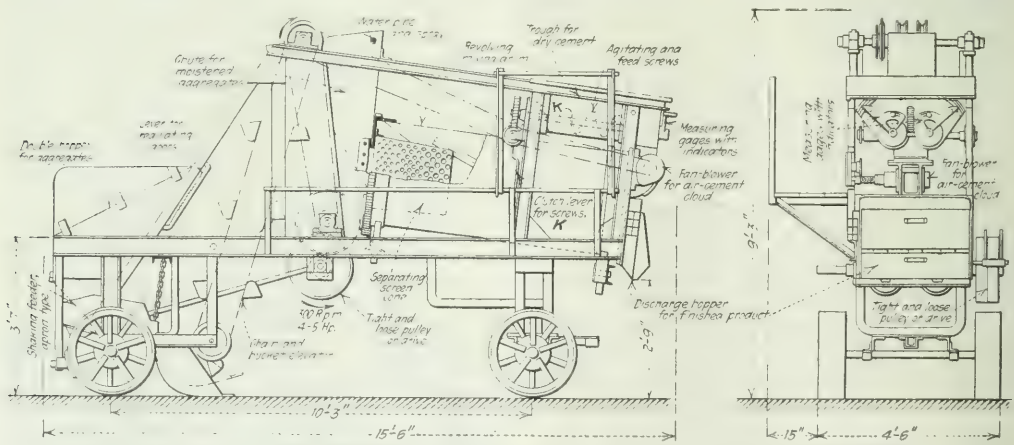
"Very inferior material, as measured by laboratory tests, may be successfully used as base material for brick roads."

New Type Continuous Concrete Mixer

FOR some years a new type of concrete mixer has been successfully used in Europe, mainly in Switzerland and France. It is continuous in action, but differs from other machines in that it provides precise measurement and proportioning of aggregate and that the already wetted and individually separated aggregate particles are passed through a cloud of cement blown in from the opposite end of a slow-rotating cylinder. The accompanying description and diagram were furnished by Joseph F. Shadgen, New York City, who is preparing to put the machine on the American market. The machine is known as the Aero mixer and is the invention of E. Springer. It is made by Couturier, Aebi & Co., Paris.

The diagram represents a machine with an hourly capacity of from 8 to 12 cu.yd. of semi-dry concrete. The aggregate is introduced at the left in the double hopper there, one part for the sand, the other for the broken stone. The hopper is equipped with a shaking apron feeder operated by a connecting rod from the main drive shaft. There are levers that open or close the two hopper-doors and thus proportion the absolute and relative quantities of the aggregates delivered to the boot of the elevator. This chain and bucket elevator lifts the coarse and fine ingredients some 10 ft. up into the steep chute that carries the sprinkler pipe which continually moistens the aggregates. The mixing drum, mounted in the middle of the machine, is provided with a short screen cone separating through its varying apertures the particles of the aggregate so as to facilitate their coating with cement. By the combined action of the plow blades inside of the drum and its inclined position together with the slow rotating movement the aggregate not only mixes thoroughly but also advances stepwise—by successive lifts and drops towards the discharge end.

The cement is emptied from the sacks or barrels into the trough at the right-hand upper end of the machine, and is constantly agitated and broken up by two screws feeding the dry powder to two measuring gages (provided with indicators, fingers and set screws) that positively proportion the amount of binding medium in the concrete. A fan blows into the mixing drum a constant stream of air loaded with the cement delivered by the screws. In this cloudy atmosphere saturated with the binding agent the aggregate repeatedly drops in its steady advance towards the discharge hopper.



CONTINUOUS CONCRETE MIXER IN WHICH AGGREGATE PASSES THROUGH CLOUD OF CEMENT

Work of Michigan State Sanitary Engineers

A summary of the work done in 1921 by the Sanitary Engineering Division of Michigan under the direction of C. M. Baker, state sanitary engineer, shows that of 185 investigations made, 115 or 62.1 per cent had to do with industrial wastes (as compared with 48.6 per cent in 1920); 44 or 23.8 per cent with sewerage and 26 or 14.1 per cent with water supplies. Of the industrial waste investigations, 93 or 50.3 per cent of all investigations, had to do with milk plants and 17 or 9.2 per cent with canneries.

What Industry Thinks of Engineering Education

Abstracts of Two Papers, Both by Industrial Executives, Read at the Recent Annual Meeting of the American Society of Mechanical Engineers

Professional Engineering Service for the Industries

By Francis C. Pratt
General Electric Co., Schenectady, N. Y.

WHILE familiarity with apparatus obtained from laboratory work coincident with undergraduate studies is of great value in giving the student more appreciative knowledge of his subjects, as are also frequent visits to, and summer work in, industrial establishments during the undergraduate period, yet I am confident that nothing which the colleges can give can take the place of the practical experience gained in the atmosphere of an industrial organization, bringing with it an intimate knowledge of both methods and men with which and with whom one's life work is to be associated. In my opinion the time in college is so valuable that it should be primarily devoted to those things which can only be acquired later with a great deal of difficulty. My observations also lead me to the conclusion that the percentage of those who fail to obtain a reasonable success is greater in the group of men of mediocre ability but narrowly specialized education than in almost any other group coming within my knowledge. Such men unless extraordinary vigilance is exercised by those in charge, become permanently attached to an organization doing specialized work for which they have no particular adaptability, clogging the opportunities for younger, more able, and progressive men to advance. It would have been far better for such a man if the head of the department had at the end of one or two years of employment, recognized the circumstances and frankly informed him that he was not likely to make a success in the professional work which he had undertaken, and advised him to enter into some other vocation.

Too Early Specialization

If I were to make a broad criticism of our methods of engineering education as they exist today, I should base it upon too early specialization of the student resulting in the turning out of a disproportionate number of men of the class to which I have just referred, that is, those of mediocre ability and narrow specialized education.

I should be disposed to strongly criticize another condition in our colleges which I recognize as an exceedingly difficult one to overcome, and that is, as the result of the high degree of standardization, induced perhaps by the numbers who have to be taught, the more brilliant men in the class are retarded in their progress by the requirements of a standard which can be met by the less capable student. If we are not only to attain, but also maintain, great eminence in the engineering professions in America, we should and I think must, devise some means whereby the more promising students can with greater facility advance with breadth and thoroughness in their work.

It is, I think, significant that in the organization with which I am in daily contact, a noticeable number of our most accomplished theoretical engineers and research laboratorians have either pursued post-graduate studies in European universities, or else have had all of their scholastic training abroad. This may suggest an opportunity for American educational institutions which is not fully met at the present time. In this connection I think that the colleges should resist the temptation to enter into specialized fields which are adequately covered by kindred institutions, and that better results would follow if, in general, each endeavored to maintain the strongest possible staff of teachers to give the most thorough instruction in the fundamentals of the sciences, engineering, economics and languages, and confine its specialization to such work as it is pre-eminently fitted to carry out.

The industries need administrative men well versed in the sciences and in engineering, in order that they may lend appreciative and sympathetic support to the technical developments, which are, in fact, the very life blood of the industry and on which its future primarily depends. That the colleges of the country are alive to this need, is evidenced by the number of courses which have in recent years been established, teaching the fundamentals of the sciences, engineering, economics and languages, and variously referred to under the names of administrative engineering, commercial engineering, or other courses.

A carefull study of a large number of college graduates employed at the several works of the General Electric Company indicates that our educational institutions are developing young men of real ability for the industry. The suggestion that is sometimes made to reduce the amount of cultural studies in order to specialize more intensively on technical subjects, is not viewed with favor.

The time in college is of such value that it should be primarily devoted to those things which can only be acquired later with great difficulty. At best, the student cannot hope to attain in college the well rounded knowledge and practical experience that are to be gained in an industrial organization.

A broad criticism of methods of engineering education is that it undertakes too early specialization of the student. Another is that lack of facility offered to the more capable student to advance rapidly.

* * *

Engineering Education as Viewed by the Industrialist

By J. E. Otterson
President Wright-Martin Aircraft Corporation

THE pedagogue is interested primarily in the process of education. The industrialist is interested primarily in its product. The student upon graduation, must pass from the supervision of the pedagogue to the critical survey of the industrialist.

It seems fair to assume that the purpose of education is something more than the mere acquisition of knowledge. The industrialist is obliged to look for something more. The student is likely to find upon graduation that those things which he has regarded as the purposes of the educational processes through which he has passed, now become only a means for the accomplishment of the real purposes of life. It is in developing this change of viewpoint that the student is likely to meet with disappointment, perhaps discouragement, and during this period the industrialist finds difficulty in adapting the student to his utilitarian purpose.

Knowledge is not of itself a qualification for large responsibility in industry. The encyclopedic type of mind which merely records impressions and facts brought before it may lack those qualities of imagination and initiative so essential to the accomplishment of practical things under adverse conditions, which do not always evidence strict conformity to the laws of governing recognized and recorded knowledge. Something more is required than that type of mind which is merely a reservoir containing a large amount of knowledge in a static state. Modern industry is dynamic and moves at a tremendous pace

We want, therefore, the type of mind that will be immediately energized when the current is turned on; the motor type rather than the storage-battery, and when the individual progresses to larger responsibility he may be called upon to animate, magnetize and electrify other minds about him, and to develop the qualities of generation as well as those of motivity.

The Encyclopedic Mind

There are doubtless certain occupations in life where the possession of accumulated knowledge is both desirable and essential, but in industry this quality alone will not carry the applicant beyond the lower orders of subordination. He will take his place among those student clerical types that are the handbooks of industry; much thumbed and used and frequently showing signs of wear and tear and dilapidation; referred to for statement of facts or formulation of laws but in the emergencies of everyday life frequently passed by in the race for accomplishment. Such are not the positions in industry that are difficult to fill. The encyclopedic type is sufficiently common to meet the need and in the search for the type with initiative, vision, imagination and dynamic force, the industrialist must apply other methods than those of the school-room examination. The industrialist is concerned more with the effect of the educational processes upon the habits and character of the applicant than he is with the degree of learning which he has attained. The industrialist is interested in mental, physical and moral character rather than in pure intellectualism; more in the ability to acquire knowledge quickly through application and concentration than in the immediate possession of knowledge.

The habits of industry should have as their foundation the habits of the student who is preparing for industrial work. In passing from student life to industrial life he should be able to do so successfully by continuation of the habits he has acquired in his college training rather than by a radical change that places him in an unfamiliar environment of work and activity.

His college life should be something more than a mere signal drill. He needs the scrimmage and the actual game to develop his full qualities.

Without endeavoring at this point to place the responsibility, the college graduate who is an applicant for an industrial position all too frequently shows no knowledge of the work to be done in the field which he is about to enter. He evidences no particular desire, ambition or purpose and he has little knowledge of the direction in which he is going or desires to go. If an opening is offered him, he has no capacity of judgment as to his adaptability. He is generally quite willing to leave the question of his future work in life to the hurried determination of the industrialist, who in a ten-minute interview may attempt to analyze his character and assign him to a task in which all parties concerned hope that he may be successful. Obviously this is an uncertain and unscientific method of directing the human forces set free by college education.

Small wonder that so many find themselves in uncongenial employment, ending in discontent, perhaps discouragement, changing from one class of work and finally from one job to another without direction or control.

A force is defined by its magnitude and direction. I am not complaining as to the magnitude of this tremendous human force launched into the world with each graduating class, but I do regret the wasted energy that results from its lack of direction. Whose responsibility is it then to give it direction? Who is to sight the gun? Who is to lay it upon the target? Some such directing hand is necessary if we are not to be content with mere intellectual fireworks.

The College's Responsibility

It is of course a question as to how far the college is expected to go in fitting men to take their places in a particular line of industry. In the ordinary four-year college course it is fair to assume that the college can do little more than lay the foundation for subsequent intensive training and development for a particular work. I am very definitely opposed to the shaping of educational processes toward training for a specialized type of work before there has been laid a foundation of general knowledge and comprehension. The specialization should come after a certain degree of intellectual maturity has been reached. I do feel, however, that at the same time the mind is being molded and stored with knowledge, an effort should be made to determine the talents and characteristics that must be the controlling factor in the student's later life, and an opportunity given for the development of those qualities that will ultimately express the real character of the individual.

Our college tests and examinations are primarily directed toward the determination of mental attainments as measured by the extent of acquired knowledge. I am making a plea for the development of tests of a different character calculated to determine the student's potentiality rather than his static state. These tests would be in the nature of or the basis of a psychoanalysis of the student's character through observation of his manner, personality, physiognomy, heredity, environment and college career. These should be matters of constant observation and record, with particular reference to progress and development. These observations and records should be the constant study of a skilled psychologist or psychoanalyst who would take occasion to periodically counsel with the student as to his predominant characteristics and talents assisting and directing him to their higher development.

The Engineer and the Executive

Two distinct types are constantly being recognized in industry, namely, the engineering type and the executive type.

The engineering type of man works for the solution of a single technical or engineering problem and is concerned with the determination of the solution rather than the application of that solution to practical activities. The true type has the capacity to concentrate continuously on a single problem until the solution has been reached. He is interested in the determination of cause and effect and of the laws that govern phenomena. He is disposed to be logical, analytical, studious, synthetical and to have an investigating turn of mind. The predominating characteristic that distinguishes him from the executive is his ability to concentrate on one problem to the exclusion of others for a protracted period, to become absorbed in that problem and to free his mind of the cares of other problems. He does not submit readily to the routine performance of a given quality of work. He deals with laws and abstract facts. He works from textbooks and original sources of information. Such men are Edison, Steinmetz, the Wright brothers, Curtis, Bell, Pupin, Fessenden, Browning. These men are the extreme of the engineering type, they have enormous imagination, initiative, constructive powers.

The executive type takes the conclusions of the engineer and the laws developed by the engineer and applies them to the multitude of practical problems that come before him. His chief characteristic is that he works with a multitude of constantly changing problems at one time. He concentrates on one problem after another in rapid succession. In many instances he has not the time to obtain all of the facts and he must arrive at a conclusion or make a decision based upon partial knowledge. He must rapidly assimilate available facts and fill in what is lacking from the ripeness of his own experience, frequently calling upon his powers of judgment, and even intuition. He is a man of action, boldness, ingenuity, force, determination, aggressiveness, courage, decision; he is possessed with the desire to get things done, impatient of delay. He works from a handbook, a newspaper or nothing at all. Such men are Schwab, Goethals, Pershing, Farrell, Hindenburg, Hoover.

If we have accomplished nothing more than to assist the boy to determine whether he is a potential engineer

or an executive, it seems to me that we have gone far.

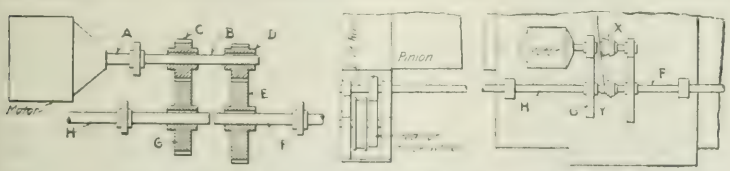
The question of whether a man has been trained in mechanical engineering or electrical engineering is not half so important as whether he is a real engineer or a real executive. I am sure that we are all acquainted with hundreds of young men who have made their success in some other branch of engineering endeavor than that in which they received technical training, and I feel quite safe in saying that the qualities of character determine a man's success rather than the particular kind or extent of technical knowledge that he has received in college.

Perhaps at the same time that the suggestion is made for the amplification of college training so as to include the psychoanalytical treatment of the student, it would not be out of place to suggest that industry take up a similar work on its own account and for its own purposes, with a view to confirming or supplementing the determinations made in the course of college life. It seems obvious that there is a community of interest as between the student, the pedagogue and the industrialist, and that all are seeking the same end, namely, the development to the full capacity of the individual for accomplishment.

We seek only to avoid the wasted energies, the wasted years and the wasted lives; the discredit to educational institutions and the loss to industrial and national life. The limitation upon industrial accomplishment today is men and the industrialist is calling for your assistance in minimizing this limitation. We require men rather than students and intellectualists. Will you give thought to the direction of the human forces which you generate?

Traveling Crane Has Radial Path

A 10-TON electric overhead traveling crane which operates on a circular track but has all its wheels of the same diameter is a special feature of the new roundhouse of the Pennsylvania Railroad System at Columbus, Ohio. In some previous roundhouse cranes circular travel has been provided for by using truck wheels of larger diameters on the outer end of the crane or by using a larger driving pinion on the outer end of the driving shaft.



GEARING GIVES RADIAL MOTION TO TRAVELING CRANE

In the new design, the usual longitudinal shaft extending the full length of the crane girder or bridge is replaced by two shafts, each half the length of the crane and separately geared but driven by one motor. This arrangement is shown by the accompanying drawings. The motor shaft, *A*, is coupled to a short shaft, *B*, on which are keyed two pinions of different diameters, *C* and *D*. The smaller pinion, *D*, engages a spur or gear wheel, *E*, on a shaft, *F*, extending to the inner end of the crane. On the farther end of the shaft is a pinion engaging a gear on one of the truck wheels. The larger pinion, *C*, on the shaft, *B*, engages a gear wheel, *G*, on a shaft, *H*, which extends to the outer end of the crane and is geared to one of the truck wheels at that end.

The two driving pinions and their gear-wheels are so proportioned as to give the required peripheral speeds for the inner and outer ends of the crane. In the Columbus roundhouse, the crane has a span of 74 ft. 4½ in. c. to c. of rails on concentric runways having radii of 137 ft. 1½ in. and 211 ft. 5¾ in.

Another function of the variable gears is to correct the tendency of traveling cranes to get out of square with their tracks, this tendency existing whether the runway is straight or curved. Such an inaccurate position may be due to unequal wear of the wheels, to the trucks not being exactly square to the girder, or to the crane being operated at high speed with a heavy load near one end.

To permit squaring or adjusting the crane bridge, the short shaft, *B*, is made in two parts connected by a clutch, *X*. A similar clutch, *Y*, provides for connecting the ends of the two longitudinal driving shafts. For a crane operating on a curved runway, this latter clutch would normally be inoperative, but for a crane on a straight runway it would be normally in action, forming in effect a single driving shaft. By the use of the clutches either end of the crane bridge may be moved independently to bring the crane square with or radial to its runways.

Simplicity of design and interchangeability of gears are among the advantages claimed for this system, which is the invention of R. W. Valls, vice-president and consulting engineer of the Champion Engineering Co., Kenton, Ohio.

Two-Story Bunk Houses Economical On Steep Sidehills

IN CONSTRUCTION camps maintained in high altitudes, the Southern California Edison Co. has adopted two-story bunk houses as standard. The reasons are that (1) foundation and roof costs are practically halved by thus doubling the floor area, and (2) heating can be done more easily and economically in the larger houses. Because of the considerable amount of dimension lumber required, foundation costs become an important factor where the camp has to be located on a steep sidehill. In the high altitudes the roofs are comparatively costly due to the necessity for taking care of snow loads. With the smaller area required, a two-story bunk-house camp can at times be located where there would not be room for a more extended arrangement. The house of standard design accommodates 16 men and conforms to all the requirements imposed by the California Immigration and Housing Commission.

One disadvantage of the two-story bunk house lies in the fact that the floor of the second story must be made tight, a condition not always easily obtained with the green lumber commonly used in building camps.

Exports for 1921 Above Pre-War Average

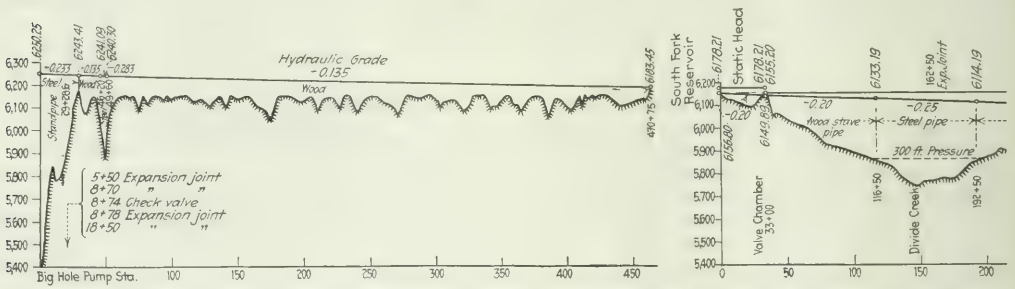
Although the amount and value of 1921 exports were below figures for the preceding two years they were in general far above pre-war averages. According to a study made by the foreign commerce department of the Chamber of Commerce of the United States, out of twenty principal exports only five show a decline, as measured in value, during the January to September period over the same nine months of 1909-1913.

Design and Construction of Welded Steel and Wood-Stave Pipe Line for Butte Water Co.

Wood-Stave Pipe Up To 300 Ft. Head and Above That Lap-Welded Steel With Welded End Joints —Regulating Chambers on Wood Pipe Expansion Joints at Crucial Points On Steel Pipe

By Eugene Carroll
Vice-President and Manager Butte Water Co., Butte, Mont.

CONTINUOUS banded redwood stave pipe for heads under 300 ft. and lap-welded steel pipe, with welded circumferential joints, for heads from 300 to 841 ft. is used on the Big Hole pipe line No. 2 of the Butte Water Co., of Butte, Mont., built in 1920, and in successful continuous use since that time. A limited number of regulating chambers on the wood pipe and of expansion joints at crucial points on the steel pipe were features of the design. Many construction difficulties were met and overcome on account of the rough country over which the pipe was laid, labor troubles, and the short working season, the latter being due to the latitude and to the altitude of some 5,000 to 7,000 ft. This article will deal with the design and construction of the pipe line, which for the first 3,000 ft. is a force main under a maximum static head of 841 ft., and then a gravity line, the total length being nearly 26½ miles, the diameters 24 and 26 in., and the nominal capacity 8 m.g.d., like the first pipe line between the same two points.



PROFILE OF BIG HOLE PIPE LINE NO. 2, BUTTE WATER CO., CONSISTING OF 24- AND 26-IN. BANDED CONTINUOUS

This earlier conduit—Big Hole pipe line No. 1—was completed in 1900. It consists of 3,000 ft. of 26-in. force main then 43,300 ft. of 26-in. pipe to the South Fork reservoir, then 97,470 ft. of 24-in. pipe to the West Side distributing reservoir, a total of about 27 miles. Banded continuous stave redwood pipe was used for heads up to 250 ft. and riveted steel for higher heads. Of the 97,470 ft. of gravity main, 63,566 ft. were wood-stave pipe.

To make feasible the use of so much low-pressure pipe the writer designed regulating chambers to keep the pressure down to what was then considered as safe limits for the wood pipe. These chambers, of which there were four in the 97,440 ft. between the South Fork and West Side reservoirs, were placed near the hydraulic grade line. They consist of a balanced valve operated by a float in a chamber on the outlet side. Each chamber has an overflow which, if the valve fails to work, will prevent an excess of pressure on the pipe line below. The discharge of the pipe line between the two reservoirs is therefore regulated by one valve at the lower or Butte end of the conduit. A great reduction in the cost of the pipe line was effected by these regulation chambers, which, together with the wood-stave pipe line, have now been in successful use for 21 years.

The success of conduit No. 1 led to a duplication of its general design for No. 2. The relative costs of wood and steel pipe in 1920 made it desirable to use wood-stave pipe up to heads of 300 ft. in the new pipe line, as compared with 250 ft. in the old one. This permitted a change in the location of portions of the new line which saved 3,912 ft. in its length. In conduit No. 1, 74 per cent is wood-stave pipe, while 81½ per cent of No. 2 is of wood. For pressures higher than 300 ft. lap-welded steel pipe was adopted at a material saving in cost over either cast-iron or riveted steel pipe. For end joints, welding was adopted, as being considerably less expensive than any other.

The objection to the welded circumferential joint was the necessity of taking care of the expansion and contraction in this line, with no precedent to govern from the fact that there is no line in existence of as large a diameter as 24-in., carrying water in which welded joints are used. The welded joint has proved to be a success in smaller diameters, being largely used for gas and oil lines in various parts of the country. In these smaller pipes, the contraction and expansion is taken care of generally by the variation in the alignment of the pipe itself, the flexibility of the pipe and curvature being sufficient to take care of the ordinary contraction and expansion after laying.

The variation in the temperature of the water supplied to Butte does not exceed 20 deg. F. between the coldest and warmest water during the year, and we believe that after the pipe is laid in a trench, covered by a 2-ft. minimum backfill, and filled with water, the contraction and expansion is negligible. The cost of a welded joint is not as great as an ordinary lead joint, which could not be used with pressures of

more than 450 ft. without reinforcement. The cost of reinforced lead joints, flange joints, or other heavy pressure joints for steel pipe is excessive.

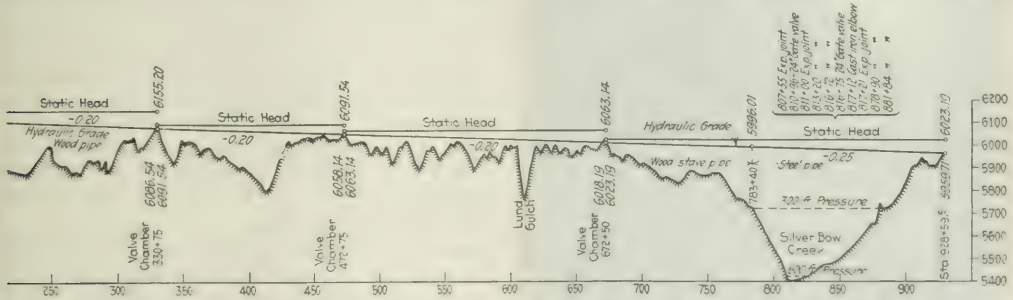
In designing the line, it was decided to make all connections between the steel pipe and castings, such as valves, cast elbows, and other fittings, with flange joints, protecting such connections with expansion joints on each side. Deeming it impossible in a pipe line of this character intelligently to place expansion joints at points necessary to take care of any strains caused during construction, it was decided to build the line without expansion joints and, after the line was placed in operation, to insert expansion joints at such points as the action of the pipe, after laying, would show necessary.

The new pipe line has a total length of 139,958 ft. or 24.6 miles, of which 25,736 ft. are of steel and 114,222 ft. of wood. In more detail, there are 3,525 ft. of 26-in. and 22,211 ft. 24-in. lap-welded steel pipe, manufactured by the National Tube Co., and 43,422 ft. of 26- and 70,800 ft. of 24-in. banded continuous stave redwood pipe, made and installed by the Redwood Manufacturers' Co. of San Francisco. The 26-in. pipe extends from the Big Hole pump station to the South Fork reservoir, from which point a 24-in. leads to the West Side distributing reservoir in the city of Butte.

Beginning at the Big Hole station, the steel pipe, under an operating head of 841 ft., extends up a slope of 32 deg. to El. 435 ft. above the station, where a 26-in. check valve is installed; thence in a level grade along the ridge, a distance of 800 ft.; thence up a steep mountain side to a point 2,900 ft. from the pump station, where the line is connected to a reinforced-concrete standpipe, 10 ft. inside diameter, and 67 ft. in height, the overflow being 841 ft. above the floor of the pump station. This standpipe relieves the line beyond this point from the strain due to water hammer, caused by the pulsations of the pumps, and provides a gravity flow from that point to the South Fork reservoir. From the standpipe to South Fork reservoir, 44,147 lin. ft. of wood pipe is used, except for 340 ft. of steel pipe across Charcoal Gulch, where the pressure exceeds 300 ft. The outlet at the South Fork reservoir is the highest point on the line, so that water is furnished to the Big Hole pump station for domestic and fire service when the pumps are not in operation. The South Fork reservoir is located on the South Fork of Divide Creek, a tributary of the Big Hole, and has a storage capacity of 13,500,000 gal., and also diverts the waters of the creek into the pipe line leading to Butte. During high water season for about sixty days each year, there is sufficient water at Divide Creek, thus permitting the closing down of the Big Hole station.

On the 24-in. portion of the conduit, at a point 3,300 ft. beyond the South Fork reservoir, the first regulating chamber is installed, which contains, in addition to the balanced valve and float, a 6-ft. Cippoletti weir. From this chamber the line extends northerly a distance of 29,700 lin.ft., crossing the continental divide, to the second float chamber. In this section of the line, wood pipe is used, except in crossing Divide Creek, where 7,600 ft. of steel pipe is laid. From this second valve chamber the line extends northerly, a distance of 14,300 ft., to the third regulating chamber, and consists of wood pipe. From the third regulating chamber the line extends northeasterly over a very rough country, a distance of 20,000 ft., to the fourth regulating chamber, and consists of wood pipe. From the fourth regulating chamber the pipe line continues in a northeasterly direction, with 11,100 ft. of wood and 14,580 ft. of steel pipe, to a weir chamber at the West Side reservoir. These regulating chambers are located on the hydraulic grade line for the full capacity of the pipe line, and are equipped as already described.

General Construction—The contracts for material were let in the fall 1919 and consisted of a contract with the Redwood Manufacturers' Co. for the wood pipe under specifications prepared by the Butte Water Co. Under this contract the ditch was prepared and material delivered by the water company from points on the Oregon Short Line R.R., which parallels the pipe line, to convenient points along the ditch. The pipe company erected the pipe in the ditch and guaranteed it against defective material for one year after completion.



STAVE REDWOOD PIPE AND LAP-WELDED STEEL PIPE WITH WELDED CIRCUMFERENTIAL JOINTS

Equipment for construction consisted of two Austin

The contract for the steel pipe was awarded to the National Tube Co. and covered only the pipe and its delivery on cars at points along the Oregon Short Line. The thickness of the steel varied to conform to pressure, 22,388 lin.ft. of the 24-in. having a thickness of 0.33 in.; 2,903 ft., of 26-in., 0.362 in.; 360 ft., of 26-in., 0.4375 in.; and 443 ft., of 26-in., 0.5 in. The pipe came in varying lengths, averaging about 17.5 ft., with beveled ends for welded joints.

The contract for the valves and fittings, consisting of four 24-in. balance float valves, three 26-in. high-pressure hydraulic gate valves, six 26-in. low-pressure gate valves, nine 24-in. low-pressure gate valves, twenty-two 6-in. gate valves and forty-one 2-in. gate valves, was awarded to the Ludlow Valve Manufacturing Company

dragline excavators, one Holt caterpillar with four Troy trailers, one Austin back-filler, two 5-ton Pierce-Arrow trucks, four 1½-ton Reo trucks, two air compressors with jack-hammer equipment, all operated by gasoline, and tents, camp equipment and tools, to take care of six hundred men.

Owing to the short working season in this climate, all construction equipment and considerable material were delivered during the winter of 1919-1920, and work was started early in April. On May 7, just as the work was well on its way, a strike was called which caused a delay of about thirty days. This and other



A 90-DEGREE BEND IN 24-IN. STEEL PIPE WELDED TOGETHER READY FOR LOWERING TO PLACE

hindrances caused by labor agitation seriously impeded the progress of the work, causing considerable additional expense by delaying all of the backfilling and considerable of the concrete work until during freezing weather. The line was finally completed and placed in operation on Dec. 7, 1920, and, except for occasional interruptions caused from repairing defective work, has been in continuous successful operation ever since.

Wood Pipe—The 26-in. wood pipe used in this line is constructed of sixteen 1½ x 6-in. redwood staves with sides dressed to conform to the inside and outside radii of the pipe, and edges dressed to true radial planes, with tongued and grooved edges. The end of two adjoining staves are in no case closer than 24 in. The 24-in. pipe is constructed of twenty-three 1⅝ x 4-in. Redwood staves dressed and laid in the same manner as the 26-in. pipe. The material was perfectly clear lumber. It was inspected at the railroad and the inspection continued with vigor through the whole construction. Building crews of the contractor consisted of one foreman and five laborers, and their average day's work of 8 hr. was 250 lin.ft. of pipe. Steel bands of ½-in. diameter were used on both sizes of wood pipe. The number of bands placed on the 24-in. pipe at various pressures was at the rate of 271 per 100 ft. of pipe under 100 ft. head, and on the 26-in., 286 bands, likewise. A factor of safety of five was used in banding the pipe, but the spacing was not permitted to exceed 8 in. on the lightest pressures. A total of 1,800,000 ft. b. m. of redwood staves and 412,720 ½-in. steel bands were used.

Steel Pipe—In laying the steel pipe, several hundred feet were welded together on skids extending across the excavated ditch, and then lowered into place from one end, the other end being left on skids above the ditch, thus permitting additional pipe to be welded and lowered into place, avoiding the necessity of trench welding and "bell holes" excavation. On the 32 per cent grade, after leaving the Big Hole pump station, two lengths were welded together at the foot of the grade, and hoisted in place over the ditch, using a hoist equipped with wire cable. These double lengths were then welded together on skids over the trench, and lowered, beginning at the foot of the slope. Where the ground permitted, seven lengths of pipe were welded together alongside of the ditch, then rolled on skids over the ditch, welded, then lowered from one end, care being taken not to cause any undue strain on the welded joints. An inspector went inside of the pipe after welding was completed, painting the welds with preservative paints and chipping off any excessive metal, thus making the inside practically smooth when completed.

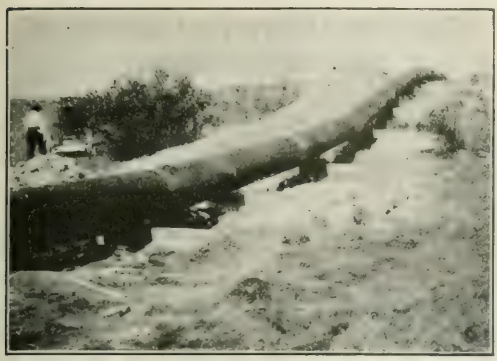
The ditch was excavated 4 ft. wide and to a minimum depth of 4 ft., which gave ample room for handling the pipe. As the pipe line through the most of the distance passes through mountainous country, the excavation was both expensive and difficult, over 40 per cent being through solid rock. From the fact that the location of the line is governed by the hydraulic grade, we had no choice as to the location.

As the pipe was lowered into the ditch it was backfilled immediately to a depth of 4 in. above the top of the pipe, carefully tamped, to protect it from the weather and to prevent excessive contraction and expansion after being put in place. As soon as possible, water was turned in to each completed section, enabling us to locate defective work.

Expansion Joints—In the original construction, two expansion joints were placed in the 26-in. and six in the 24-in. pipe at various points along the line. These expansion joints were installed originally to protect the valves and other castings. Later it was found necessary to install six expansion joints at points where strains had developed in the pipe line. This number was much less than anticipated. The last of these joints was inserted in January, 1921. The continuous operation of the pipe line without trouble since that time indicates that all construction strains have been cared for.

In the finished pipe line the longest section of pipe between expansion joints and horizontal angles is 4,600 ft.; the longest section of pipe between expansion joints, but with horizontal bends, is 6,170 feet.

That so few expansion joints were necessary is attributed (1) to the very small variation in the tem-



STEEL PIPE WELDED TO FORM A REVERSE CURVE READY TO LOWER INTO TRENCH

perature of the water and (2) to the uneven alignment of the pipe, caused by the rough country through which it is built taking care of the contraction and expansion and by settling of the pipe after construction. Most of the defective joints were cracks on top of the pipe, indicating that the majority of them were caused by settlement of the pipe after laying. Where a joint broke and the pipe pulled apart, indicating a strain no further trouble in that part of the line was experienced after the installation of an expansion joint.

Connections to Valves and Special Fittings under the original design were made by welding a steel flange to the pipe. This proved to be extremely difficult work, and we failed to weld properly any flanges to pipe without warping the flanges, which necessitated the refacing of all flanges. To overcome this difficulty, we discarded all cast-iron fittings, with the exception of valves, and made the bends from steel pipe. These bends were cut according to patterns furnished the welders, and the result was a neat and uniform bend at much less cost than a cast-iron fitting.

Welding End Joints—The oxy-acetylene process was used to weld the circumferential joints. Portable Oxweld low-pressure generators and union carbide were used to supply the acetylene gas, each generator being capable of furnishing 50 cu. ft. of gas per hour, which gave an ample supply at all times for two blow pipes of suitable size. Oxygen was furnished by the Linde Air Products Co., in 100-lb. cylinders. A contract was let to a local firm for the welding but, owing to an incompetent foreman, it became necessary to cancel this contract, after which we awarded the contract to F. E. Woodbridge, who had had considerabl experience in welding pipe of smaller diameter for oil lines. After awarding him the contract, we had very little further trouble, except from the fact that it was very difficult to secure competent welders.

Under the first contract for welding, notwithstanding careful inspection, a great deal of defective work developed. In the first pipe laid under the original contract, 10 per cent. of the joints were found defective and had to be repaired. This was reduced on the later work to 1.7 per cent. Of the 1,568 welds made on both the 24- and 26-in. pipe, 58 joints were defective, amounting to 3.7 per cent. of the joints made, but most of these were small cracks, usually on top of the pipe, and were repaired at very small cost. Considering the fact that this kind of work was new to all of us, and that a large part of the work was done through a very rough country, which necessitated more or less rough handling of the pipe, the percentage of defective work was exceedingly small.

In making the welded joints, we found that the best results were obtained by thoroughly heating the pipe for 6-in. on each side of the joint. Troubles from contraction and expansion were very small when this rule was adhered to. Most of our trouble, aside from the defective work, is attributed to the settling of the pipe after being placed in the ditch and filled with water, causing small cracks in the joints, which were easily repaired. In the welding, great care was taken to fill the joints entirely full of metal, without permitting the molten metal to run inside the pipe. The welding was started at the bottom of the groove, and carefully worked out to the outside diameter of the pipe, where a good ridge was made above the pipe. In welding, the ends of the pipe were held together by collars, until the pipe was tacked at four places with tacks about 4-in. long. The collar was then removed. The best results were obtained by using two welders on opposite sides of the pipe, working towards each other.

When the grade of the pipe line was uniform the pipe was placed on skids alongside the ditch and welded together in lengths of 120 ft. This enabled all welding of each section to be made from above, the pipe being turned as required. These sections of pipe were then placed on skids over the trench and welded together. It was found that sections of a maximum length of 120 ft. of pipe was all that could readily be placed in a position to be welded together. In handling the pipe in this manner only a small percentage of work was overhead welding.



STEEL PIPE TACKED TOGETHER READY FOR WELDING

Welding rods of $\frac{5}{16}$-in. diameter were used at the beginning of the work, but were soon discarded for $\frac{1}{4}$ and $\frac{3}{16}$-in. rods. On the heavy pipe and flanges, with a skillful welder, $\frac{3}{8}$-in. rods were used. Number 12 and 15 Oxweld tips were used almost exclusively on the work.

All joints were painted inside and out with preservative paint after completion and inspection.

Costs—After over one year's operation of Big Hole Pipe Line No. 2, we feel justified in asserting that the use of steel pipe of large diameter with welded joints has proved a success. The reasons for adopting this construction have been fully justified in the results as to cost. A table of costs in this line would be of very little value to the profession because conditions were

abnormal, both material and labor being at the peak, with efficiency very low, besides which labor in the vicinity of Butte was extremely scarce, and labor troubles added materially to the cost. Finding it impossible to come to any kind of a satisfactory agreement with the labor unions during the whole construction, the company was on the unfair list, being unduly annoyed by boycotts and other difficulties arising from the troubles with union labor. While union wages were paid in all the different departments and no attempt was made by the management to oppose union labor, the construction was handled under the "American plan," which caused continual friction between the company and the union heads, who endeavored to force closed shop conditions.

In the welding, particularly in the early part of the work, competent foremen and operators seemed impossible to secure, causing considerable extra expense, not only in construction but also in defective work. Welders were paid $9 a day of 8 hr., with time and a half for overtime, but even so, it was very difficult to procure competent men.

Common labor was paid $5.50 per day of 8 hr.; skilled labor in proportion. All kinds of labor-saving machines were used in the construction. The cost of the delivery of material, on account of the mountainous character of the country, was extremely high in many places, requiring handling three times—(1) in a truck, (2) thence by tractor with trailers; and (3) by hand—before delivering alongside of the ditch. The total construction cost was 45 per cent. greater than the estimate made in 1917, which was based on current prices at that time. Labor costs exceeded the estimate from 8½ per cent for compressor men to 100 per cent. for cooks and flunkies.

Material costs exceeded the estimate—principally on wood pipe—from 18 per cent on structural steel to 62 per cent on lumber. The labor cost for 241 welds on 26-in. steel pipe was $28 each, and on the 1,327 welds on 24-in. pipe, $16.13 each; the average cost of the 1,548 welds—9,973 ft. of welding—was $51.47 per joint. The estimated cost of an ordinary lead Matheson joint was $50.55, showing that the welded joint cost 1.8 per cent more than the Matheson joint, which joint could not have been used without reinforcement on more than 31 per cent of the joints. The final cost of joints per lineal foot of steel pipe, including elbows, etc., was $3.18 per foot, divided as follows: Unloading and transportation $0.429; erection, $0.941; welding labor, $1.059; welding supplies, $0.751. The average length of pipe between joints was 16.83 feet.

All location and construction work was under the supervision of James H. Kyd, chief engineer of the Butte Water Company.

Panama Canal Traffic in 1921

Traffic through the Panama Canal during 1921 averaged 232 vessels a month, only 2.4 less than in 1920. In net tonnage and tolls 1921 exceeded 1920, 11,435,811 tons passing, as compared with 10,378,265 tons the previous year. The tolls, according to the *Panama Canal Record*, aggregated $10,325,718.02 in 1921, and $10,295,362.21 in 1920. Cargo carried through the Canal in 1921 was 527,771 tons less than the previous year.

Tests on Absorptive Qualities of Concrete Blocks

Effect of Varying Aggregate, Cement and Water Content, Curing Conditions and Density Observed on Small Test Blocks

By Stanton Walker
Structural Materials Research Laboratory, Lewis Institute, Chicago, Ill.

Abstract of paper presented at meeting of Minnesota Section of the American Concrete Pipe Association

ABSORPTION holds a prominent place in all specifications for quality of concrete products. Notwithstanding the importance attached to this property, little information has been published concerning it. It is felt that it will be of interest, particularly to the manufacturers of concrete products, to present data showing the relation of absorption to various factors which govern the strength of concrete. Much information on this subject has been obtained from researches carried out at the Structural Materials Research Laboratory, Lewis Institute, Chicago, under the direction of Prof. Duff A. Abrams. This laboratory is conducted through the co-operation of the Lewis Institute and the Portland Cement Association.

This paper is based on data from an investigation of the strength and wearing qualities of concrete for floor surfaces (Series 134). Strength tests were made on 6 x 12-in. cylinders and wear tests on 8 x 8 x 5-in. blocks. The wear blocks were used later for the absorption tests. Mixtures ranging from 1:4 to 1:1 were studied. The size and grading of the aggregate was varied from sand finer than a 28-mesh sieve to concrete aggregates graded up to 1½ in. The consistency of the concrete as affected by the water content was varied from dry to sloppy. The effect of time of storage of concrete in a moist condition was studied.

The specimens used for the absorption tests were 8 x 8 x 5-in. concrete blocks. The concrete for each specimen was proportioned separately and mixed by hand in a shallow metal pan with a bricklayer's trowel. A cubic foot of cement was assumed to weigh 94 lb. Mixtures are referred to as one volume of cement to a given number of volumes of aggregate mixed as used. In general the aggregate was sand and pebbles from Elgin, Ill. The cement was a mixture of equal parts of five brands of portland cement purchased in Chicago. Water from Lake Michigan was used for mixing. The concrete was puddled into the forms by means of a ⅝-in. round rod pointed at the lower end. The specimens were removed from the forms 16 to 20 hr. after molding and stored in damp sand for 14 days and the remainder of time in dry air, except in instances where the effect of time of storage was investigated. At the age of 3 months the blocks were subjected to the wear test in the Talbot-Jones rattler; after which they were again stored in a dry room for about 9 months.

The blocks in a dry room condition were immersed in water at room temperature and the absorption determined at periods of 1, 2, 3, and 7 days. The gain in weight expressed as a percentage of the dry weight was taken as the absorption. The absorption at 48 hours is used in most of these studies, due to the fact that this period is used as the basis of many specifications for the absorption of concrete products.

Due to the large number of specimens it was not practical to dry them to constant weight. Several blocks which were dried to constant weight at a temperature of 110 deg. C. showed a loss in weight of from 2.5 to 3 per cent. This method of handling is partly responsible for the somewhat low absorption found. It is believed however that the values determined under these conditions give reliable data on the relative effect of different factors.

The 6 by 12-in. cylinders used for the compression tests of concrete were molded at the same time as the blocks. The conditions of storage and age at test was the same as for the corresponding wear blocks.

Size and Grading of Aggregate—The fineness modulus is used as a measure of the size and grading. Fig. 1 shows

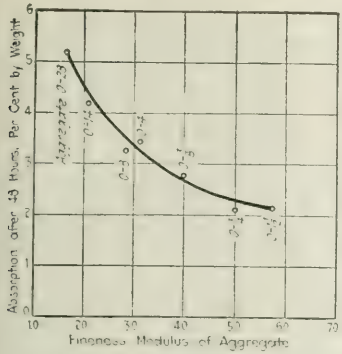


FIG. 1. EFFECT OF SIZE AND GRADING OF AGGREGATE ON THE ABSORPTION OF CONCRETE

8 x 8 x 5-in. blocks. Relative consistency 1.10. Aggregate; sand and pebbles from Elgin, Ill. Specimens stored in damp sand 14 days, and in dry room for about 1 year. In general, value is the average of 12 tests, two from each of 6 mixtures, as follows: 1:4, 1:3, 1:2½, 1:2, 1:1½, 1:1.

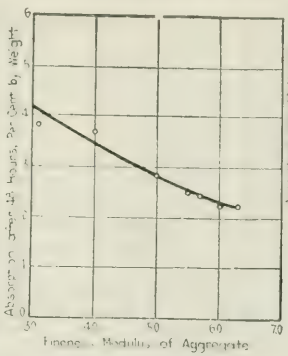


FIG. 2. EFFECT OF GRADING OF AGGREGATE ON THE ABSORPTION OF CONCRETE

8 x 8 x 5-in. blocks. Relative consistency 1.10. Aggregate; sand and pebbles from Elgin, Ill., and crushed limestone from Chicago, graded 0-1½ in. limestone from Chicago, graded 0-1½-in. Specimens stored in damp sand 14 days, and in dry room for about 1 year. In general each value is the average of 16 tests, two from each of 4 mixtures as follows: 1:4, 1:3, 1:2½, 1:2, and 2 aggregates.

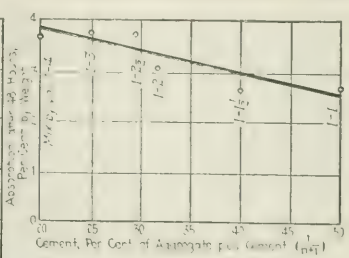


FIG. 3. EFFECT OF QUANTITY OF CEMENT ON THE ABSORPTION OF CONCRETE

8 x 8 x 5-in. blocks. Relative consistency 1.10. Aggregate; sand and pebbles from Elgin, Ill. Specimens stored in damp sand 14 days, and in dry room for about 1 year. Immersed in water at room temperature for 48 hours. In general each value is the average of 12 tests, two from each of 6 sizes of aggregates, 0-28, 0-1¼, 0-1, 0-¾, 0-½, 0-¼, 0-1½.

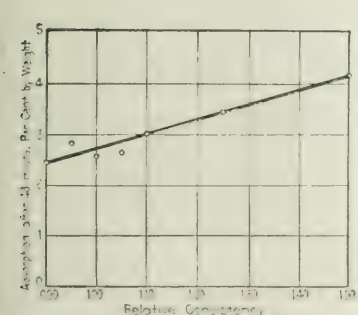


FIG. 4. EFFECT OF QUANTITY OF WATER ON THE ABSORPTION OF CONCRETE

8 x 8 x 5-in. blocks. Aggregate; sand and pebbles from Elgin, Ill., graded 0-1½ in. Specimens stored in damp sand 14 days, and in dry room for about 1 year. Immersed in water of room temperature for 48 hours. In general each value is the average of 6 tests, two from each of 3 mixtures as follows: 1:3, 1:2½, 1:2.

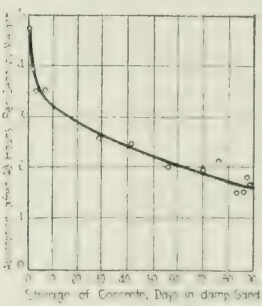


FIG 5. EFFECT OF CURING ON THE ABSORPTION OF CONCRETE

8 x 8 x 5-in. blocks. Relative consistency 1.10. Aggregate; sand and pebbles from Elgin, Ill., graded 0-1½ in. Specimens stored in damp sand for periods noted, remainder in air. Tested at age of about 1 year. Immersed in water of room temperature for 48 hours. In general each value is the average of 6 tests, two each from 3 mixtures as follows: 1:3, 1:2½, 1:2.

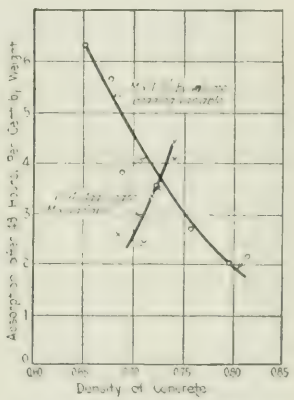


FIG 7. RELATION BETWEEN DENSITY AND ABSORPTION OF CONCRETE

8 x 8 x 5-in. blocks. Aggregate; sand and pebbles from Elgin, Ill. Specimens stored in damp sand 14 days, and in dry room for about 1 year. Immersed in water of room temperature for 48 hours. In general each value is the average of 2 tests.

data for seven sizes of aggregate. The values are the average of tests made on six different mixtures ranging from 1:4 to 1:1. Each aggregate was well graded within the range of sizes indicated. The sieve analyses are shown in the accompanying table. The absorption decreased from 5.2 per cent for concrete made from 0-28 aggregate to 2.2 per cent for the 0-1½ in. aggregate. Fig. 2 shows the effect of variations in grading of the aggregate caused by wide variations in the sand content. The aggregate having a fineness modulus of 3.10 is sand only; that having a fineness modulus of 6.25 is made up of 20 per cent sand and 80 per cent No. 4-1½ in. pebbles or crushed limestone. The values are the average of tests made on the two aggregates and on four mixtures. It will be noted that the absorption decreased as the aggregate became coarser (less sand was used) confirming the indications of the data in Fig. 1. Comparison of Fig. 1 and 2 with the upper left portion of Fig. 6 shows that the strength of concrete is affected by the grading of the aggregate in an opposite manner from the absorption. These diagrams indicate an intimate relation between the absorption and strength of concrete.

Quantity of Cement.— The effect of variation in the quantity of cement on the absorption is shown in Fig. 3 for mixtures ranging from 1:4 to 1:1. The values are averages from six grading of aggregate. The percentage absorption decreased about 0.04 for each additional 1 per cent of cement. That is, if changed from 4.8 for 20 per cent of cement to 4.4 for 30 per cent of cement. Reference to Fig. 6 shows that the strength increased with the quantity of cement.

Quantity of Mixing Water.—The absorption of concrete increased with the quantity of mixing water so long as the concrete was plastic. The strength was decreased by the addition of water. (See Figs. 4 and 6.) The quantity of mixing water is expressed as "relative consistency." A relative consistency of 1.00 represents concrete of such a plasticity that a freshly molded 6 x 12-in. concrete cylinder will slump ½ to 1 in. upon the removal of the metal form by a steady upward pull. Concrete of a relative consistency

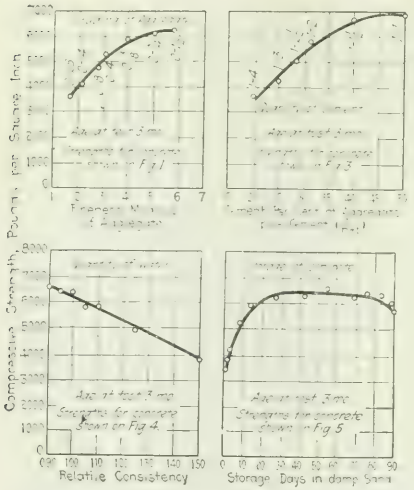


FIG. 6. STRENGTH RELATIONS OF CONCRETE
Compression tests on 6 x 12-in. cylinders made parallel with absorption blocks referred to in Figs. 1, 3, 4 and 5.

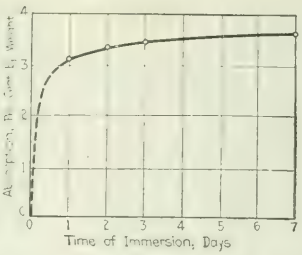


FIG. 8. EFFECT OF TIME OF IMMERSION ON THE ABSORPTION OF CONCRETE
8-in. x 8 x 5-in. blocks. Relative consistency 1.10. Aggregate; sand and pebbles from Elgin, Ill. Specimens stored in damp sand 14 days, and in dry room for about 1 year. Immersed in water of room temperature. In general each value is the average of 84 tests, two each from 7 sizes of aggregate and 6 mixtures.

of 1.10 contains 10 per cent more water than that of a relative consistency of 1.00. It should be remembered that these tests were made on hand-molded concrete blocks. All of the concrete was sufficiently plastic to be puddled into place with a rod. The 0.90 relative consistency represents about the driest concrete that can be handled in this way. It contains about 20 to 25 per cent more water than the average machine-made block. This does not mean, however, that, other conditions being equal the machine-made block would have less absorption than that molded by hand, in proportion to its lower water content. The minimum absorption will be found for some quantity of water which varies with the method of molding mixture used, characteristics, of aggregate, etc. The tendency is to make the machine-molded products with too little rather than too much water.

Curing Concrete.—The importance of curing concrete in a moist condition is illustrated in Fig. 5. Tests made for periods of storage in damp sand up to 3 months showed less absorption for the longer periods of storage. The absorption for concrete stored in damp sand 3 weeks was less than half of the value obtained for the same concrete stored in dry air from the time it was removed from the forms. Fig. 6 shows the beneficial effect of storage in a moist condition on the strength of concrete.

TABLE SHOWING SIEVE ANALYSES OF AGGREGATES

Sieves were square mesh, woven wire from "Tyler Standard Screen Scale," manufactured by the W. S. Tyler Company, Cleveland, Ohio.

Aggregate; sand (Lot No. 4653) and pebbles, (Lot No. 4768) from Elgin, Ill., and crushed limestone (Lot No. 3958) from Chicago, Ill. The sieve analyses may be identified with the aggregates represented on the diagrams by the size and fineness modulus.

Size of Aggregate	Amount Coarser than Each Sieve, Per Cent by Weight: 100	48	28	14	8	4	¾	¾	1½	Fineness Modulus	Weight Lb. per Cu. Ft.
0–28	94	71	0							1 65	105
0–14	96	80	34	0						2 10	108
0–8	98	90	60	32	0					2.80	111
0–4	99	90	62	39	20	0				3 10	112
0–¾	99	93	74	58	45	31	0			4.00	117
0–¾	99	96	82	71	63	53	36	0		5.00	127
0–1½	99	92	71	53	38	23	18	6	0	4.00	124
0–1½	99	95	81	69	59	49	36	12	0	5.00	128
0–1½	99	96	85	77	69	62	47	15	0	5.50	130
0–1½	99	97	88	80	74	68	52	17	0	5.75	128
0–1½	99	97	90	84	79	74	58	19	0	6.00	127
0–1½	99	98	93	88	85	81	61	20	0	6.25	123

Density of Concrete.—There is no *general* relation between the density of the concrete and the absorption. Fig. 7 shows two features of this variation. For a constant quantity of cement and for different sizes of aggregate, the absorption was less for the higher densities. Although not shown on this figure, this relation was also found to hold for variations in consistency. Varying the cement content with other factors constant, showed an *increase* in absorption as the density increased—an exactly opposite relation from that found by varying the grading of the aggregate or the quantity of mixing water.

Time of Immersion of Concrete.—Fig. 8 shows the absorption after immersion for periods of 1, 2, 3, and 7 days. It will be noted that the increase in absorption is very slight after 48 hours. A study of all of the data showed that the rate of increase was approximately the same for all conditions. The value for 48 hours, which was used in the discussion of the tests, showed no essential difference in relationship with the different variables from the values for the other periods.

Relation between Strength and Absorption Concrete.—All tests in this investigation show that the absorption varied inversely with the strength. In general concrete having a low absorption had a high strength. So far as these data show, this relationship cannot be represented by a single function, that is, concretes of different composition having the same strength do not necessarily have the same absorption; but all factors which tended to *increase* the strength, *decreased* the absorption, and vice versa. The absorption was most affected by changes in grading of aggregate and was least affected by changes in cement content.

1. The absorption of concrete was reduced by using coarser aggregates, so long as the concrete was plastic.

2. The absorption of concrete was reduced by increasing the quantity of cement.

3. *For the conditions of these tests* the absorption of concrete was increased as more mixing water was used.

4. The storage of concrete in a moist place immediately after molding decreased the absorption. The longer the concrete was kept moist the lower the absorption.

5. The relation between the density of concrete and the absorption depended on conditions. For a constant quantity of cement the absorption became *less* as the density of the concrete increased. For a variable quantity of cement, with other factors constant the absorption became less as the density *decreased.*

6. There was an intimate relation between the strength and absorption of concrete; in general concrete of a high strength gave a low absorption.

Is Engineering a Healthful Occupation?

Engineering is a healthful occupation by statistics; at least so far as tuberculosis is concerned. In a table of 53 occupations compiled by the Chicago Tuberculosis Institute engineers and surveyors were forty-third and had a mortality rate of 145 per 100,000 due to the white plague. Marble and stone cutters came first with a rate of 531. Architects are worse off than the engineers, being in thirty-eighth place with a rate of 187, while teachers, lawyers, soldiers and sailors, steam railroad employees, miners, quarrymen, farmers and bankers, brokers and officials of companies are all better off than the engineer in the order named. The bankers, brokers and company heads are in a distinct class at the end of the list, with a rate of 92 against 112 for the farmers the next highest.

Port Authority Presents Arguments Against Narrows Tunnel

Bi-State Body Contends that Its Scheme Will Cost Less and Will Operate More Efficiently Than That of City

UNDER date of Jan. 23, 1922, the Port of New York Authority issued a statement comparing its comprehensive plan with the Narrows tunnel plan proposed by the City of New York. From that report the following extracts are taken, to present the arguments of the bi-state body on approximately the same issues as were discussed by the city's representative, Col. W. J. Wilgus, in the abstract of his report in last week's issue, p. 248.

The variation in costs noted in the footnote in the table is apparently due to the difference in estimates of the southerly and northerly routes proposed by the city. It should also be noted that the unit costs given in that table for the city's plan are those figured by the Port Authority and are in excess of those figured by the city for the same route. The basis of unit cost figuring, however, is so different by the two bodies as to make comparison difficult.

The table contains a comparison, based on engineering analysis, of the important features of the Port Authority's plan with the city's proposal. Reference to this table will show that the middle belt line of the Port Authority's plan from its northernmost terminal to Bay Ridge, Brooklyn, is 17.1 miles long while the city's belt line from its northernmost terminal to Bay Ridge, Brooklyn, is 67.5 miles, the excess length of the city's line being 50.5 miles.

The Port Authority's tunnel is 24,290 ft., while the [southerly] Narrows tunnel proposed by the city is 22,750 ft. or 1,540 ft. shorter. In this connection it must be remembered that the ruling grade of the Port Authority's tunnel is 1.6 per cent while the ruling grade of the tunnel under the Narrows is 2 per cent. If the grades of the city's tunnel were the same as the grades of the Port Authority's tunnel, the length of the city's tunnel would be increased appreciably.

Comparative Costs

The estimated cost of constructing the 17.1 miles of belt line including the tunnel under Upper New York Bay as proposed by the Port Authority is $65,000,000. The City Engineers estimate the cost of constructing the belt line it proposes together with tunnel under the Narrows at $93,000,000. It will be seen that the excess cost of the city's line is twenty-eight million dollars.

As the length of the city's belt line is so much greater than the middle belt line proposed by the Port Authority, it is easy to comprehend why the table shows that to move via the city's line the same amount of tonnage and the same number of cars between the classification yards in New Jersey and their destination or point of origin in Brooklyn, Queens or the Bronx, would necessitate 1,620,000 train miles as against 910,000 train miles under the Port Authority Plan and 973,000,000 net ton miles under the City's Plan as against 477,000,000 net ton miles required under the Port Authority plan.

The dissimilarity of physical characteristics of the two lines in grade and length, of course explains the excess first cost and the excess amount of effort measured in operating costs, required to perform a given service under the city's plan.

Naturally these disadvantages are reflected in the cost per car which would amount to $11.34 under the Port Authority's plan as against $15.17 under the city's proposal, the excess under the latter scheme being $3.83 per car. On a traffic movement of 1,340,000 cars annually, this excess cost would amount to more than $5,000,000 per annum, which if capitalized at 6 per cent amounts to $85,000,000.

Discussion in the report of the Board of Estimate and Apportionment fails to convince the practical railroad operator that its proposal is an operating feasibility. Let us assume that the freight destined to Brooklyn and Queens and for interchange with the Long Island and New Haven railroads would be broken out of trains arriving by the many railroads entering the port, as those trains reach a junction point with the outer belt line. But this assumption is not reasonable. There is nothing in the city's engineers' estimated cost of the proposed facility for construction classification yards at each of these junction points. Nor is there included in the estimated cost of operation any expense for *yarding*, that is, the breaking up of trains, classifying and switching cars and making up trains into switching units at these junction points.

The city's report is likewise silent *on the matter of delay that classification at junction points would occasion to the balance of the 50 or 60 million tons of freight moving into and out of the Port annually, besides that which the city engineers have assumed would move via its proposed belt line and tunnel.*

If, however, the traffic to and from the easterly side of the port is not to be broken out of trains and made up into switching units at the junction points, what then is the plan of operation? Transportation experts familiar with the character of the traffic handled through the Port of New York and its currents of flow, cannot even begin to take seriously the suggestion that it is practicable, to any extent, to make up solid trains at divisional yards of the several lines in the interior and move such trains directly to junctions with the proposed belt line, thence via that line to the proposed yard in the Borough of Richmond.

Trains now arriving at the port district contain freight for every section, that is, Manhattan, Newark, Greenville, Jersey City, Bayonne, Hoboken, Edgewater, Brooklyn, Queens, Bronx, Richmond, and as well for interchange with the New Haven, Long Island and New York Central railroads; also freight for export and coastwise shipment. This freight originates all along the line of each railroad from a distance of a thousand miles or more right up to the port district.

Without interminable delays it would be impossible so to classify this freight at divisional yards in the interior as to enable it to move in solid trains from those yards directly to the junction points with the belt line, thence to the proposed yard at Richmond.

Yard Needs

That this is true can be illustrated by taking the inbound business on one of the trunk lines as an example. It approaches the Port District through six yards. Business from the west through one yard; business from a large city through its yard; business from the south through another yard; business from a branch line through its yard; business from western New Jersey through another yard and business from southern New Jersey through still another yard. There is not enough traffic passing through any one of these yards daily, to make up a solid train for any particular section of the port district, except one which has enough business to make up a few solid trains daily.

To hold cars at the divisional yards in the interior until solid trains could be dispatched would in many instances cause several day's delay to the freight. It is plain to be seen that additional yards will be necessary at junction points with the proposed belt line. However, even though yards were provided at junction points, there would be a considerable volume of business which would have to be handled into the present classification yards and back again to the junction point, for example: all cars for transfer stations would have to be taken to the transfer platforms which are now located near the classification yard, and freight for Brooklyn, Queens or Long Island reloaded into other cars would have to be hauled back to the junction point of the belt line, thereby causing a direct loss of time and money. Such operation as this is impracticable, with reference to the eastbound movement; it is impossible when the westbound movement is considered.

Even with new classification yards on Staten Island at which westbound cars would be classified by railroads, it would be necessary for each railroad to take these cars to their present yards and transfer station in order to make

.p solid trains for such points as Chicago, Cleveland, Buffalo, etc. There would certainly be serious objection from shippers to the delay that would occur by any such movement. It is doubtful if freight shipped one day would move out the same day; at best it would be several hours later in leaving. Not only would there be this delay, but the additional expense of the back haul.

The proposed belt line in New Jersey is approximately fifteen miles west of the Hudson River and an average of twelve miles west of the present classification yards of the New Jersey railroads. It has been shown that the operation of such a line for the purposes intended, if otherwise practicable would necessitate yards at the junction of each railroad line with the belt line.

What justification can there be for advocating such a waste of capital? There exists today a classification yard on each railroad to serve the terminal district in New Jersey. These yards are outside of the congested area of terminal operation.

The congestion that has occurred in present classification yards in the past and that will undoubtedly occur in the future if measures of relief are not taken, comes about by reason of congestion along the New Jersey waterfront.

From Weehawken to Communipaw there are handled approximately two million cars annually between the two sides of the port. More than one and one-half million of these cars are bridged to and from the carfloat at the New Jersey waterfront yards. This is where the congestion occurs. The Port Authority's plan will relieve this congestion by diverting part of this traffic directly at the classification yard to its Middle belt line, by which it will move directly to Brooklyn, Queens and New England; the balance destined to Manhattan, will be diverted to the joint yards which it proposes for Manhattan freight, thus keeping out of the waterfront yards on the New Jersey side all of these cars.

COMPARISON OF SALIENT FEATURES OF THE PROPOSAL OF THE CITY OF NEW YORK WITH THE PORT AUTHORITY'S PLAN

Physical Characteristics:	P. A. Plan	City's Plan
Belt line, northernmost terminal to electric section	1 1.1 mi.	57.9 mi.
Electric section, including tunnel to Brooklyn	6.0 mi.	9.6 mi.
Total New Line to bring N. J. lines to Brooklyn	17.1 mi.	67.5 mi.
Excess length of City's line		50 4 mi.
Ruling grade, electric section	1.6%	2 0%
Tunnel length, portal to portal	24,290 ft.	22,750 ft.
Excess length of Port Authority tunnel		1,540 ft.
First Costs:		
Belt line, including power exchange yard, as described	$6,200,000	$42,000,000*
Electric section, including tunnel to Brooklyn	58,800,000	51,000,000†
Total cost, new line to reach Brooklyn	65,000,000	93,000,000
Excess cost, City's line		28,000,000
Traffic Expectations:		
Net tons, annually	18,500,000	18,500,000
Cars (loads and empty) annually	1,340,000	1,340,000
Train miles required	910,000	1,620,000
Excess effort necessary under City's Plan, train miles		710,000
Net ton miles required	477,150,000	973,150,000
Excess movement necessary under City's plan—net ton miles		496,000,000
Unit Costs: (Including all operating expenses, interest on investment, taxes, etc.)		
Per car	$11 34	$15.17
Excess, City's plan		3.83
Total cost, operation and overhead, annually	15,204,365	20,352,543
Excess, City's plan		5,148,178
This difference in favor of the Port Authority's Plan, if capitalized at six per cent, amounts approximately to		85,000,000

* Given as $32,000,000 in Jan. 23, 1922, report of Board of Estimate.
† Given as $53,000,000 in Jan. 23 report. E. or M.

The construction of classification yards at the junction points of the city's proposed belt line would not release any of the present classification yards.

Every railroad must have a classification yard within switching distance of the waterfront, in which to separate and classify the cars for various destinations, stations, sidings, etc., both for inbound and outbound movement and particularly in the case of outbound cars, which have to be made up in solid trains for principal destinations and in station order for way points.

A very serious ommission [in the city's report] is that no charge has been made for use of the Long Island and New York Connecting railroads or a line of similar purpose, which would be absolutely essential to distribute the tonnages which the city's engineers have assumed would move over the proposed belt line and through its proposed tunnel to Bay Ridge.

In working out the cost of the proposed operation, the City has assumed that nine million tons of freight would be distributed after reaching Bay Ridge, along the proposed marginal waterfront line in Brooklyn. The balance of the traffic allocated to its belt line and tunnel, amounting to eleven million tons, it leaves at the mouth of the tunnel on the Bay Ridge side, nothing being included for the cost of handling this freight between that point and its destination in Brooklyn, Queens or the Bronx.

Economy and Efficiency In Modern Highway Bridge Building

Increase in Loads Demands Closer Attention to Design in Details, Fabrication and Maintenance

By Howard W. Holmes
Bridge Engineer, State Highway Commission of Montana, Helena

MODERN types of motor vehicles with their heavy concentrated loads have given rise to much discussion as to proper loadings and impact factors to use in designing highway bridge structures. That many of the existing bridges are light and poorly designed has long been known to engineers, but only recently has the fact become known to highway officials and road users. There has resulted a crystallization of sentiment in favor of competent control of the design and construction of all bridges to be built in the future. It would seem, however, that a warning should be sounded against abuse of the desire for stronger bridges.

Undue increase of weight of future structures may result from present tendencies if they are not guided by proper regard for efficiency. Economy and sound business demand that not a single pound of unnecessary material be employed. Fundamentally, it would seem that a double obligation rests on the bridge engineer; to build highway bridges that will carry any load that may reasonably be expected to be imposed during the life of the bridge, and at the same time to build them at a cost that the community can afford.

In a great many sections of the country the latter obligation will make it impossible to provide for the greatest load that might possibly pass over the bridge during its life on the basis of the usual permissible working stresses. What then must be the first consideration under such circumstances? We must give most careful consideration to the probability of occurrence of possible maximum loads, and the effect of these loads on the structure. Full advantage must be taken of our knowledge of the properties of the materials entering into construction.

Take structural steel for example; has practice kept pace with the advances made in manufacture? Our answer must be in the negative. Today we are crediting this material with the same working stresses as when steel was first introduced into the art and when methods of control during manufacture were comparatively crude and unreliable. If a unit working stress of 16,000 lb. was then considered conservative practice, today such practice represents nothing short of economic waste. This reasoning leads to the first step in meeting the obligation as above submitted. We are

fully justified in discounting the likelihood of extreme loads, and provide for such loads at stresses but little below the elastic limit of the material.

We now come to a second phase of the problem. Main members are not fully efficient unless extreme care be used to develop their capacity by properly designed details and connections. Further, strength is not the only factor to be considered. It is common to see structures whose main members are amply sufficient but are detailed and braced in such way that traffic movement will induce dynamic stresses greatly in excess of the live-load stresses provided for. The stresses may also be increased greatly, or even doubled, through neglect in guarding against eccentricity of stress.

Many structures are today being built with suspended floors and without end floor beams. We see portals and sway frames gripping but one face of the members they connect. Rivets are laid out so that some cannot be driven effectively. These defects, together with a multitude of others, all tend to tax the material far beyond the stresses that would result from any conceivable live load.

Construction, Workmanship and Maintenance

A third thought relates to shop work and erection. The modern bridge works is equipped to execute work calling for any reasonable degree of refinement, and simply asks that the requirements be definitely outlined in advance. A well-designed structure may be so fabricated and erected as to cast serious doubt upon the propriety of becoming too enthusiastic over the problem of assumed design loadings and impact allowances. Some specifications governing shop work and erection will nullify all attempts to develop a proper and economical design. The engineer, if he be rightfully considered as such, must have had experience in actual shopwork and erection operations in order that he may fulfill his dual responsibility of assisting both the contractor and the public in securing a structure so built as to perform in actual service the work the designer intended it should.

Finally, we must not lose sight of maintenance. Consideration of practical and effective maintenance must begin in the designing room. Details must be such as to prevent the lodgment of débris and to permit of easy access with a paint brush after erection. Periodical inspection must be carried out, and minor repairs not neglected from year to year as is the prevailing custom. Steel bridges should be kept well painted, and the paint used should be purchased on a definite specification embodying features known to be particularly applicable to the purpose—the protection of structural steel exposed to extremely severe conditions.

While it may be reasonably assumed that live loads will increase, it is equally reasonable to assume that the distribution of such loads will not greatly vary from assumptions used in present-day design. Frequency of application of excessive loads must be considered.

Much is heard today of military loads. When considering these, the limits of mobility must not be lost sight of. A 12-in. howitzer equipped with shoes will impose a load of about 22,000 lb. on the two front wheels. The 75-hp. caterpillar tractor adopted as the haulage unit for this howitzer weighs 25,000 lb. It would seem that even allowing for a material increase in the weight of heavy artillery, the typical 15-ton truck loading is ample for present-day design.

As to impact, present-day theories tend to resolve into a question of vibration rather than the dynamic effect produced by rough surfaces or the passage of a wheel over a single obstruction. The remarks already made about rigidity apply here with even greater force than in the case of load-carrying capacity. Investigation along most rational lines will disclose that an allowance of 25 per cent in connection with the floor design should be ample to care for the impact increment.

There are many locations where the concrete arch will be found to be the most economical type of structure. The determining factors will be, suitable foundation and construction materials; if these can be had at reasonable cost future live loads need not cause much apprehension. This applies particularly to the earth-filled spandrel type. Since the matter of clearance is usually an important consideration in highway work, arches of low rise must be resorted to, making the earth-filled spandrel type extremely economical. Properly designed arches and suitable foundations combine to produce a structure calling for practically no maintenance in so far as the structure itself is concerned.

To conclude: We must build bridges that are capable of carrying the traffic and at the same time not lose sight of the fact that there is a limit to the public purse. The solution of this problem lies in giving more attention in the future to details of design and erection, and in crediting the material with its full stress-carrying capacity within known limits of safety. If these things are done our highway bridges will meet all conditions of loading that may be reasonably expected, provided intelligent maintenance is made a part of our road-building program and not overlooked when funds are apportioned for highway development.

California Counties Place Weight Limit on Auto Trucks

THREE COUNTIES in Southern California, Riverside, San Bernardino, and Orange, have recently passed ordinances limiting the gross weight of any four-wheeled vehicle to 22,000 lb. The weight on six wheels, under the new ordinances, is limited to 30,000 lb., and the limit for a truck with two trailers is 36,000 lb. gross.

Last year the California State Supervisors Association urged the highway commission to limit gross loads on public highways to 20,000 lb. Since then local organizations have taken up the same request, the most recent endorsement being from the Tulare County Taxpayers Association, which adds the suggestion that no more franchises should be granted to motor carriers in territories now being served by other motor or rail routes, until the legislature shall have had opportunity to (1) enact laws protecting the highways from excessive weight and speed and (2) assess against motor vehicles fees that are in proportion to their wear and tear on pavements. The purpose of this suggestion is to release the general taxpayer from the burden imposed on him by highway reconstruction and maintenance made necessary by the heavy automotive traffic to which objection is made.

The state law in California permits as a maximum a gross weight of 30,000 lb. on four-wheeled vehicles and 40,000 lb. on six-wheeled vehicles provided axles are at least 96 in. apart and there is not more than 800 lb. on each inch of rubber-tire width.

ENGINEERING LITERATURE

Office Circulation of New Literature

By Ruth Canavan
Librarian with Metcalf & Eddy, Boston, Mass.

That all members of our staff may keep themselves informed with respect to up-to-date developments in the engineering field, as set forth in current literature, the periodicals received at this office are circulated according to the following plan:

A list was prepared of all the men interested in any or all of the magazines received. This was typewritten in multiple on slips headed "Circulation List—Please check your name and pass this on." One of these slips is pasted by the librarian upon the front cover of each magazine as it is received. Note is then made of the page numbers of articles of especial interest against the names of those to whom they would appeal. Some names are crossed off the list. The magazine is then ready for circulation. It is placed upon the desk of the man at the head of the list or, in his absence, upon the next man's desk. He looks the magazine through, checks his name and passes it on. Or, in case he finds that he wants to read it more carefully he takes it home for one night. If he discovers data which should be abstracted he makes note of the fact at the bottom of the slip, or if he finds reference to books, bulletins or other matter which he thinks should be added to the library, he makes note of that fact. The second day he must pass the magazine along to the next man on the list. Some delays were anticipated, but the eagerness of the individuals to get each his turn promptly has taken care of this difficulty. The last man on the list returns the magazine to the librarian, who sees that all the names have been checked, takes care of the requests at the foot of the slip, and files the magazine in the current periodical stack.

To keep everyone posted, also, as to newly acquired material in the library a sheet prepared in duplicate and headed "Recent Acquisitions" is put up in the drafting room and in the library. Upon these sheets are typewritten the titles of all books, bulletins, pamphlets, etc., as they come in, the date of receipt, filing number, and in the case of books, the name of the purchaser. When the sheets have been filled they are taken down and a new listing started. The completed lists are turned over to the senior partners for their information and are afterward returned to the librarian, who destroys one copy and files the other in a binder, to serve in cumulative form as the library acquisition list.

Maryland Health-Engineering Bulletins

ENGINEERING BULLETIN NO. 1, MARYLAND STATE DEPARTMENT OF HEALTH. Robert B. Morse, Chief Engineer, Baltimore, Md. Paper, 6 x 9 in.; pp. 127; illustrated.

The engineering staff of the Maryland State Department of Health has been doing notable research work. Some of its studies of more than local interest have been reported from time to time in various technical journals, including *Engineering News-Record*. Ten of these, most of them dealing with statistical and other studies of the quality of water, or with storage, coagulation and filtration, are reprinted in this bulletin. Mr. Morse states that if the reception of this number is favorable others will follow. The value of the material and the convenience of having it thus assembled from scattered original sources warrants the enterprise. Commendation is also due to the practice of making individual papers immediately available by publication in some technical journal instead of holding then until enough to make a bulletin are available. It should be noted that some of the studies were made jointly with specialists not connected with the Maryland Department of Health, thus adding to the breadth of the investigation.

Ketchum's Mill Buildings Rewritten

Reviewed by R. Fleming
American Bridge Co., New York City

THE DESIGN OF STEEL MILL BUILDINGS: The calculation of Stress in Framed Structures.—By Milo S. Ketchum, C.E., Consulting Engineer; Mem. Am. Soc. C. E. Fourth Edition, Rewritten. McGraw-Hill Book Co., Inc. Flexible, 6 x 9 in., pp. 852, illustrated. $6, net postpaid.

The first edition of Ketchum's "Steel Mill Buildings" was the pioneer work of its kind and at once met with a favorable reception. Subsequent editions were enlarged. (See reviews: *Engineering News*, Oct, 15, 1903; Dec. 13, 1906; March 13, 1913.) Several entire chapters have now been added, the others rewritten, with new matter inserted. About half the cuts are new and many of the others redrawn. The present edition has more than twice the content of the first edition. It is practically a new book.

The book is written, the author states, to serve as a textbook in structural engineering and also as a book of reference for engineers. Part I, Stresses in Framed Structures, and Part II, Deflections of Structures and Stresses in Statically Indeterminate Structures, were probably written primarily with the classroom in mind. The author has admirably presented a comprehensive course of study in a clear and concise manner. A chapter on Influence Diagrams and a section on Oblique Loading of Beams are observed in Part I. The 80-page chapter of Problems is worthy of special mention. The method of presenting a solved problem followed by a similar one unsolved is highly commendable. Any student able to apply the methods of solution given for the 40 problems has a pretty thorough knowledge of stresses in statically determinate structures.

Area Moments have a prominent place in Part II. The deflection of framed structures is taken up at length and the slope deflection method of obtaining stresses in stiff frames rather briefly. A chapter is devoted to Problems in Higher Structures. The reviewer notes that for the approximate determination of wind stresses in the frame of a six-story building the author follows a decidedly better method than the one he gives in his "Structural Engineers' Handbook."

The 18 chapters of Part III, Design of Steel Mill Buildings, cover a wide range, giving not only data for designing buildings and proportioning members but also illustrations of specific examples. The chapters on Roof Coverings, Floors, Doors, Windows and kindred sub-

jects bring condensed information from many sources that will prove valuable to the engineer. Several "Examples of Industrial Buildings" are given in a chapter with that heading. Just here it may be stated that in common with most textbooks, designs and details shown do not always represent the latest practice. (This is not altogether the fault of authors. Fabricating firms are reluctant to give out for publication examples of their latest thought.) For instance, on p. 422 is shown a cross section and part longitudinal section of the Steam Engineering Building at the Brooklyn Navy Yard. The building was erected in 1900. (See *Engineering News*, April 25, 1901, for description.) It was extended in 1917, and while the outlines of the old building were followed changes were made embodying what had proven to be better practice. An illustration of the extension would have been more appropriate than the one showing the old portion.

Some of the details shown in Part III have been abandoned. The angle purlin (p. 406 and elsewhere) is turned the weak way of the angle. From the standpoint of fabrication undue stress is laid upon bringing purlins at panel points. It is often preferable to proportion the top chord for bending rather than to increase the number of truss members in order to bring purlins at panel points.

General Specifications for Steel Frame Buildings are given as an appendix. The 211 paragraphs can be read with profit by any one at all interested in steel frame buildings. A question that arises, especially to the engineer engaged in competitive design, is: Are not the specifications in some paragraphs needlessly severe? The reviewer believes that they are. Rollers or rockers under roof trusses on masonry walls need not be used until a span of 90 ft. instead of 70 ft. is reached. The wind pressures of 20 lb. and 30 lb. can be reduced to 15 lb. and 20 lb. The value of field bolts in shear can be increased from 6,667 lb. to 9,000 lb. and their use in field connections can be extended beyond attaching purlins and girts. Connections need not always be of sufficient strength to develop the full strength of the member. If ⅞-in. rivets are used in a roof truss and ⅜-in. be the minimum thickness of metal allowed, the minimum angle will be 2½ x 2 x ⅜-in. There is little advantage in connecting the angle for its full tensile strength when it is subject to but 5,000 or 6,000 lb. in tension. A minimum depth of rolled beams in floors of $\frac{1}{24}$ instead of $\frac{1}{20}$ the span is sufficient. But the depth of beams and channels used as roof purlins should not exceed $\frac{1}{15}$ instead of $\frac{1}{10}$ the span. A side lap of 1½ instead of 2 corrugations is enough for corrugated steel roofing. Flashing can be of same gauge as the covering instead of always No. 20.

Anchor bolts should be shipped in advance by the steel-contractor and set by the mason. When existing structures are to be removed it is usually preferable to all concerned that the work be done by the owner instead of the contractor. The purchaser is seldom willing to pay for two coats of paint after erection.

A paragraph should be added specifying live loads to be carried by floors of factories, machine shops, power houses and other industrial buildings. It would also be well to have a paragraph regarding assumptions to be made for shafting carried by the bottom chords of roof trusses. Several paragraphs could be omitted as belonging more properly to the classroom.

The personal equation always enters into the selection of matter presented in a technical book. It also enters into the comments of the reviewer. A chapter, Theory and Practice, could well be added to a book of this kind. Prof. Ketchum understands both and knows that there is no conflict between sound theory and good practice. But the engineer fresh from college halls is confronted with the assertion that theory and practice are separate and distinct entities. As proof of this, structures are pointed out to him that have been built by "practical" men and that do not seem to accord with what he has been taught. A few pages from the professor on this subject would be welcomed. Some of the many minor points which the engineer is constantly meeting and on which he derives little help from textbooks could also be taken up in a chapter of this kind.

In conclusion: Professor Ketchum deserves the thanks of the engineering fraternity for bringing together such a wealth of material. No engineer who has anything to do with steel buildings is fully equipped for his work without "The Design of Steel Mill Buildings." It is an essential addition to his library.

Metcalf and Eddy's Sewerage Condensed

SEWERAGE AND SEWAGE DISPOSAL: A Textbook by Leonard Metcalf and Harrison P. Eddy. First Edition. McGraw-Hill Book Co., New York and London. Cloth; 6 x 9 in.; pp. 598; illustrated. $5.00.

In response to repeated urging, the authors of the monumental three-volume treatise on "American Sewerage Practice," published in 1914-15, have produced a "textbook" which promises to be equally successful within its intended field. The authors state that the present single volume contains "little" not given "in much greater detail" in the three volumes. This is too modest, for the "textbook" gives later information and conclusions than does the treatise. The present volume, like the earlier three, has had the benefit of the large experience of John M. Goodell, formerly editor of the *Engineering Record*, who did the larger part of the condensation.

The authors appear to have entered upon the preparation of this "textbook" with reluctance and to view the result with some question because they "are engineers, not teachers" and thus the book "reflects the engineer's rather than the teacher's viewpoint." Elsewhere in their Preface they say that they "finally decided to prepare a book giving the information which they consider it desirable for the young student to acquire before taking up work in the field," and that they felt "under obligations as professional engineering specialits to do their part in smoothing the way for the first steps taken by engineering students in this branch of engineering." These statements are sufficient justification for the production of a textbook on this subject by practicing engineers, especially when they have a successful treatise of their own to base it upon. Although the teachers of engineering have had the textbook field almost wholly to themselves heretofore we think most of them will not object to giving practicing engineers a chance to show what they think, as quoted more exactly above, the student should know when he turns from the classroom to the field.

In view of the well known antecedents of this volume, it is unnecessary to outline its contents further than to say that it covers the various phases of sewerage design, including sewage disposal (which is given about half the space) and contains much on construction.

Cost data are omitted because of the disturbing effect of the war and for other reasons, but there is a chapter on Cost Estimating. A few pages on the theory and practice of sewer assessments seem to be needed. It would also be illuminating if dates were used more frequently in connection with citations of data and practice. The value of dates is indicated in at least two cases where they are given: in the remarks on the Paris and Berlin sewage farms, where the year 1910 suggests that material changes in practice that have probably occurred since then should be noted.

Finally, whether regarded as a "textbook" or condensed treatise, this volume deserves hearty commendation.

Freitag on Fire Prevention Revised

Reviewed by Clinton T. Bissell

Structural Engineer, National Board of Fire Underwriters, New York City

FIRE PREVENTION AND FIRE PROTECTION, as applied to building construction—Second Edition, Revised. By John Kendall Freitag, B.S., C.E. John Wiley & Sons, N. Y. Flexible; 4½ x 7 pp. 1038; illustrated.

The second and revised edition of this handbook covers the broad field of fire insurance, fire hazards, design, construction and protection, although treating more specifically of building construction. There are six parts: Fire Prevention and Fire Protection; Fire Tests and Materials; Fire Resisting Design; Fire Resisting Construction; Special Structures and Features; and Auxiliary Equipment and Safeguards.

[The first edition was revised at length by Prof. Frank B. Sanborn in *Engineering News*, Dec. 12, 1912, p. 1117, and briefly in the *Engineering Record*, Sept. 26, 1912, p. 336—EDITOR.]

The important changes in this revision have been in the provisions dealing with theaters and garages. In numerous other parts also, there are new data on design and standards for construction in accordance with methods of the last decade, superseding similar matter which appeared in the first edition. For a volume dealing with so many topics, the material changes from the original edition are comparatively few. It is to be regretted that the chapter on fire losses has not been brought up to date. The student of fire prevention and fire protection naturally is more interested in present-day conditions than in what the conditions were from ten to twenty years ago. The argument of the author that revisions for the purpose of up-to-date comparisons with governmental expenditures would be less striking than as the figures stand, is out of harmony with the concurrent statement in the preface that the annual fire loss in the United States for the five-year period 1915 to 1919 inclusive was about 40 per cent greater than during the period from 1900 to 1909 inclusive.

The book is based largely on quotations and extracts from various publications. The action of structural materials and the results of faulty construction design in the conflagrations of Baltimore and San Francisco are liberally extracted from reports on these conflagrations by competent authorities. Similar information regarding fires in numerous individual buildings, principally in New York but also in Pittsburgh and elsewhere, is given. This material adds considerably to the size of the volume, but is not of much importance.

To be of full value the Fire Protection Library, or list of books that for a good course of reading in fire insurance, might well have had the list as made in 1906 considerably increased. The writings of various authors on the general subject of fire prevention and fire protection since that date have been numerous and there was opportunity here to present a fairly full bibliography, which would include the several valuable recent works on the subject.

One of the excellent chapters in the book is on the theory and practice of fire insurance. Here are given a brief history of the origin of fire insurance in America, the duties of the insurance agent, the method of rating, the tax that insurance brings to the whole country, and the method of reducing insurance as practiced by the stock companies, with brief reference to mutual company methods.

Under the reference to the fire resisting qualities of concrete and to the fire tests made by German and British authorities, the United States Geological Survey and others, it is unfortunate that this edition was completed too early to include the results of the co-operative fire tests of building columns made by the National Board of Fire Underwriters, the Associated Factory Mutual Fire Insurance Companies, and the United States Bureau of Standards at the Underwriters' Laboratories, as reported last year. This experimental investigation of the resistance of columns and of their fire resistive coverings, including concrete, is an especially interesting and valuable addition to the previous knowledge of the action of fire and water upon protected and unprotected columns. It is also regrettable that the results of the exhaustive tests on the fire resistance of concrete and reinforced-concrete floor slabs, as reported by the British Fire Prevention Committee in 1921, could not have been included, as they constitute an important addition to our knowledge of this subject.

The matter in the handbook, as revised or entirely new, on theater curtains, chimney construction, practical suggestions for reducing fire loss in factories, and on garages is timely and valuable.

The general style of the book is that of exposition and description. It will be found especially interesting to a reader who is familiar with the elements of fire protection engineering, and wishes to pursue by casual reading the story of fire, fire prevention and fire protection. It should be valuable also as a book of reference and as a guide in developing sound building construction and protection through proper equipment and in management.

A Great Architect and City Planner

DANIEL H. BURNHAM, ARCHITECT, PLANNER OF CITIES—By Charles Moore. In two volumes. Boston and New York. Houghton Mifflin Co. Cloth; illustrated. 8 x 11 in. Vol. 1, pp 260; Vol. 2, pp. 238. $20.

To engineers the subject of these handsome and interesting volumes is best known as a pioneer in tall office building construction, director of works, one of the creators of the Columbian Exposition, architect of several large railway stations; chief of which is the Union Station at Washington, and as a city planner. In the latter capacity, Burnham played a large part as a member of the committee that replanned the City of Washington in the early years of this century, but it was his experience, his associations and his inspirations gained in connection with the World's Fair that gave him his start in the city planning field, and that did much to spur him on in his later work on that magnificent conception, the Chicago Plan. Other city planning accomplishments outlined in these volumes

had as their scene West Point, Cleveland (as a member of a board), Manila and Baguio, and San Francisco. Much of his city planning work was done without fees, for the good of the cause and the country; and the same was true of other successful efforts here described. Nothing could better show the spirit of the man and his work than what the author of this biography calls Burnham's "own oft-repeated injunction, formulated in 1907, which has become the motto of city planners since that day." The words run:

Make no little plans; they have no magic to stir men's blood and probably themselves will never be realized. Make big plans; aim high in hope and work, remembering that a noble, logical diagram once recorded will never die, but long after we are gone will be a living thing, asserting itself with ever-growing insistency. Remember that our sons and grandsons are going to do things that would stagger us. Let your watchword be order and your beacon beauty.

The biography shows a life and deeds corresponding with such inspiring words. Most fortunately, too, the biography is written by one well fitted for the task, a man for years intimately associated with Burnham, and who prepared the Washington Plan report, edited the Plan of Chicago and, with Burnham, was a member of the National Commission of Fine Arts. Among the many fine illustrations in the two volumes are reproductions in color of some of the notable Washington and Chicago plan drawings by Jules Guerin, and reproductions of black and white drawings by F. Janin. Throughout the book there are many allusions and intimate word sketches and letters, as well as portraits, of the leading architects, sculptors, artists and art critics of Burnham's day, thus increasing the value of the biography as a contribution to the art history of the period, and particularly to the history of some of the larger aspects of the growth of city planning in the United States.

International Health Journal Suspended

With the November-December number, publication of the *International Journal of Public Health* was suspended. The *Journal* has been published in several languages at Geneva, Switzerland, by the League of Red Cross Societies. The League will continue to issue its *Bulletin*, with increased space for scientific information.

Standard Chimney Specification Improved

A thoroughgoing revision of the standard chimney specification (written in such form as to be available for adoption as a municipal building ordinance) has just been issued by the National Board of Fire Underwriters (76 William St., New York City). It was prepared largely by Prof. Ira H. Woolson, acting for a committee of the board. It is more precise in its specifications, and therefore safer, on a number of details of construction, while at the same time it makes all reasonable allowances for the use of different kinds of material. In general, clay flue lining is required in all chimneys except those for ordinary low temperature heating of dwellings. As against the prior edition of the specification one-brick partition walls are now pretty generally required between the A the chimney is one of the key items in fire danger, being fourth on the list of fire causes in the country, the importance and value of this specification will be apparent. Every engineer concerned with building construction or maintenance will find it a necessary piece of file information.

Publications Received

AN ANALYSIS OF PUBLIC ACCIDENTS: 1921. National Safety Council, 168 N. Michigan Ave., Chicago, Ill.

BITUMINOUS PAVEMENT INVESTIGATION IN CERTAIN TEXAS CITIES—Part II. Asphaltic Concrete (Topeka and Modified Topeka) Uvalde Rock Asphalt, and Oklahoma Rock Asphalt. By Roy M. Green, Manager, Western Laboratories (Inc.), Lincoln, Neb.; Formerly Professor of Highway Engineering, A. and M. College of Texas. Paper; 6 x 9 in.; pp. 120; one half tone. Copies sent free on application to J. C. Nagle, Director Texas Engineering Experiment Station, College Station, Tex.

Although dealing primarily with Texas conditions this bulletin contains material of general interest. It is a continuation of Mr. Green's earlier bulletin on Bitulithic.

THE CARNEGIE FOUNDATION FOR THE ADVANCEMENT OF TEACHING. Report for 1921. New York City. Paper, 7¼ x 10 in.; pp. 205.

COMMISSION ON STATE ADMINISTRATION AND EXPENDITURES. Report to the Massachusetts Legislature, January 1922. By Robert T. Brady, Secretary, State House, Boston, Mass. Paper; 6 x 9 in.; pp. 102. Illustrated.

This Commission, consisting of three members of the Senate, five members of the House and five citizens, had as its chairman Edwin S. Webster, of Stone & Webster, Boston. It was provided with a fund of only $8,000. Mr. Webster, without expense to the State, placed at the service of the commission "a corps of engineers and specialists from his staff," the other members of the Commission state. The Commission submits recommendations for the consolidation of departments, abandoning of some activities and assessing the cost of others on the beneficiaries, for increased efficiency and other measures which it says would reduce by $10,000,000 a year the general tax levy of the State.

CONSTRUCTION, COST KEEPING AND MANAGEMENT. A Treatise for Engineers, Contractors and Superintendents Engaged in the Management of Engineering Construction—By Hubert Powers Gillette, M. Am. Soc. C. E., Editor *Engineering and Contracting*, and Richard T. Dana, M. Am. Soc. C. E., Consulting Engineer, Chief Engineer, Construction Service Co. New York and London: McGraw Hill Book Company, Inc. Cloth 6 x 9 in.; pp. 572; illustrated. $3.50.

DEPARTMENT OF PUBLIC HIGHWAYS: Annual Report, 1919. Toronto, Ontario, Canada. Printed by Order of the Legislative Assembly of Ontario.

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LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Against Engineer Licensing Laws

Sir—In regard to the very decided drift in all states towards a license law for engineers, which the American Association of Engineers seems to be leading and pushing, I often wonder where the idea of licensing engineers originated and why all the propaganda in favor of it. In my observation of the operation of the law in various states in the South, infinitely more harm than good has been done. In some states a man must have resided for a period of time before being eligible. In others a man must pass an examination, which is entirely unfair in that it does not give proper credit to his experience. I know an instance where a man going into another state to accept a $7,000 position could not pass the examination.

Such laws are absurd and where does the engineer come in on it? You hear members of the American Association of Engineers say that it protects the public. As far as I know the public did not originate the demand for a license law for engineers, so why worry about it, especially as it is not clear where the public is being benefited?

Too much depends on the personnel of the board selected to administer such a law. A great many engineers are in highway work and I think the officials of the state highway departments are fully capable of selecting subordinates who are competent and who will safeguard the public without the need of a board to pass on a man's qualifications. It is my opinion that many engineers are drifting into the idea that licensing is a good thing without stopping to ask if there is another side to the question. I am not writing this for the sake of starting an argument, but am merely giving my sincere belief.

L. G. SMITH,
Bridge Engineer,
State Highway Department of Alabama.

Montgomery, Ala.
Feb. 2.

Arch Problems in the Palm Beach Failure

Sir—R. F. Ensey's report on the bridge failure at Palm Beach, Fla., in the issue of Jan. 26, p. 148, contains some valuable lessons for engineers. There seems to be a tendency among engineers to take greater and greater chances in the design and construction of concrete structures; and too often this tendency grows until an expensive disaster takes us back to safer and more conservative policies.

As to design: These arches of 63 ft. clear span have a thickness of 12 in. at the crown and 24 in. at the skewbacks. Also, the reinforcement is comparatively light. The theory of hingeless arches is based on the assumption that the modulus of elasticity of the material used is constant. Yet it is a well-known fact that the modulus of elasticity is different for different grades of concrete, and that for a given grade of concrete it is different for different unit stresses. When these facts are taken into consideration how is the designer to know the exact location of the resultant line of pressure? With a crown thickness of only 12 in. it is quite possible for this resultant to fall outside the limits of the arch. By choosing the ring type of arch instead of the barrel type the thickness could have been doubled or trebled without increasing the amount of materials required. It should also be remembered that arch theory involves the moment of inertia of the arch section, and here again the deeper section would have a great advantage over the barrel type. Had the spandrel walls been continuous over the entire span and securely tied to the barrel of the arch they would have greatly stiffened the barrel, but Mr. Ensey's report indicates that they were designed and constructed in such a way as to give little or no support to the arches.

It appears from one of the photographs that the centering was poorly designed. No provision whatever was made for taking care of lateral forces, and it is almost impossible to cast an arch without setting up lateral forces which act upon the centering. This defect is of special importance because of the manner in which the arch spandrels were filled.

I cannot agree with Mr. Ensey concerning the effect of filling the arch spandrels successively. If one side of an arch is completely filled while the other side remains empty the arch will certainly be deformed by this eccentric loading, and no amount of filling on the second half will overcome this deformation. If the material used for the fill were a liquid the deformation would be overcome when the loads on the two sides of the arch became equal. But with sand or any other material used for fills the greater part of the deformation would be permanent.

In the construction of any concrete structure subjected to high unit stresses the best of materials and the best of workmanship should be required. Mr. Ensey's report indicates that some of the concrete in the Palm Beach arches is of a very poor quality. It would be interesting to know just what tests were used to determine the fitness of the cement, sand and stone used in the construction of these arches. The report states that some of the concrete could be broken with the hands. It also states that the newest concrete was 26 days old. At that age concrete for arch construction should show high strength.

The report does not give much information concerning the foundations. It mentions that they were placed by means of a tremie. Anyone who has had much experience with a tremie knows how difficult it is to do good work by this method. There are times when the tremie offers the only practical method of placing foundations and this may have been the case at Palm Beach. It would be worth while to make a thorough examination of the foundations, but, from the evidence presented by Mr. Ensey, it seems to me that one need not go below the spring line of the arches to find the causes of the disaster.

C. C. CARPENTER.

Ada, Ohio, Jan. 31.

Sir—In the article on the Palm Beach failure, giving the report of Mr. Ensey and that of Mr. Howard, the cause of the failure is treated somewhat as a mystery, chiefly because of the disappearance of pier 9. From the meager details of the design it appears that the piers were founded on rock so soft that it was rock in name only. The softness of the rock, however, will scarcely account for the manner and extent of the failure. It appears to me from the descriptions given that the failure was caused by the thinness of the stratum of this soft rock, which in addition probably surmounted a comparatively soft material. If this soft rock had, underlying it, a hard rock the result would simply be some settlement and possible cracking of the arches. If my assumption of the rock condition is correct and the stratum was particularly thin under pier No. 9, this pier would puncture the stratum and in sinking through the layer of "rock" it would cause the failure of the adjacent spans, which would pull piers 8 and 10 in the direction of pier 9. During the first collapse the bond resistance of the dowels was not sufficient to pull pier 8 along with span 8-9, so that the dowels pulled out and left pier 8 standing with span 8-7.

This condition placed pier 8 into the position of an abutment pier with the unbalanced thrust of the arch exerting its pressure against it, which thrust being applied at a horizontal joint (the report states concreting was not continuous), in pier 8 below the water line, the pier failed at this joint because the adhesion of the section above to that below was not sufficient to resist the thrust. The failure of this pier caused arch span 8-7 to fail, pulling in the direction of pier 9, tending to overturn pier 7 in that direction; the bond of the dowels, however, being

overcome before overturning occurred, pier 7 remained tilted while the dowels pulled out.

While Mr. Howard's explanation, placing responsibility on method of filling, would account for excessive pressure, a factor of safety of four should have covered this unforeseen condition. Moreover, it would not account for the manner or extent of the failure.

Incidentally, I wish to differ with Mr. Ensey's criticism of the lightness of the arch ring. With a proper curvature of intrados and extrados an arch ring 12 in. thick at the crown and 24 in. at the haunches, properly reinforced, is perfectly good design for highway loading with span shown, and an analysis will show a factor of safety of four in the stresses developed. The fact that the dowels pulled out in all cases rather than fractured, indicates that there was not sufficient embedment to develop the bond, otherwise at least as many bars would have broken as were pulled out.

M. HIRSCHTHAL,
Concrete Engineer, Delaware, Lackawanna & Western R.R.

Hoboken, N. J., Jan. 31.

Sir—The editorial: "Arches and the Palm Beach Accident" in *Engineering News-Record* of Jan. 26 brings to mind the classical accident at Pont-y-pridd, South Wales, of more than a hundred years ago.

So far as I remember the story, the village bricklayer, named Edwards, was engaged to construct a bridge over the river Taff, and he designed and built it in one span with a high, thin arched center having heavy spandrels. This bridge collapsed by reason of the light center being pushed upwards due to the weight of the heavy spandrels. Edwards, nothing daunted, rebuilt the bridge to the same general design but made great circular openings through the spandrels, reducing their weight, which made it stable and the bridge stands today.

WILLIAM GORE,
of Gore, Nasmith & Storrie, Consulting Engineers.

Toronto, Feb. 1.

Sir—The American public in general and the engineering profession in particular are indebted to *Engineering News-Record* and its publishers, for the prompt and full details covering the failure of the Palm Beach concrete arch bridge, together with the valuable editorial bearing upon the subject, which strongly suggests the basic cause of this collapse.

It is noted with pleasure that the engineers of this structure plan to make a complete statement when investigations are finished.

The first-hand report of your special investigating engineer, R. F. Ensey, published simultaneously with part of the report of the engineers themselves, discloses sufficient information, in my opinion, to establish the cause of the failure of this structure. Whether the bridge would have stood up, or been self-supporting, if its erection had been carried out properly is an interesting question.

The collapse of this structure is due, according to the findings of your expert, to poor engineering, involving both faulty design and failure to enforce the specifications. It is unnecessary to give time and space to a discussion of the second cause of failure, since the engineers in their report repeat this in their statement, "This filling was placed in a manner which produced unsymmetrical loading of the arches, contrary to the stipulations of the specifications." The inference is, that if the violation of a *major* stipulation of the specifications—one so vital to the integrity and safety of the entire structure—was permitted and tolerated, then other stipulations of a comparative minor character must have shared a similar fate.

The lack of reinforcement in the piers indicates that no consideration was given to the fact that the piers, in a system of arches, are not *merely supports* of the structure, but *are integral parts of the elastic system*, and are component parts of such system, together with all its arches. A practice too common in the design of a system of arches is the consideration of only one of the arches constituting the structure and applying to it the usual theory of the elastic arch, as if it were a single-arch design. This is the usual practice, unfortunately, when all the arches of a series are identical or differ slightly. When a system of arches is made up of arches differing considerably in size, an arch of each size-group is selected and the usual elastic theory of design applied to this one representative of the group.

In the case in point, it appears that no attention whatever has been paid to the fact that a system of arches should be designed as a whole and not as a single arch, and that the elasticity of the piers, as well as that of the soil upon which the piers rest, all enter intimately and decidedly into the design of arches in series. Such considerations are of the highest importance and no design of this character can be passed upon as safe or reliable, where such methods have not been applied correctly.

It is high time that the engineering profession realized that the correct design of a system of arches is not an everyday task; it is a very serious matter, and should not be treated lightly. It means human life. It means "an indictment of the whole profession"; and should be done only by "its trusted builders," as you state in your editorial.

It is well known that the theory of virtual work applied in the design of a single arch holds only so long as the supports for the arch are unyielding or practically so; but this is not the case with an arch supported by piers, when one of a series. This theory, therefore, in spite of its simplifications, short-cuts, etc. should not be applied to structures of several arches.

Some years ago (1912) the above facts were explicitly set forth, and the proper theoretical analysis covering multiple arch designing was presented for the first time in this country by A. C. Janni in a paper presented Jan. 13, 1913, before the Western Society of Engineers. This method, now well known as the method of the ellipse of elasticity, and widely used, was again published in still more detail in Prof. George A. Hool's "Reinforced-Concrete Construction," Vol. III, Chap. VIII.

Another important factor in design, which is prompted by the many pictures and actual examples of multiple arch bridges in reinforced concrete, is that these structures almost generally have piers of uniform dimensions or thereabouts Convenience, aesthetic design, and above all safety itself, demand that in a bridge composed of a series of arches, its piers should not be all of the same dimensions, but should vary in size, weight and resisting power. Piers of two sizes should enter into every design of a multiple series:

The regular or standard pier, and the abutment pier.

Regular piers are those which are of such dimensions as to enable them to stand the ordinary combined reactions of two adjacent arches. Abutment piers are those of larger dimensions, which enable them to withstand, if need be, extraordinary reaction of one arch in emergencies, regardless of the presence or absence of the adjacent arch on the opposite side of this pier. These abutment piers should enter the series in the order, say, of 3,6,9, or vary to meet the conditions imposed by symmetry, character of the stream bed, foundations, etc. The analogy between these abutment piers in a series of arches and a fire wall in a large building or series of buildings is obvious.

The importance and utility of the abutment piers are obviously to forestall a complete disaster, from approach to approach, in case one or more arches, for some reason or other, collapsed, thus confining the damage between two abutment piers. An admirable example of their use is found in the beautiful Kingshighway Viaduct in St. Louis, Missouri.

As stated before, aesthetic consideration also demands designs of this character, for a succession of arches of like dimensions is always unpleasing and monotonous. The introduction of an irregular size of pier, at intervals, immediately breaks the monotonous continuity and affords beauty with the impression of strength.

PHILIP ASELTA,
Valuation Department, New York Central R.R.

New York, Feb. 8.

NEWS OF THE WEEK

New York, February 16, 1922

Federal Officials Define Trade Association Activities

Indicate Functions Which Do Not Violate Law—Conditions for Collecting Statistics

Concluding discussions which have been in progress for some months the Department of Commerce has made public letters recently interchanged between Herbert Hoover and the Attorney-General, Harry M. Daugherty, regarding the legality of various types of activities of trade associations. The most important points cover the collection and dissemination of statistics. Provided these be given to the public at the same time that they are distributed to the members of the association, the Attorney-General holds that their distribution would not be illegal. Nine other types of activities are covered in the questions put to Mr. Daugherty by Mr. Hoover.

The questions asked by Mr. Hoover are as follows: Whether a trade association may

1. Provide a uniform cost accounting system for its members.

2. Advocate and provide for uniformity in the use of trade phrases and trade names for the purpose of ending confusion in trade expressions.

3. Advocate and provide for the standardization of quality and grades of product; standardize technical and scientific terms, processes of production and machinery; co-operate with its members in determining means for the elimination of wasteful processes in production and distribution and for raising ethical standards.

4. Collect and disseminate to its members credit information as to those using the products of the industry.

5. Arrange for the handling of the insurance of its members, including fire, industrial, indemnity, or group insurance.

6. Engage in co-operative advertising for the promotion of trade of the members; engage in such form of promotion by furnishing trade labels, designs, and trade-marks for the use of its individual members.

7. Engage in the promotion of welfare work in the plants or organizations of its members.

8. Handle legislative rate litigation and railroad transportation questions that may affect the particular industry.

9. Undertake the promotion of closer relations between the particular industry and the federal and the state departments of government.

10-A. Collect statistics from each member showing his volume of production, his capacity to produce, the wages paid, the consumption of his product in domestic or foreign trade, and his distribution thereof, specifying the volume of distribution by districts, together with his stock, wholesale or retail.

B. Compile the information in each report into a consolidated statement showing totals.

C. Provided the information received from the members as well as the combined information is not previously given by the association to any other person, file the combined statement with the Secretary of Commerce for distribution by him to the members of the association through the public press or otherwise and to the public generally and to all persons who may be in any way interested in the product of the industry.

11-A. Collect information regarding the prices received for the products sold, specifying the volume of each grade, size, style, or quality, as the case may be, and the price received for the volume so sold in each of the respective districts where the product is sold.

B. Without making known to any person the individual price reports of any member, consolidate all of the reports into one, and show the average price received for the total volume of each grade, brand, size, style, or quality, as the case may be, distributed in each district covered by the distribution statistics for the period covered by each individual report.

C. Send the compiled report as to average price to the Secretary of Commerce, to be by him distributed to the public and to any or all persons who may be interested in the particular industry making the report.

Closing the enumeration Secretary Hoover specifically asked whether trade associations might engage in these activities "without violating the law, provided the organization and the activity engaged in are not for the purpose of hiding or concealing some agreement, contract, etc., to actually restrain trade or otherwise violate the anti-trust laws."

Attorney-General's Reply

In his reply to Mr. Hoover, the Attorney-General made exceptions to only two of the activities. He declared that as to uniform cost accounting systems, associations must not agree on uniform cost of any item of expense, such as a stumpage figure in lumbering operations. As to uniform trademarks it was his view that they would tend toward securing a uniformity of price. Mr. Hoover, in a second letter, informed the Attorney-General that the original question should have been worded to inquire into the legality of associations actually designing dissimilar trademarks.

As to all other activities cited by Mr. Hoover, the Attorney-General held that, as put by Mr. Hoover, they are not illegal. His words are as follows:

"I can now see nothing illegal in the exercise of the other activities mentioned, *provided always* that whatever is done is not used as a scheme or device to curtail production or enhance prices, and does not have the effect of suppressing competition. It is impossible to determine in advance just what the effect of a plan when put into actual operation may be. This is especially true with reference to trade associations, whose members are vitally interested in advancing or, as they term it, stabilizing prices, and who through the medium of the associations are brought into personal contact with each other. Therefore the expression of the view that the things enumerated by you, with the exceptions [as to cost figures and trademarks] stated, may be done lawfully is only tentative; and if in the actual practice of any of them it shall develop that competition is suppressed or prices are materially enhanced, this Department must treat such a practice as it treats any other one which is violative of the Anti-Trust Act."

Large Highway Program for Alabama in 1922

The State Highway Commission of Alabama, following the passage by a large majority on Jan. 30 of the $25,000,000 highway bond issue has authorized W. S. Keller, state highway engineer, to advertise for bids for construction of all projects which are ready to be built. This will mean the immediate advertising for bids on 17 projects with a total length of 202.53 miles, and a total estimated cost of $2,950,052.

The report of the state highway engineer shows further that there are 12 additional projects with a total length of 129.6 miles and a total estimated cost of $2,095,415 which have already been approved by the U. S. Bureau of Public Roads, and these projects will be ready to advertise for bids as soon as plans have been completed.

A number of large projects now in the proposal stage will also be pushed forward and contracted for during the coming year.

Coroner's Jury Holds Nine Men for Knickerbocker Collapse

Blaming the collapse of the Knickerbocker Theater roof in Washington, D. C., on Jan. 28 upon faulty designing and construction and inadequate supervision and inspection, a coroner's jury, after taking testimony for a week, reported on Feb. 14 that nine men connected with the construction work be held for action by the Federal grand jury. The nine ordered held are:

R. W. Geare, the architect of the theater; John H. Ford, the engineer who prepared the design of the steel framework as built; Morris Hacker, building inspector of the District of Columbia at the time the theater was built; Donald Wallace, general foreman for the contractor; Frank L. Wagner, the general contractor for construction of the theater; Richard G. Fletcher, foreman for the Hammett Fireproofing Co., subcontractors for the cement and mason work; John L. McDonald, subcontractor for erection of the steel; Thomas L. Costigan, formerly engineer and computer in the building inspector's office, who approved the plans for the theater; and Julian R. Downman, formerly assistant building inspector.

Indianapolis Planning Commission Begins Active Work

Active work on a city plan for Indianapolis begins this month with the employment of Robert H. Whitten, of Cleveland, Ohio, as consulting engineer to the City Planning Commission. Mr. Whitten is to devote at least ten days a month to the Indianapolis plan and is to be paid $400 a month.

Akron Chooses City Manager

Effective Feb. 1, the City Council of Akron, Ohio, has appointed Homer C. Campbell as chief administrator or city manager, at $7,500 a year, to fill the vacancy caused by the Council in discharging W. J. Laub, who was paid $10,000. Akron is the largest city in the United States having a city manager, but Cleveland will have one early in 1924. Mr. Campbell is a native of Akron, a college and law school graduate. Recently he has been manager and secretary of the Akron Home Owner's Association and vice-president and general manager of the Coventry Land & Improvement Co.

Denver Water-Works Problems Under Survey by Engineers

A review of the present and future water supply problems of the Denver Water-Works is to be undertaken by a board of three consulting engineers. Two have been selected, Dabney H. Maury, Chicago, and Herbert S. Crocker, Denver, but the third engineer, an authority on irrigation, is still to be named. The appointment of the board follows a recommendation made by the Civic and Commercial Association shortly after the defeat of a bond issue for improvements. A statement of the water needs of the city by a disinterested engineering board is sought to create confidence in the citizens as to the needs of the plant.

Reject Plan for New Official To Study Railroad Needs

At its mid-year meeting held last week the National Council of the Chamber of Commerce of the United States refused to submit to a referendum vote of the membership a recommendation by its railroad committee that there be created a new government official who should be appointed by the President and bear the title of Commissioner General of Transportation. This official was to be charged with the duty of studying transportation problems and needs from the viewpoint of the general public and of representing the public at hearings before the various governmental bodies that deal with transportation matters.

The proposal was supported by George A. Post, president of the Hudson River Bridge and Terminal Co., and chairman of the railroad committee, and by Alexander W. Smith of Atlanta, another member of the committee. The opposition was led by Alba B. Johnson of Philadelphia, president of the Railway Business Association. Disapproval was voiced also by Herbert Hoover, Secretary of Commerce and Howard Elliott, president of the Northern Pacific R.R., both of whom believed that existing laws and agencies looking to the same end have not yet had time to demonstrate their utility.

New Type of Bascule Bridge At Detroit

At the crossing of the Wabash RR. over River Rouge, Detroit, a bascule bridge of radically new type has just been built to replace an old swing bridge. The photograph reproduced herewith, taken last week, shows the new structure completed.

The new bridge was made necessary by improvement of the channel to a width of 300 ft. with depth of 20 ft., which required a width through the draw of 125 ft. The old structure was a single-span swing bridge about 180 ft. long with a pivot pier in the center of the stream. The new structure is a single-lead double-track bascule bridge designed for Cooper's E50 loading, with 162-ft. lift span. The total length is 291 ft. including A-frame and deck plate-girder approach. In addition to carrying Wabash trains this bridge is used by the Baltimore & Ohio, Detroit & Toledo Shore Line, Pere Marquette, and Pennsylvania R.R. A three day count showed 113 trains in 24 hours or a train every 13 minutes.



WABASH RAILROAD'S NEW TYPE OF BASCULE BRIDGE

The foundations for the A-frame at the trunnion end of the bascule were placed west of the original west abutment, the rest pier between the pivot pier and east abutment. Foundations were carried to rock 88 ft. below the base of rail by pneumatic caissons. Hydrogen sulphide gas was encountered a short distance above the rock, at about 30 lb. air pressure in the caissons; this gas gave no difficulty when the pressure was raised to 40 lb.

The steel structure was erected with the leaf lifted, leaving out certain floor beams and stringers giving a portal for the passage of trains. Just before the leaf was lowered the old draw span was rolled upstream on temporary bents. When the leaf was lowered the omitted members were then erected and the approach girder span set in place, all of which was done in 7½ hr. Steel erection was started July 1, 1921, and leaf closed Jan. 26, 1922.

The lift is operated by the strut supporting the counterweight traveling down an inclined track. The operating controls are completely interlocked. Safety locks to hold the strut fixed to its track are provided. The motive power is supplied by two 100-hp. 440-v. A. C. motors, and in emergency operation by a gasoline engine.

To give the channel its full width it is now necessary to remove the old pivot pier and west abutment.

Congress to Consider New Federal Aid for Roads

Hearings to Begin on Woodruff Bill—Highway Officials Oppose Soldier Bonus from Road Revenues

(Washington Correspondence)

Active consideration of legislation authorizing appropriations for federal aid roads has begun in the House of Representatives. The Woodruff bill, which authorizes the appropriation of $100,000,000 annually for a period of five years, is to be the basis of the work which will be done by the committee on roads. Hearings on that bill probably will begin Feb. 17. Since the President has expressed the earnest wish that the annual expenditure be not greater than $75,000,000, and has indicated that he would not be displeased if it were found that $50,000,000 were adequate, it is regarded as probable that the committee will reduce the amount of the annual appropriation carried by the Woodruff bill.

W. C. Markham, legislative representative of the American Association of State Highway Officials, states that his organization is making a careful survey of the amounts which each state can absorb and will not ask for more federal aid than can be taken up within the year. He points out, however, the necessity for planning ahead, especially with the 7 per cent system called for in the Act of Nov. 9, 1920.

The American Association of State Highway Officials, Mr. Markham says, will fight to the last ditch against the proposal to raise soldier bonus money by federal taxes on automobiles and gasoline. Such action, he points out, would usurp the sources of taxation on which the states are relying for their maintenance funds. Fifteen states already have levied a gasoline tax. Three legislatures are in session at this time which will act on bills providing a gasoline tax. Next winter the legislatures will meet in thirty-four states. Mr. Markham predicts that practically every state will resort to this source for funds for road construction and maintenance. Were the Federal Government to add another tax on gasoline and automobiles, the burden would be out of proportion and would cause a very unfavorable reaction. Mr. Markham makes it clear that the highway officials are not fighting the soldier bonus. The organization is convinced, however, that this money should be raised from sources.

McClellan and Junkersfeld Form New Engineering Corporation

Announcement was made last week of the incorporation of McClellan & Junkersfeld by William McClellan, Peter Junkersfeld and Horace T. Campion for engineering and construction work. The new firm, a Delaware corporation, has $1,000,000 authorized preferred stock and 2,500 shares of no-par common stock; all the financing has been arranged for. Offices are temporarily at 141 Broadway, New York City. The new organization will specialize in power plants, transmission systems, water powers, electrification of railroads, and general industrial and utility engineering and construction.

Mr. McClellan is president of the American Institute of Electrical Engineers. His early experience was as engineer in charge of construction with the Philadelphia Rapid Transit Co. For several years he was a managing engineer with Westinghouse, Church, Kerr & Co., participating in the Pennsylvania Terminal engineering and construction and electrifying the Rochester division of the Erie R.R. For several years he was electrical engineer and chief of the division of light, heat and power of the Second District Public Service Commission of New York. He has been associated with the Cleveland Electric Illuminating Co., for about eight years and was for two years one of its vice-presidents. During the war he was director of the Intercollegiate Intelligence Bureau, an organization of more than 200 of the principal colleges of the United States. For a time he was Dean of Wharton School of Finance and Commerce of the University of Pennsylvania.

WORKED ON ARMY PROJECTS

Col. Junkersfeld, from 1895 to 1919, was associated with the Chicago Edison Co. and its successor the Commonwealth Edison Co. During this time he was associated with all the large power work of these companies and when he resigned was assistant vice-president, supervising contracting, engineering, construction and operation work. During this long service he was intimately identified with all the design and construction of many large stations, aggregating 600,000 kw., together with the transmission lines, substations, distribution system and other physical properties. In 1916-1917 he was president of the Association of Edison Companies. In June, 1917, Col. Junkersfeld entered the army and was successively major, lieutenant-colonel, and colonel in the Construction Division, U. S. Army, engaged in constructing cantonments, camps, hospitals, port terminals, warehouses, munition plants and other war construction. Soon after the close of the war he became engineering manager for Stone & Webster, in charge of the engineering department, and an executive of the division of construction and engineering.

Mr. Campion's early business life was spent in engineering and construction work of the Philadelphia Rapid Transit Co., where he was assistant chief engineer in charge of the design and construction of all car barns, power houses, shops, parks and other physical property. In 1903 he entered the general construction field and has to his credit the design and construction of numerous buildings of steel and reinforced concrete of every type, construction of the forebay work of the Ontario Power Co., substations for the Philadelphia Rapid Transit Co., extensive paper mills of the Warren Mfg. Co. at Milford, N. J., shops at Ardmore, Pa., and terminal stations. He is now associated in the engineering for the new stadium of the University of Pennsylvania.

Bill to Oust New Jersey Vehicle Tunnel Commission

A bill ousting the majority of the members of the New Jersey Interstate Bridge and Tunnel Commission, which is in joint charge, with a similar New York commission, of the Hudson River vehicle tunnel project, has made its appearance in the State Legislature at Trenton. During the term of the existing commission the work of tunnel construction, except for ventilating shafts on the New York side, has been repeatedly blocked, due to failure of the two commissions to agree on matters of administrative policy.

Private Garbage Collection for Salt Lake City

Salt Lake City recently entered into a contract with the Plymouth Stock Company by which the city is to pay the company $13,500 per year for the collection of residential garbage, heretofore collected by the city. The garbage is to be delivered at a receiving station to be established at the old union stock yards.

Iowa Society Raises Dues and Seeks More Members

To meet the need for money to carry out its program of expansion, including a half-time secretary, the Iowa Society of Engineers at its recent Sioux City meeting raised the annual dues from $6 to $10 for members; juniors' dues were raised from $4 to $6. The vote was unanimous. As a further source of revenue a sustaining membership costing $25 annually was provided. Already 25 to 30 members have signified their intention of becoming sustaining members.

The increase in dues of the 550 members, however, is not considered sufficient and a campaign is under way to enlist a large increase in numbers. There are 1,135 registered engineers in the state, according to a report of K. C. Kastberg, secretary of the Board of Engineering Examiners, and probably 400 to 500 unregistered engineers in subordinate positions.

The society is strongly in favor of registering engineers and a movement is on foot by the architects to join the engineers in passing a combined bill based on the model law of the Federated American Engineering Societies.

Since the annual meeting conflicted with the dates of several other important societies an amendment was introduced to make the time of meeting flexible.

One of the most important innovations introduced at the meeting was the plan of the local committee in arranging for talks by visiting engineers before the noon luncheon clubs of business men and also an assembly at Morningside College. The result sought was to effect personal contacts between engineers and business and professional men of Sioux City thereby creating a better understanding.

U. S. Chamber of Commerce Opposes Metric System

Adoption of the metric system as the sole standard of weights and measures in the United States was disapproved by the National Council of the Chamber of Commerce of the United States at its recent mid-year meeting. The council refused to follow the recommendation of a special committee that the subject be submitted to a referendum of the Chamber membership.

Recommend Competitive Bidding for Salt Lake Improvements

The General Association of Contractors of Utah presented a suggestion to the city commissioners of Salt Lake City recently, that they adopt a policy of awarding contracts for all public improvements on a competitive bidding basis, instead of doing part of the work in the regular city departments.

Special attention was called in the communication to two conduits now under construction with estimated costs of about $10,000 each. The association announced that it was ready to co-operate with the commission on all improvement work and recommended that contracts for such work be let after competitive bidding.

The contractors believe the cost under the present plan to be excessive.

Slate Producers Organize

Action was taken to form a national organization at a meeting of slate producers held at the Engineers' Club, New York, Feb. 8, under the auspices of the National Federation of Construction Industries. About 50 delegates, representing all the slate-producing sections in eastern states, except Virginia, were present. It was decided by unanimous vote to organize, and a committee of 7 was appointed to suggest a name, prepare a constitution and by-laws, and issue a call for a future meeting to complete organization.

In opening the meeting as chairman, Oliver Bowles, mineral technologist, U. S. Bureau of Mines, spoke of the prevalence of unscientific methods of quarrying slate and the need of substituting machinery for manual labor. Waste, he stated, was enormous—in some quarries over 90 per cent—and no considerable development of by-products has been undertaken. Slate production, and particularly the production of roofing slate, has rapidly decreased and substitute materials have gained precedence, very largely because no concerted effort was being made by the industry to maintain and strengthen the market for slate. G. F. Laughlin, U. S. Geological Survey, in endorsing the movement to organize, deplored the decreasing use of a material naturally so superior as slate for many purposes.

Standardization was urged by Victor D. Abel, Structural Service Bureau, Philadelphia. At present sanitary slate products have to be manufactured to order, thus preventing producers from manufacturing for stock. Studies recently made, he said, showed that most sanitary and chemical slate products could be standardized to a great degree without the slightest disadvantage in use. D. Knickerbacker Boyd, architect and structural standardist, also urged standardization as a means of increasing the market for slate.

Competition for Moving-Platform Project in Paris

The city of Paris, France, has announced a competition for moving-platform projects with the idea of relieving congestion of traffic along the grand boulevards and other thoroughfares. The platforms, according to present plans, are to be located underground. The competition closes Sept. 20, 1922, and contestants are advised to send their plans to "La Direction Générale des Travaux de Paris, 98 Quai de la Rappée, Paris, France." The competition is open to engineers and inventors of all countries and three prizes, amounting respectively to 100,000 francs, 50,000 francs, and 30,000 francs, are announced. The successful projects will remain the property of their promoters who have the right to make such use of them outside of the city of Paris and the Department of the Seine as they may wish.

Competitors are requested to submit a memorandum giving information regarding the mechanical details of their systems, dimensions of parts, kind of traction used, starting devices, etc., maximum grade and minimum radius of curvature allowable, data as to speed, estimate of first cost and cost of operation, longitudinal and cross-sectional plans, and similar information necessary to a complete understanding of the project submitted. A fee of 100 francs is demanded of entrants in the competition.

In case actual construction of a moving-platform project is undertaken on a large scale, the city of Paris reserves rights to the plans by paying the inventor an indemnity of 500,000 francs, unless some other agreement may be reached.

Full details regarding the competition are contained in the Bulletin Municipal Officiel, of Paris, dated Dec. 30, 1921, a copy of which has been made available for the use of *Engineering News-Record* through the courtesy of Robert Ridgway, chief engineer, New York Transit Commission.

Chicago Labor Unions Accept Landis Award

Chicago labor has agreed to go to work. Judge Landis on Feb. 1 fixed Chicago wage rates for a year beginning June 1, substantially the same as those now in effect. Three days later the Building Trades Council, representing the unions, agreed to accept the scales and other conditions with reference to restrictions. The unions also agreed to let the non-union men continue working until the employers are assured of the good faith of the unions. Only the carpenters dissented from the nearly unanimous agreement on the part of the unions to go to work. They insisted on a wage of $1.10 per hour while the Landis scale calls for $1.00 only. About 60 per cent of the carpenters now at work are said to be non-union.

The citizens' committee to enforce the Landis award joined the two contractors' associations in a newspaper advertisement in which the committee states its lack of confidence in the ten insurgent unions and pledges its continuous support to men now working open shop in these particular trades, although union men who desire to go to work will be given positions in the order of their applications. A month ago the conservative element in the Chicago Building Trades Council was overthrown and a new set of officers, pledged to nullify the Landis award, was selected. A general strike was immediately called but proved a failure. This is the basis, as published, for the lack of confidence expressed by the committee.

The temporary injunction sought by the carpenters to restrict the activities of the citizens' committee has been denied, mainly because the carpenters did not come into court with clean hands, the judge referring to assaults on non-union men by members of the union while the case was in the hands of the court.

Seattle Wants Bids on 17 Miles of 66-in. Steel or Wood Pipe

Plans and specifications for 17 miles of 66-in. conduit, comprising Cedar River Pipe Line No. 3, of the waterworks of Seattle, Wash., have been approved and alternative bids for steel and for creosoted wood pipe will be invited within about a month. The conduit will extend from a point near Swan Lake to the Volunteer Park Reservoir, in Seattle, and is estimated to cost $2,000,000. Swan Lake will eventually become an impounding reservoir, and for this purpose a $75,000 dam has been built across the outlet of the lake. When Pipe Line No. 3 is constructed, Lines Nos. 1 and 2, now leading from the Cedar River watershed, will be diverted into the lake and a tunnel will be built from the lower end of the lake to the point where No. 3 line begins. Through this tunnel, water will be brought from the lake and sent into all three pipe lines. The Swan Lake water supply project, when completed, will cost about $6,000,000.

Broad-Gage Railroad to Tap Montana Mining Region

According to a report from the firm of J. P. Ernster & A. W. Barker, engineers of Minneapolis, surveys have practically been completed for the location and construction of a broad-gage railroad from Columbus, on the main line of the Northern Pacific R.R. in Montana, southwesterly into the New World mining district. The country tapped by the railroad is rich in coal, timber, and minerals. The road will be 83 miles in length. Construction is to start early in the spring. Designs are now being prepared for a bridge which is to span the Yellowstone River. All of the engineering work is in the hands of the above-mentioned firm.

Research Graduate Assistantships Open at Illinois

The dean and director of the college of engineering and the engineering experiment station of the University of Illinois has announced that a number of research graduate assistantships are available for graduate students who wish to secure degrees of Master of Science through research work in civil engineering. If the full quota of research graduate assistantships is secured, there will be ten vacancies to fill and in addition one in gas engineering. Applications for appointment to these vacancies should be sent to Dean C. R. Richards, at Urbana-Champaign. They should reach him not later than March 1. Application blanks will be furnished upon request.

Hoover Presents Views on Railroad Needs

Outlines to Commerce Commission Effect of Carriers' Plight on General Business

In a statement before the Interstate Commerce Commission Feb. 3, Secretary of Commerce Hoover declared that the greatest impulse that can be given to business recovery from any source is a reduction of railroad rates on primary commodities, combined with the immediate resumption of railroad construction and equipment. He divided his program for progress in these directions into three periods: (1) The immediate present; (2) the early period of decreasing costs, increasing efficiency and slowly recovering traffics; and (3) the period of normal operations.

Although the present lean earnings of the railroads preclude the possibility of immediate important rate relief, Secretary Hoover believes that there are cases in which lower rates would recover lost traffic and increase earnings. In order to stimulate improvements he advocates the use of government credit through the medium of a guarantee on equipment trusts.

Prospects for 1922

During 1922, designated as the second period, the Secretary assumes that railroad wages and supplies will at least in part fall to the levels of decreased cost of living, that efficiency of operation will increase and that the volume of traffic will increase toward normal. These savings, he believes, should be devoted to the reduction of rates on primary commodities.

On the return of normal business conditions, Secretary Hoover believes, the rates on primary commodities can eventually be reduced to a pre-war basis and still earn sufficient to insure the free flow of capital into new construction.

In discussing the influence of the railroads on general business conditions, Secretary Hoover said:

"One thing is absolute. Our transportation facilities are below the needs of our country, and unless we have a quick resumption of construction, the whole community—agricultural, commercial, and industrial—will be gasping from a strangulation caused by insufficient transportation the moment that our business activities resume. For the past five years, we have had no consequential expansion to our railway transportation machine. With but one interval of 9 months in 1918 and 1919 we had a car shortage throughout the whole of the years 1916-17-18-19 and 20. This shortage rose to as high as 160,000 cars with a corresponding shortage of motive power. We paid tremendous sums in commercial losses and unemployment in consequence. We laid it onto the war. We should lay it onto our lack of foresight and antagonism to railroads.

Expansion Necessary

"Few people seem to realize the amount of expansion in our transportation machinery necessary to keep pace with the growth of the country. And an equal few seem to have any notion of the price we pay for not having it. Our country is more dependent upon railway transport than any other. All others have comparatively greater cost

lines and internal waterways. The experience of the twenty years before the war has shown that we must build an extension of lines, including terminal facilities, additional sidings, etc., every year equal to the construction of a new railway from New York to San Francisco. We must add at least 120,000 cars and 2,500 locomotives annually to our equipment.

"Since we entered the war in 1917 we have constructed at least 10,000 miles of railways less than our increasing population and economic development called for and we are behind in rolling stock by about 4,000 locomotives and 200,000 cars. I wish to emphasize that unless we can have an immediate resumption of construction and equipment, our commercial community will pay treble the cost of the whole of them in their losses of a single season. The very moment that we reach anything like normal business we shall see a repetition of car shortages, followed by an increase in the cost of coal to the consumer from $1 to $3 a ton; we shall again see premiums of 20c. a bushel for the use of cars for moving grain; we shall in fact see a shortage of commodities to the consumer; and we shall see gluts upon the hands of the producers. We shall see factories, filled with orders, again closed for lack of cars; we shall see large intermittency in employment; and we shall see the usual profiteering in commodities due to a stricture between the producer and the consumer.

"There would be no difficulty whatever, by basing such losses on the experiences we have already had, to calculate a loss to the American people of a billion dollars for each one of these periodic transportation shortages.

SPENDING A BILLION TO ADVANTAGE

"We talk glibly of giving billions of credits to foreign countries, to increase our farm exports. I wish to say with all responsibility for the statement that a billion dollars spent upon American railways will give more employment to our people, more advance to our industry, more assistance to our farmers, than twice that sum expended outside the frontiers of the United States—and there will be greater security for the investor."

Secretary Hoover deprecated criticism of our railroad system on the ground of inefficiency and expressed his conviction that, in comparison with foreign railways, our own are of higher standards, better in methods, and growing in efficiency. He said in speaking of Government ownership, "No one with a week's observation of government railways abroad, or with government operation of industry in the United States, will contend that our railways could ever be operated as intelligently or as efficiently by the Government as through the initiative of private individuals. Moreover, the welfare of its multitudes of workers will be far worse under Government operation."

Aqueduct Commissioner Dies

Francis M. Scott, member of the Aqueduct Commission of New York City from 1888 until he became corporation counsel in 1895, died on Feb. 5. At the time of his death he was chairman of the recently appointed Charter Revision Committee of New York City.

Investigate Identical Cement Bids in Indiana

Governor McCray and the state legal and highway departments of Indiana are undecided as to what they can do about identical cement bids submitted to the state highway commission recently by three cement companies. They were in conference with representatives of cement interests Feb. 8.

The Governor said the cement representatives explained in the conference that the Universal Portland Cement Co. is the big cement manufacturer, and that when it quotes prices "all the other smaller companies come in under the wire." This, he said, was the explanation of the companies for the fact that three bids submitted for the highway department business were identical. Blaine S. Smith, of Chicago, representative of the Universal company, and spokesman for the cement men, would make no statement concerning the conference.

Besides Mr. Smith there were in the conference B. H. Rader, of the Lehigh Portland Cement Co., of Chicago; Harry Jennings, Wabash Portland Cement Co., Detroit; D. H. McFarland, Atlas Portland Cement Co., Chicago; O. A. Strass, Indiana Portland Cement Co., Greencastle, and others.

The state is in the market for approximately $500,000 worth of cement to be used principally in highway improvement. U. S. Lesh, attorney-general, is investigating to see whether the state can break up what the state officials believe is a cement trust.

Metcalf Comments on Boston's Society Affiliation Move

The idea of bringing into closer cooperation or affiliation the technical societies of Boston and vicinity for more effective public service, and economy of time and expense, as announced in this journal Feb. 9, p. 257, has been current in Boston for at least 30 years. At *Engineering News-Record's* request Leonard Metcalf has made the following comment on the movement:

It took definite form in 1911 when the Engineers Club of Boston was incorporated and its incorporators hoped that the club might become a center of activity in matters touching the public interest in which engineers might be particularly interested or capable of service. This hope was, however, not realized in any large measure.

Two years or more ago, representatives of sixteen or more technical societies or sections of national societies held conference with the same end in view, and a committee was appointed to investigate such a project and report its findings. This effort too failed. The interest and faith, however, of a small group of far-sighted men who were members of various technical societies in Boston, persisted, and resulted in the development of the specific plan covered by the "Prospectus on the Affiliation of Technical Societies," which is now under active consideration.

The details of the working agreement between the several societies have not yet been perfected, but the general project to affiliate has been unanimously endorsed by the local sections of the Americal Society of Mechanical Engineers, the American Institute of Electrical Engineers, the American Society of Heating and Ventilating Engineers, the American Association of Engineers, and by the Plant Engineers' Club. It has been favorably reported by the board of government of the Boston Society of Civil Engineers and will be acted upon at the next meeting of that society. It has been disapproved by the American Chemical Society. The American Institute of Mining and Metallurgical Engineers and the New England Water Works Association have not yet acted upon the matter. The Northeastern Section of the American Society of Civil Engineers has already affiliated with the Boston Society of Civil Engineers and has voted to participate in the movement which has been inaugurated.

It may fairly be said, therefore, that the engineers of the Boston district heartily favor the principle of affiliation and there is every reason to believe that a workable plan will soon be evolved for bringing about the desired result.

$60,000,000 Available for Highway Work in Texas

Records of the State Highway Department show that over $25,000,000 were spent on the designated highways of Texas during the calendar year 1921—more than twice as much as had been spent during the four years prior to 1921. This amount was spent on state roads under the direct supervision of the highway department and does not include the amount spent by individual counties, which is estimated at between $25,000,000 and $30,000,000 additional, making an approximate total of $50,000,000 spent on the highways of Texas during 1921.

Up to Jan. 1, 1922, there was an unexpended balance of $13,391,859.35 state and federal aid and the department's share of the Registration fees for 1922 is estimated at $1,750,000 over and above operating expenses, which means that there will be more than $15,000,000 aid available for 1922 and future road construction. The total amount has already been allotted and at least $7,000,000 is under contract at the present time. The allotments were made early in order that the various counties might get their work under way as soon as possible and at the same time help relieve the unemployment situation in Texas. The $15,000,000 state and federal aid represents about 35 per cent of the total amount that will be expended, making approximately $60,000,000 available for future road work under the present road building program.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN RAILWAY ENGINEERING ASSOCIATION. Chicago; Annual Convention, Chicago, March 14-16.

AMERICAN WATER WORKS ASSOCIATION. New York City; Annual Convention, Philadelphia, May 15-19.

PERSONAL NOTES

A. N. REECE has been appointed chief engineer of the Kansas City Southern Railway Co. with headquarters at Kansas City. Mr. Reece, who is a graduate of the University of Kansas, was formerly connected with the St. Louis and San Francisco R.R.

J. W. MARTIN, structural engineer with the Whitehead & Kales Co., Detroit, Mich., has been appointed chief engineer for the York Milk Machinery Co. at York, Pa.

H. O. WILES, formerly city engineer of Bluefield, W. Va., has been appointed county engineer of Wayne County, W. Va., succeeding H. A. Levering, resigned.

ROBERT M. GATES has resigned his position as engineer with the Lakewood Engineering Co., effective Feb. 1.

GEORGE K. ALLEN, Red Bank, N. J., has been appointed county engineer, Monmouth County, N. J., succeeding George B. Cooper.

STEPHEN S. BUNKER, for the past nine years an engineer of the state highway commission in Maine, has been appointed city engineer of Bangor, Me. Mr. Bunker is a graduate of the University of Maine, class of 1897. Under the amendment to the city charter the city engineer will be in charge of the street and highway, park and sewer departments, with power to appoint subordinates approved by the board of public works.

JOHN K. GRONHOLT, who has had charge of Highway construction on the National Trail, a federal aid road in Bond County, Ill., has been promoted from junior to Assistant State Highway Engineer and put in charge of highway construction in Jersey, Calhoun, Macoupin and Green Counties with headquarters at Carrollton, Ill.

ROBERT H. WHITTEN, of Cleveland, has been appointed consulting engineer for the city plan commission of Indianapolis, Ind., at a salary of $4,800 per year.

H. E. FEELEMYER has taken over the business of the Ajax Engineering Corp. of Philadelphia.

L. J. TOWNE, who has been in the engineering department of Stone & Webster, Boston, for four years, has been appointed structural engineer.

EARL WHEELER, formerly local manager of the Washington, D. C. office of the General Electric Co., has become associated with the investment department of Dominick & Dominick, members of the New York Stock Exchange. He will specialize in engineering, industrial, and public utility securities.

LEWIS E. MOORE, formerly associate professor of structural engineering at the Massachusetts Institute of Technology, and recently with the Massachusetts Department of Public Utilities, is now in consulting engineering practice in Boston. Mr. Moore specializes in designs and specifications for the strengthening of old bridges, buildings and foundations.

O. A. MECHLIN, formerly consulting engineer, Washington, D. C. has become associated with W. G. Triest in the Triest Contracting Corp., New York City, which was formerly known as the Associated Contractors, Inc. During the war, Mr. Mechlin was commander in the Civil Engineer Corps of the U. S. Navy, in the charge of the construction of the large concrete army and navy office building in Washington, D. C. Later he was attached to the League Island Navy Yard.

COL. JOHN R. FORDYCE, who served in the Construction Division of the Army during the war, has been appointed by Governor McRae State Highway Commissioner of Arkansas. He is the first engineer to hold this position.

STUART MANNELL, manager of the A. G. de Sherbinin & Co., importers, exporters and engineers, has been elected president of the Engineers' Club of Seattle.

CAPT. A. W. FUCHS, formerly of the U. S. Public Health Service, has resigned to become sanitary engineer for the Missouri Pacific R.R., with headquarters at Memphis, Tenn.

B. C. MCCURDY, formerly with the highway department of the Morgan Engineering Co., has been made county highway engineer of St. Clair County, Ill.

A. G. BARTLETT, who has been a member of the City Planning Commission, Los Angeles, Cal., has resigned to become a member of the board of public service commissioners.

BRADLEY STOUGHTON, formerly secretary of the American Institute of Mining and Metallurgical Engineers, has been elected president of the Yale Engineering Association.

F. UHLENHAUT, JR., for twenty-two years chief engineer of the Philadelphia Co., of Pittsburgh, Pa., has retired. He has been succeeded by Capt. Ralph Rainsford of New York.

CLARENCE W. HUBBELL has resigned as city engineer of Detroit, Mich., to resume his private practice, his resignation to become effective March 1. Mr. Hubbell has been city engineer of Detroit since January, 1917. He accepted the position after having been formerly engaged by the Detroit Water Board on a survey to determine the degree of pollution of the Detroit River, and took a particular interest in the sewer program started at the time of his appointment as city engineer. During the time he has held his present position the sewer program costing approximately $40,000,000 and providing drainage for over 40 square miles of newly annexed territory has been practically completed. Mr. Hubbell will maintain an office in Detroit as consulting engineer.

OBITUARY

DENNIS O'BRIEN, president of the general contracting firm of Dennis O'Brien & Sons Co., Inc., Hartford and Middletown, Conn., died at his home in Middletown Feb. 4. Mr. O'Brien was 72 years old, and has been associated with the building business in Connecticut for the past 45 years. During that time he has constructed several large building and factories in Hartford, among them being the extensive Royal Typewriter plant there.

FRANK CHITTENDEN OSBORN, of the Osborn Engineering Co., Inc., Cleveland, Ohio, died suddenly on Jan. 31. A fuller notice of Mr. Osborn's life and work will appear in next week's issue.

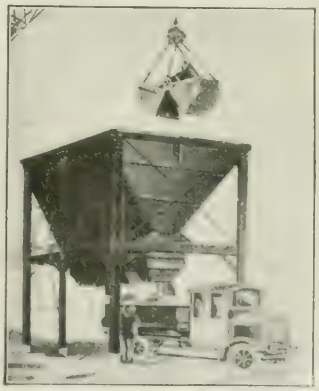
J. J. WRIGHT, for many years manager of the Toronto Electric Light Co., and builder of one of the first electric railways in Canada, died at Newcastle, Ont., Jan. 31.

DUDLEY BALDWIN HINE, superintendent of bridges and buildings for the Guayaquil & Quito R.R., died in Ecuador Jan. 18 from injuries sustained while at work. His home was in Los Angeles, Cal.

EQUIPMENT AND MATERIALS

Steel Materials Bins Equipped With Measuring Hoppers

Steel bins for aggregate road work provided with measuring hoppers adjustable to size of batch are being manufactured by the Blaw-Knox Co., Pittsburgh, Pa. The bins are assembled and dismantled in sections which can be transported by truck. The measuring hopper called a "batcher" is made entirely of steel and is located immediately beneath the bin; it includes the bin gate for the bottom of the storage bin. Operation, it is stated, necessitates no greater effort than is required by closing and opening any gate attached to a storage bin. When the storage bin gate is closed, the material is struck off. The right volume is then held suspended. When the hoppers are



full and the storage bin gate is closed, one operator can dump one, two, three, or four at the same time, thus loading a four-compartment truck with sand and stone in less than ten seconds. Only one workman is necessary to operate a 100-ton capacity bin having four measuring hoppers of sand and four measuring hoppers of stone. Each hopper consists of two parts, a top cone and a lower section. The top cone moves within the lower section, and an adjustment of a fraction of a cubic foot can be obtained at will. By the use of lock bolts which are furnished as part of the outfit or by other simple methods, the engineer or contractor can seal the adjusting mechanism so that no change can be made without his knowledge.

Business Side of Construction

Facts and Events that Affect Cost and Volume

The Low Exchange Rates

Par and Current Rates for European Money and What They Mean—The Mighty Dollar

Each week in the Trend of Business column brief consideration is usually given to current rates of foreign exchange. The value of foreign moneys in terms of United States currency has an important bearing on commerce and a certain influence on the money market of this country. It is therefore important for even the casual student of business to understand what is implied by the current rates of exchange.

The soundness or value of a currency depends largely upon the amount of paper money in circulation. For example, par value of the German mark is 23.8 cents. One authority states that in 1914 Germany had 2,000,000,000 marks outstanding, against about 95,000,000,000 now. The present quotation is 0.505 cents (Feb. 15), while in November 0.33 cents was quoted.

The situation is more or less the same as regards other European currencies. The Russian ruble was once worth 51 cents; its present value is negligible outside Russia. The Polish mark at par is worth 23.8 cents; it is now quoted at 0.03125 cents — one seventy-sixth its par value.

The seriousness of the exchange situation—also of the European economic situation—will be evident by examination of the following par and current demand values of European currencies:

	Par in Cents	Denomination	Current Value in Cents
England	486 62½	sovereign	435 50
France	19.3	franc	8.63½
Italy	19 3	lira	4 87
Belgium	19.3	franc	8.23½
Germany	23 8	mark	0 50½
Austria	20 3	crown	0 03½
Poland	23 8	mark	0 01¾
Greece	19 3	drachma	4 58
Rumania	19 3	leu	0 80
Serbia	19 3	franc	1 32
Spain	19.3	peseta	15.73
Holland	40 2	florin	37 35
Sweden	26.8	crown	26.05
Norway	26 8	crown	16 60
Denmark	26 8	crown	20 55

A large American importer asserts that the dollar is the form of payment in overwhelming demand by European exporters to this country. Europe does not want to be paid in its own currency. Exporting to Europe is light. Construction machinery is sold abroad even now, but materials are not being exported. As regards foreign products, American concerns prefer to buy from importers than to place orders directly with foreign houses. Such purchases are usually spot from stock.

Although the American dollar is worth only about 60 cents in its own country (as compared with its buying power in prewar days), it is the purchasing unit of the world. The persistant acuteness of the exchange situation has given rise to much talk of an international bank and currency, and the idea seems to be gaining favor.

Next Week — Comparison of cement prices with some other construction materials. With graphs.

The Decision in the "Open Competition" Case

The National Lumber Manufacturers Association has taken the position that it will not advise or recommend to any of the subscribing associations any specific policy with respect to any of their activities. It urges, however, that each association give careful consideration to the applicability, if any, of the recent decision of the Supreme Court in the American Hardwood case of their own activities and that they do so in the light of competent legal advice and of full knowledge of the policies of the Government, as and when they may be announced. Such was the advice given recently by the Secretary and Manager; Wilson Compton, to the annual conventions of the Michigan Hardwood Manufacturers Association and the Northern Hemlock and Hardwood Manufacturers Association.

In the meantime, Mr. Compton stated, scrupulous associations need not fear unreasonable or oppressive action, for both Secretary of Commerce Hoover and Attorney General Daugherty are broad-minded, intelligent and observant men who are not likely to "whack" associations that exhibit a real purpose and desire to abide by the law. But there is no place for a spirit of evasion of law.

The apparent aim of the Government is free competition, conducted intelligently. Mr. Compton stated that in his judgment as a result of his inquiry and observation, general action against trade associations as a whole is not likely. Rather that an effort will be made, as it ought to be made, "to separate the goats from the sheep." The Government undoubtedly realizes that the trade association marks a stage in economic progress — else it would not have developed as it has, among American industries; and that unreasonable interference with helpful trade co-operation would only mean its dispersion and the consequent setting back of the clock of the country's business progress twenty or thirty years.

Representative Public Bond Sales in January

Long term municipal bond sales, in the United States, for the month of January, 1922, reached a total over $94,000,000 as compared with a total of slightly over $86,000,000 for January, 1921. Among the important bond issues of the month were: State of Oregon, $1,000,000 5s; Chicago Sanitary District, Chicago, Ill., $5,000,000 5s; Merced Irrigation District, Cal., $3,120,000 6s, and Minneapolis, Minn., $2,295,000 4¼s. Following are some representative sales:

REPRESENTATIVE BOND SALES OF JANUARY, 1922

State	Purpose	Amount	Maturity	Rate per Cent	Sold for	Dated
Idaho	Highways	$250,000	1923	5	100 06	Jan. 16 1922
County						
Allen Parish						
Rd. Dist. No. 3, La.	Roads	136,000	Due serially 1 to 13 yr.	5	85 50	Dec. 1, 1919
Door, Wis	Highway	75,000		5	100	
Montgomery, N. Y.	Highway	70,096	$14,096—1926 $14,000—1927—30	5½	100 823	Feb. 1, 1922
Morgan, Ohio	Bridge repair	23,500	1922—32	6	102 06	Jan 1, 1922
Noble, Ind.	Highway	39,480	1923—32	5	100	Jan 15 1922
Palo Pinto, Tex.	Roads	250,000		5½	94.70	
Westmoreland, Pa.	Roads	375,000	1931	5	101 563	Sept 1, 1921
		375,000	$37,000—1932—40 $42,000—1941	5½		
Wright, Iowa	Road	65,000	1929	5½	102 87	
	Bridge	30,000				
Brooks, Ga	Road	280,000		5	100	Jan. 1, 1920
Central Highway						
Dist. Lewis Co., Ida	Highway	50,000		6	100	Jan 14, 1922
Chippewa, Mich.	Road	75,000	1923—28	5½	100 34	Feb. 1, 1922
Douglas, Neb	Road-paving	1,000,000	1937—41	5	103 20	Oct. 1, 1919
Greene Township						
Erie Co., Pa.	Roads	11,000	1926—27	6	100	Dec. 8, 1920
Municipality						
Akron, Ohio	Tunk sewer	500,000	$16,000 yearly 1923—32 $17,000 yearly 1933—52	5½	105 183	Feb. 1, 1922
Ardmore, S. D.	Water-works	29,500	1940	5	100	Feb. 15, 1922
Arkport, N. Y.	Ltg. System	15,000	1925—34	5	100 39	Feb. 15, 1922
Collegeview, Neb.	Paving	95,000	1940	6	96.50	Jan 1, 1920
Fort Lee, N. J.	Temporary Imp.	250,000	1928	5	100.	Feb. 1, 1922
Fulton, N. Y.	Bridge	4,000	1923—26	5	100 30	Feb. 1, 1922
Gloversville, N. Y.	Waterworks	173,500	1922—32	5½	101 58	Apr. 1, 1920
Livingston, Tenn	Street Imprvt.	25,000	1922—32 1922—42	6	100.	
Mt. Vernon, N. Y.	Incinerator	65,000	$3,000—1923—41 $8,000—1942	4½	100 89	Feb. 1, 1922
New Haven, Conn.	Park Imprvt.	250,000	1947	4½	107.172	Jan. 1, 1922
Plattsburgh, N. Y.	Waterworks	100,000	1923—32	5	103.78	Jan. 1, 1922
Seaford, Del	St. Improvement	25,000	1951	5	100	Sept. 15, 1921
Yakima, Wash	Sewer	80,000	1942	6	105.38	Dec. 1, 1921
Berlin, N. H.	High-school bldg.	400,000	1922—41	5	102.20	Nov. 1, 1921
Burlingame, Cal.	City Imprvt	60,000	1923—52	5½	106.15	Jan. 16, 1922
Elm City, N. C.	Electric light	25,000	1942	6	100.	Feb. 1, 1922
East Orange, N. J.	Gen. Imprvt.	476,000	$17,000—1922—23 $18,000—1926—47 $12,000—1948	5	105 07	Dec. 1, 1921

Large Contracts Let

Among this week's announcements of contracts awarded in Construction News, pp. 63@69 are the following large projects: A 9-story office building in Chicago, Ill., to Leonard Construction Co., 37 South Wabash Ave., $2,000,000; an 8-story hospital in New York City, to M. Eidlitz & Son, Inc., 41 East 42nd St., New York, $1,000,000.

Policy of National Lumber Manufacturers Assn.

As Recently Outlined by the Secretary and Manager of the Organization.

"The National Lumber Manufacturers Association can, in my judgment, be conducted in only one of two ways, namely, either for the sake of avoiding criticism, or for the sake of doing the greatest benefit to the lumbermen composing the regional associations. It is not possible to conduct effectively an enterprise of this sort without encountering criticism. For the most part the criticism of the National Association has been with a desire for enlightenment and has had a constructive purpose. But as long as lumbermen, even in their own regional groups, are not in agreement on some of the practical problems which confront the industry, one of two things must occur, so far as they relate to the affairs of the National Association, either nothing must be done, and as a consequence important interests of the industry go by default; or, criticism and occasional controversy must be expected.

"It is perfectly practicable for an organization of this sort to be conducted with great effectiveness, openly and frankly in the equal interest of all the subscribing associations. This, however, cannot be done without occasional refusal to meet the views and requests of individuals. But if ever the Association departs from the policy of impartiality, and of strict adherence to the activities in which all members are interested in common, it will have surrendered its only real title to the support and confidence of the lumbermen of the United States. I believe that the lumbermen should support a national organization of this kind only if they are willing to have it conducted in that way and for that purpose.

"The National Association has now a peculiar opportunity for helpfulness in that its activities are separate and apart from these activities which have recently become involved in legal controversy. In the interest of maintaining co-operation in the lumber industry there is, it seems to me, in the light of this situation, added reason for the maintenance of a strong national organization. This would apply no more and no less to the lumber industry than to other industries similarly situated."

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for in Construction News, pp. 63@69 are the following:

A high school at Hartford, Conn., $1,500,000.

A clubhouse at Cincinnati, O., $2,000,000.

A hotel at Grand Rapids, Mich., $1,000,000.

An exposition building at Chicago, $5,000,000.

A water-works project for Seattle, Wash., $2,000,000.

A sewerage system for Los Angeles, Cal., $2,500,000.

Roadwork in Ontario, $4,000,000.

Paving 21 miles Cannon Ball Trail, Kansas, $575,000.

Plans for Unemployment Relief

Provision of actual funds by subscription and otherwise for the relief of unemployment conditions in various parts of the country are being undertaken according to a recent report made known by the Department of Commerce. New Haven, Conn., is raising a community chest of $500,000 which includes an item of $50,000 for an emergency fund for the unemployed. Hartford is advancing to unemployed persons on their notes in favor of the city small sums for repayment.

Detroit has appropriated $2,000,000 to meet unemployment conditions. Indianapolis has a city fund of about $165,000, and in addition $120,000 has been raised by popular subscription. This is to be used in municipal work and an increasing payroll is reported daily.

The sum of $3,500,000 has been raised in Cleveland and in Cincinnati the city council has appropriated $10,000 to the mayor's unemployment committee. One of the salutary features of the work being done to relieve unemployment is that reported from Poughkeepsie, N. Y. The city is lending up to $100 to any unemployed man of reputable character, and accepts his note for ninety days at reasonable interest, charged to make up for any loss which may occur through failure of others to pay.

Union Wages in Massachusetts 1914 to Date

More Uniform Rate Resulting from War Advance — Present Average 65 per cent over 1914 Schedule

Wages in the Massachusetts building trades rose from an average of 50.4 cents in July, 1914, to 97.2 in 1920, and then declined to 92.3 in 1921, giving an increase of 83.2 per cent for 1921, according to the Massachusetts Department of Labor and Industries. These averages are for thirteen crafts. *Engineering News-Record* quotes weekly the rates paid members of six skilled crafts—bricklayers, carpenters, hoisting engineers, hodcarriers, piledrivers and structural ironworkers,—and the average for Feb. 1, 1922, was 82.5. This would indicate that wages in Massachusetts are at present between 60 and 70 per cent above the 1914 schedule. The table gives the average union hourly rates as compiled by the Massachusetts Department of Labor and Industries. Present rates, as quoted by *Engineering News-Record*, are: Carpenters, 75c.; bricklayers, hoisting engineers and structural ironworkers, and piledrivers, 90c.; hodcarriers, 60c.

A comparison of the average rates for the several occupations in 1921 shows that the average rates for stonemasons, 98.9c.; plasterers, 98.3c.; bricklayers, 98c.; and lathers (wood, wire, and metal), 96.8c. were the four highest of the rates for the 13 occupations, but, when a comparison of the rates in 1921 is made with the corresponding rates in 1914, it is seen that the occupations in which highest percentage of increase were maintained were the paperhangers, 113.3 per cent; painters, 106.0 per cent; inside wiremen, 98.1 per cent; and decorators, 95.6 per cent, for each of which occupations the rates in 1914 were relatively low. Thus it will be noted that while the changes in the rates for the several occupations during the period 1914 to 1921 varied quite widely, yet the result was the establishment of a general standard.

AVERAGE UNION HOURLY RATES OF WAGES IN THE BUILDING TRADES IN MASSACHUSETTS, 1914, 1919, 1920 AND 1921.

Occupations	Number of Reports	Number of Municipalities	Average Hourly Rates of Wages, July 1 — 1914	1919	1920	1921	Per Cent Increase in Rates — 1919	1920	1921
All occupations represented	230	69	$0.504	$0.737	$0.972	$0.923	46.3	92.9	83.2
Bricklayers	27	27	0.619	0.803	1.033	0.98	29.7	67.0	58.3
Carpenters (house)	61	60	0.467	0.719	0.959	0.899	54.0	105.3	87.6
Decorators	6	6	0.452	0.742	0.933	0.883	64.2	106.6	95.6
Hodcarriers and laborers	6	5	0.392	0.579	0.75	0.717	47.9	91.4	83.0
Lathers (wood, wire and metal)	11	8	0.55	0.755	1.007	0.968	37.4	83.1	76.0
Painters	27	27	0.429	0.67	0.895	0.885	56.3	108.8	106.0
Paperhangers	6	6	0.426	0.65	0.933	0.908	52.6	119.2	113.3
Plasterers	15	15	0.598	0.797	1.052	0.983	33.3	76.0	64.6
Plumbers	21	21	0.525	0.747	0.979	0.945	42.2	86.4	80.0
Sheet-metal workers	9	9	0.482	0.73	0.964	0.905	49.4	100.0	87.5
Steamfitters	19	19	0.502	0.748	0.987	0.942	49.0	96.4	87.5
Stonemasons	11	11	0.594	0.816	1.061	0.989	37.3	78.6	66.3
Wiremen (inside)	11	11	0.456	0.764	0.973	0.902	67.6	113.5	98

Comptroller General's Decision Affects Building Contractors

Where specifications for construction of a building expressly require the contractor to clear the site for reception of the building and direct inspection of the site prior to submission of bids, the Government is not liable for cost of removing rock from the site not shown on the blue print, the object of the blue print being to show only the elevation and depression of the ground and not the presence of rock or other matter on the surface.

Delay in the approval of a contract can impose no liability upon the Government to reimburse the contractor for increased cost of labor and materials occurring between date of tentative contract and date of its final approval.

Under a contract providing for changes in the work during its progress when ordered in writing, and providing a corresponding increase or deduction in the price, the contractor can not be reimbursed for additional cost on account of changes which were not ordered in writing.

Trend of Business

Bonds — Municipal issues light. Liberty bonds strong and active. Railroad list active. An important [illegible] offering [illegible] Great Northern Ry general mortgage 5½s at 96¼; yield 5.8.

Foreign exchange still [illegible].

Money plentiful; time loans [illegible] per cent.

Primer for Lumber Buyers and Shippers

The National Lumber Bulletin prints nine definitions of general interest.

A *standard* equals 165 cubic feet or 1,980 board feet of lumber; about 1,650 board feet of squared timber; 1,320 board feet of logs.

A *cubic meter* equals 424 board feet of lumber; 353 board feet of hewn timber; 283 board feet of logs. Board measure is often expressed as "b.m."

A *metric ton* equals 1,000 kilos or 2,204.6 pounds. It is equivalent to 735 board feet of softwood lumber; 551 board feet of hardwood lumber; 490 board feet of logs (softwoods); 367 board feet of logs (hardwoods); 612 board feet of squared timber (softwoods); 459 board feet of squared timber (hardwoods).

A *hectare* equals 2,471 acres. F. O. B. means "free on board"; that is with freight not prepaid from point named. F. O. W. means "first open water," applied particularly to deliveries on cargoes in northern countries. C. I. F. means "cost, insurance and freight"; all three items being included in the quotation, to point named. F. A. S. means "free alongside ship." L. C. L. means "less than carload lot."

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted. Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section. The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of January 2; the next, on March 2.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$2.63	$3.50	$4.00	$2.63	$2.81	$3.50	$3.10	$3.36	$4.00
Structural rivets, 100 lb	3.50	5.00	5.50	3.43	3.90	4.25	4.50	4.00	6.50
Reinforcing bars, ¾ in. and larger, 100 lb	2.53	3.20	3.50	2.53	2.81	3.42½	2.75	3.26	2.75
Steel pipe, black, 2½ to 6 in. lap, discount	61%	57.65%	45%	57%	61.9-5%	44%	53.7%	53%	35.10
Cast-iron pipe, 6in. and over, ton	47.30@48.30	45.00	48.30	40.60@42.60	46.00	52.00	50.00	+45.00	60.00
Concreting Material:									
Cement without bags, bbl	2.30	2.55	2.40	1.97	2.24	2.90	2.73	2.94	3.10
Gravel, ¾ in., cu.yd	1.75	1.85	2.00	2.00	1.50	2.50	2.25	1.50	1.50
Sand, cu.yd	1.00	1.25	2.00	2.00	1.00	1.10	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd	1.75@1.85	2.00	2.93	1.60	2.25	3.50	2.25	3.00	2.10
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	42.00	37.00	34.00	44.00	38.00	50.00	32.00	20.00	....
Lime, finishing, hydrated, ton	18.80@19.80	19.00	25.00	18.00	29.00	24.00	22.00	27.00	26.00
Lime common, lump, per bbl	2.75@3.48	1.50	2.75	1.40	1.40	2.70	1.75	2.75	11.00
Common brick, delivered, 1,000	+21.40	8.50	11.00	11.00	15.00	14.00	15.50	14.00	16.00
Hollow building tile, 4x12x12, block	Not used	.0675	.13	.0821	.0752	.08	....	.10	.08
Hollow partition tile 4x12x12, block	.11120	.0675	.13	.0657	....	.10	.108	.11	....
Linseed oil, raw, 5 bbl. lots, gal	+.85	+.86	.93	+.88	+.93	+.98	.89	.86	.82
Common Labor:									
Common labor, union, hour	.60	.35	....	.72½	.40@.50	.50@.55	.62½	.50@.60	....
Common labor, non-union, hour	....	.20	.35@.45	.35@.40	.40@.50	.35@.40	43¾@.50	.50	.20@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 1c. per 100 lb. for cutting reinforced steel into 2-ft lengths or over.

New York quotations are delivered except tiles, which are "on trucks." Common lump lime per 280-lb net, both lump and hydrated quoted f.o.b. cars New York. Sand gravel and crushed stone are quoted alongside dock. Cement and steel pipe delivered to contractors on job. Gravel ready mixed $2 per cu.yd.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net.

Minneapolis quotes on tile instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized.

Denver quotes cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 5½ x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to contractors in yards at San Francisco. Lumber price is for No. 1 fir, common.

Seattle quotes on Douglas fir instead of pine. Common lump lime per 180-lb. net.

Montreal quotes sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 95.8 cents). Bag change is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net.

Changes Since Last Week

Structural steel shapes and plates are quoted at $1.40, Pittsburgh, for large tonnages and $1.50 for smaller lots; reinforcing bars are quoted at $1.40@$1.50 per 100 lb. Mill shipments, New York, of shapes and bars are quoted at $1.78@$1.88 per 100 lb. Mill price reductions on wire nails, rails and six other leading steel products have been quoted during the week; bringing the average price of the eight products very close to the 1913 level.

Cast-iron pipe is quoted at $45 as against $44 per ton in Seattle, prices unchanged in eight other cities reporting.

Cement, quoted last week in New York at $2.20@$2.30 per bbl. (net) has shown a tendency this week to maintain the $2.30 level.

Continued depletion of the winter reserve of common brick in New York city and ice-bound waterways necessitating rail shipments of fresh supplies, have combined to advance the price $1 per 1,000 wholesale. Brick are now quoted at $18 as against $17 one week ago.

Linseed oil has advanced 4c. in New York and Chicago, 1c. in Atlanta, 2c. in Minneapolis and 3c. per gal. (5 bbl. lots) in Denver.

One hundred and twenty-nine mills reporting to the West Coast Lumbermens' Association for the week ending February 4, show 75,959,140 ft. cut; 66,361,854 ft. sold and 63,368,338 ft. shipped. Production was 13 per cent below normal, shipments 17 per cent cent and new business 13 per cent below production. One hundred and thirty-two mills reporting to the Southern Pine Association for the week ending February 3 show 74,798,573 ft. cut; 61,225,780 ft. shipped and orders for 62,068,820 ft. Production was 19 per cent; orders 33 per cent and shipments 34 per cent below normal.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, President

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren, Editor

Volume 88 — NEW YORK, FEBRUARY 23, 1922 — Number 8

The Shortest Code of Ethics

CONTRACTORS of a generation ago had the world's shortest code of ethics, according to Daniel A. Garber, who told the Associated Pennsylvania Highway Contractors recently that the old code was summed up in just two words: "Be slick." Today, contractors have a new conception of their responsibilities to employer and public, but they still can claim the record for brevity in their ethical code, which, Mr. Garber says has been amended to read: "Don't be slick."

"Standard" Paving Brick

QUESTION has been raised as to the interpretation of the word "standard" in connection with the recent action in simplifying the varieties of paving brick. Some fear that the word may be taken to mean that the conference which met in Washington on Nov. 15 declared that the retained varieties were all equally good from a technical standpoint. For ourselves we do not believe that this interpretation will often be made by engineers, though obviously it may be used by unscrupulous salesmen in urging particular varieties on the uninformed and particularly on non-technical councilmen and city officials. The term standard is used in two senses in American technical practice: as indicative (1) of a type or procedure that qualified experts have formally declared to represent the best practice and (2) of a type so largely used as to form the bulk of the manufacturers' product. It is in the latter sense that we refer to "standard" I-beams, "standard" cast-iron pipe, "standard" drain tile, etc.; and in distinction to this use of "standard," we have "special" I-beams, "special" pipe, etc. It is obvious that it is in this sense that the term "standard" was used by the conference on simplification of paving-brick variety and not in the sense that it gave equal technical value to the varieties retained.

Bad Steelwork

AS REPORTED in our accounts of the Knickerbocker Theater collapse the steel roof framing of the ill-fated structure did not cause the disaster by primary failure. But it was apparent from the first that the framing was defective in arrangement and contained many objectionable details. Subsequent study of the wreckage by the authorities has brought out more definitely how bad the steelwork really was. It lacked stability, it was stressed far beyond safe limits, and its details were shockingly slipshod. The fact is that all engineers who examined the ruins came away with wonder that the shoddy assemblage of columns and trusses, negligently tacked together, had not failed. Engineering instinct insisted that such work must condemn itself by breaking down, yet, flaunting sound principle, it seemed to have justified itself by surviving. Now, however, the fact is developing that the fear-inspiring weakness of this steel "structure" (save the mark!) did play a part in the disaster, a determining part. Of the many elements and details of the roof that were ready to fail, one was so terribly fatal in its wretchedness—we refer to the end joint of the main truss where it rested on its wall support—that, had it not crumpled up on the night of the great storm, it would surely have done so a little later, when the destructive stresses on the lower chord and gusset had concentrated a trifle more. The weakness of this part was not due to error or oversight, for it was of a piece with all the other bad engineering in the roof. Nor was it the product of incompetence, for the designer was able, we have reason to believe. It represents the inevitable outcome of the downhill course of departing from sound principle of design, of "getting by" with one job of slighted or skinned detail and thereby being tempted to another and another—in short, it is what the whole debasing system of bad engineering habit leads to. Steelwork is sturdy, and has a reserve strength that enables it to resist even severe abuse; but the engineer who presumes on this fact to excuse bad practice merely prepares for disaster.

To Weed Out Road Boosters

LEGITIMATE highway-improvement financing is making such heavy demands upon the public's pocketbook that a diversion of private funds into other channels than construction and maintenance of routes economically justified constitutes a menace to the good-roads movement. The public has made such a ready response to calls for money that the good-roads slogan has been seized upon by scores of road-boosting organizations as a means of supplying "easy money" to the promoters who head these bodies. At the present time there are somewhat more than 200 of these organizations which select highway routes for their boosting operations, give them a fine-sounding name, like the "Yankee-Doodle Highway," and then proceed to go out for money. Some of the funds may be used for leigtimate purposes of highway promotion, but the chances are that a large portion does no other good than to fatten the pockets of the professional road-boosters. The danger in the situation is that the public, once victimized by one of these booster organizations will withold funds from legitimate highway-development projects. With taxes of one sort and another constituting a heavy burden for all citizens, funds for highway improvement should not be dissipated in wildcat schemes instituted largely with motives of personal gain. Conditions in the road-boosting business —for it has developed into practically that—have reached a stage which has indicated to the American Automobile Association the desirability of a thorough weeding-out process. All good-roads associations, of course, are not open to charges of uselessness and dishonesty, but enough goats have mingled with the sheep to warrant a separation of the flock to the end that more money shall go into road-building and less into road-boosting.

Propaganda of Fact

THERE are trembling on the brink of disclosure—with some misgivings on the part of the planners—a number of campaigns to tempt the public into more active buying. They are of the variety made familiar by the "Buy Now" and "Let's Go" campaigns of some years back.

The efficiency of such efforts is very doubtful. The public is suspicious. Obvious propaganda leads it to question whether the efforts are not entirely selfish; there is apt, therefore, to be reaction rather than compliance. On the whole it seems best to let the usual processes of education take their course.

For practical results facts like the Bethlehem Steel Company's decision to go forward with improvements and extensions to cost $25,000,000 are far more potent than the generalities of a boom-and-boost campaign. Nor does the disapproval of blatant propaganda carry with it condemnation of efforts to get favorable factors before the public. Far from it. The public should be acting with intelligence. It cannot do that unless it knows the business situation. To show, for example, that building prices have materially declined is not a mere selfishness on the part of materials dealers, engineers and contractors, but is rendering a service to the public. Even then, however, there can be an unfavorable reaction if an impression of an effort to hurry the market is created.

We need propaganda—but propaganda consisting of a fair presentation of facts, and with the public's interest, and not solely the seller's, in mind.

Bonus Legislation and Industrial Revival

SOLDIER Bonus is occupying one of the prominent positions on the Washington political stage. It is truly a political question—or rather one of politics and of sentiment. The members of Congress are impressed with the volume of the soldier vote; the public, largely, looks with a soft heart on any proposal that favors the men who wore khaki. Examined critically, in the light of the justice of the proposals, the probable benefits to the veterans and the effect on the country's economic condition, the payment of a bonus, at the very best, is of doubtful advisability; in fact, we think the general opinion of those who would so examine it would be unfavorable.

We do not propose here to review the arguments for and against the bonus, but merely to repeat the suggestion so frequently made that the burdens the American people are carrying already constitute a very serious drag on American business. To increase that burden must further retard business revival. What the individual veteran may gain in dollars he will lose in deferred and less lucrative employment.

Potential economic dangers are so apparent that the proponents of the bonus have dropped the proposal to issue bonds to cover the cost, and have worked out alternative methods of compensation which will spread the cash outlay over many years. Even so, however, the immediate annual cash outlay will be large. Additional burdens on business will be inevitable. We have just removed taxes on railroad travel and freight shipments to stimulate business; now some would impose a tax on parcel-post shipments. We have wiped out excess profits taxes (as of this year's earnings), yet some bonus advocates want a 2½ per cent tax levied on undivided profits, thus curtailing the capital available for extension of industrial enterprises. In other words, to pay the soldier bonus we must again clap on the industrial restraints which we have only recently removed.

We believe that, calmly considered, the bonus legislation under present conditions is a mistake. We hope that statesmanship, not votes, will decide the issue at Washington.

Road Grading Costs Underestimated

GRADING probably offers more ways of losing money and is more generally underestimated by contractors than any other item of paved-road construction. These statements are especially true where the yardage moved is small, as is usually the case, particularly in the prairie states.

When road-yardage figures begin to mount and especially where isolated deep cuts or fills present themselves, the contractor takes notice at once and gives overhaul, classification, length of haul and all the other factors of the problem of earth-moving his undivided attention. If, however, there is only a skin cut of two or three thousand yards a mile, the tendency is to throw the item of grading in with the minor charges for construction without looking far into its character or cost. Safe practice would, of course, be just the opposite.

The high-cost operations in road grading are scarifying, shaping, ditching, slope dressing, grubbing, sod removal, replacing over-cut, etc., and where yardages are small these items dominate the unit costs. The price per yard of grading should, therefore, be greater for small than for large yardages per mile of road. This is an elementary lesson in earth-moving costs but the history of highway bids in recent years indicates that contractors have learned it poorly. In a measure the reason is that many of them have had experience in pavement laying rather than in earth moving, but more generally it is because few contractors keep separate costs of bulk excavation and of the grade-finishing operations.

Finishing is a large part of the cost of any grading operation and most highway grading requires a "sandpapered" finish. If contractors had the itemized costs of slope dressing and the other processes of road grading, which are not primarily true excavation, and had put the costs into their bids they would have less complaint to make about specifications which call for sandpapered grades.

Possibly, also, the price of sand-papering might bring home to highway officials its decidedly small value to the road.

A Challenge to Sewage-Works Engineers

A CHALLENGE to American and British sewage-works engineers is perhaps the best short characterization of T. C. Hatton's paper on centrifuges for sewage-sludge dewatering. The challenge lies first in Mr. Hatton's sweeping allegations that both British and American engineers have gone only or little more than half way in preventing a nuisance and menace from the liquid portion of sewage while almost neglecting like nuisance and menace from sludge. Secondly, Mr. Hatton, at least by inference, charges American and British engineers with negligence in sewage-sludge utilization and credits the Germans with doing much better. In his opinion, centrifuges may be used to de-

water sludge so it will become a commodity sought by the farmer and truck gardener.

If we rightly interpret the best British and American thought and practice, Mr. Hatton has gone too far in both these challenges. Certainly there has been much justification in giving first place to the liquid rather than the solids of sewage, whether considered as a mere nuisance or as a menace to health. As to sludge utilization, it has been a veritible will-o'-the-wisp for a half century. Recovering processes by the score, patented and unpatented, have come and gone and others are now at the front, but who can bring forward a commercial balance sheet that would warrant private capital investing money in any of these processes, new or old? At most, there has been and is now promised only some lessening of the cost of sludge disposal, with very few thorough-going data to show just what that lessening cost is. The activated-sludge process has promised most among recent processes in the way of sludge recovery for fertilizing purposes, but engineers await official word that the only large-scale dewatering plant yet built—the one contracted for several years ago at Houston, Tex.,—is yet in successful operation or that Mr. Hatton himself, after years of experimentation at Milwaukee, has solved the problem to his own satisfaction, even experimentally.

Nevertheless, Mr. Hatton's paper is a challenge that deserves the careful attention of sewage-works engineers, for eventually we must go on to better things in sludge disposal and with every year's increase in population, and consequently in food and fertilizer demand, there is more need for recovering the fertilizing values in sewage, if that can ever be made economically possible.

Private Initiative for Public-Works Enterprises

FOR the past year or two activity in public-works construction has surpassed that in other fields of the civil engineer's work. With all this activity, little in the way of starting new improvements has been done except in highway-building. A beginning has been made, but only a beginning, in catching up with the deficit in maintenance and extensions accumulated during the disturbed conditions of the last eight or nine years.

Public-service improvements—such as meet real needs and are wisely planned—are among the most potent means of increasing the efficiency of the community's life. There are many, very many, that wait to be carried out in every part of the country. Yet, aside from high-pressure highway construction, little more than routine betterment work is going on. There are good reasons for this. They lie in the tremendous difficulty of public financing, in the cumbersome and inefficient procedures required for organizing large public undertakings, and in similar hindrances. Perhaps the most formidable obstacle is the absence of live initiative from public planning; but, in addition, even when a promising plan is suggested, and even when it receives the support of both government and the general public, it has a rough road to travel before it reaches concrete realization, and all but the most persistent supporters are discouraged by the prospect. The underlying factors of this condition are such as will continue in operation for a long time, and it can hardly be doubted, therefore, that for years to come many urgently needed public improvements will remain dormant, if they depend upon public action.

These circumstances create a new opportunity for private engineering enterprise. Public works for which there is a true demand can be built by private initiative, and built rapidly and efficiently, where their construction by public machinery is substantially impossible. Such enterprise is entitled to welcome and encouragement, since its effect is to raise the level of the community's working efficiency.

Private enterprise formerly was the controlling agency in the construction of public improvements. It was enterprise of the purely exploitational type—that of the railway and canal companies, let us say, or later of the street railways. We have progressed rather far beyond the conceptions of that day. New ideas prevail as to the obligations entailed by public service, conceptions that indeed are considerably ahead of what is represented in many of our surviving semi-public corporations. Public-works enterprise by private initiative today must be organized to carry out with thoroughness its public-agency functioning, as the condition of receiving public support. But there is no reason for believing that such organization would hamper the enterprise or render its success doubtful.

Proper organization and satisfactorily fixed relations with the public being provided for, two decisive advantages of private public-works enterprise call for notice. The are *first*, the allocation of cost of service to those directly benefited by it, admittedly an ideal condition; and, *second*, the guarantee against unwise or unproductive enterprise offered by the fact that financial returns are a controlling consideration. These two advantages speak so obviously for themselves that fuller discussion is hardly needed to justify them. But a word on the first may be appropriate.

Tolls—or service charges—are better than taxes. This truth is recognized in many kinds of public service. Thus, free water supply has been advocated and has been practiced; but none have fought the practice more consistently than the staunch supporters of public water supply. Moreover, they have fought the flat rate and the nominal charge, and have come to stand determinedly for true service charges. By their own efforts, arguments marshalled in convincing manner have proved that every device for throwing public services upon the general tax rate is undesirable. It is these very arguments that speak for a method of public-works construction by which charges for any special service are placed upon those who use the service, as against methods that would further swell the heavy burdens of taxes and public debt.

Were it practicable, perhaps even today the toll system would be invoked to support our road maintenance; an obvious effort to reach the same end indirectly may be seen in the steadily evolving principles of our motor license system. Direct toll collection is not practicable for roads. This does not signify, however, that the system may not be applied to a bridge.

The interesting bridge project for the Hudson River Highlands, sketched in this issue, is a case in point. It gives a tangible basis for the discussion of questions that have long been in the air, and as the most prominent recent proposal of public-works construction by private initiative, it directs attention anew to the possibilities of this method and should help in encouraging its application to other needed public improvements.

Building a Rib-Arch Concrete Bridge in Arkansas

Fourteen 146-ft. and Two 212-ft. Arches with Girder Span Approaches, Form Concrete Structure 3,173 ft. Long—First Highway Crossing of the Arkansas River—At Fort Smith, Ark.

By C. A. Prokes
Resident Engineer, Missouri Valley Bridge & Iron Co., Fort Smith, Ark.

ARCH centers were special features in constructing the nearly completed Arkansas River bridge at Ft. Smith, Ark. Methods of erection and the way of building out 146 ft. steel centers to carry a 212-ft. arch, were uncommon. The pier work was unusual in plan and in some of the construction methods. Incidentally the bridge is one of the largest concrete structures of the southwest, being 3,173 ft. long and containing over 20,000 cu.yd. of concrete reinforced with 784 tons of steel.

A view, Fig. 1, of the nearly completed bridge, looking from Oklahoma toward Arkansas, indicates the principal structural features. Besides an earth fill approach 2,000 ft. long on the Oklahoma shore, there are 3,173 ft. of concrete structure as follows: Arkansas retaining wall approach, 203⅓ ft.; twelve girder spans, 498⅔ ft; fourteen 146⅓-ft. arch spans, 2,047½ ft., and two 212⅓-ft. spans, 424⅔ ft. The overall width is 41 ft., comprising a 28-ft. roadway and two 6½-ft. sidewalks. The highest point of the roadway is 76 ft. above mean low water.



FIG. 1. ARKANSAS RIVER HIGHWAY BRIDGE NEARING COMPLETION AT FT. SMITH

A 1:2½:5 concrete mixture was used in the bases of all piers, the railing concrete was a 1:1½:3 mixture, and all the remaining work was of 1:2:4 concrete. The arch ribs were designed for a live-load of two 49-ton street cars on a single track; 100 lb. per square foot on the remainder of the roadway; 80 lb. per square foot on the sidewalks, and 25 per cent impact. The floor slab and girders were designed for the live-load of a 15-ton road roller, or 150 lb. per square foot; 100 lb. per square foot on sidewalks, and 25 per cent impact. The maximum allowable stresses used in the slabs and girders were 600 lb. per square inch concrete compression, and 16,000 lb. per square inch tension in steel. The allowable compression in concrete in the arch ribs, including dead and live loads, rib shortening and temperature stresses for a range of 40 deg. F. was 800 lb. per square inch.

All the piers, including the abutment piers, have solid rectangular concrete footings, varying in height from 14 to 16 ft., and resting on a hard shale river bottom. From this rectangular footing the two abutment piers rise vertically in front, and on an incline in the rear, to take the thrust from the arch ribs. There are no wing walls on the abutment piers. The other fifteen piers above the footing, have a section like capital H, Fig. 2. The sides of the H which take the thrust are at the spring line, 8 x 14 ft. for the two longer spans, and 6 x 9 ft. for all the others. The web section is 48 in. wide. The two side sections are battered 1¼ in. per foot in height, from pier base to spring line.

The arch ribs for each of the fourteen 146-ft. 3-in. arches are 4 ft. 6 in. wide, varying in height from 3 ft. at the crown to 5 ft. 6 in. at the haunch. On the two 212-ft. 3-in. arch spans the arch ribs are 6 ft. 6 in. wide, with a height 3 ft. 6 in. at the crown and 7 ft. at the haunch. The small arch ribs are braced laterally by four rectangular concrete beam struts to each half span, and the large arch ribs have three beam struts per half span. (Fig. 1.) The spandrel columns are rectangular, 11 ft. 3 in. apart horizontally, and support the cross beams, or floor beams, 15 in. wide, which carry the roadway slab. The sides of the spandrel columns are battered ⅛ in. per foot, downward from the floor beam, in the width only. At each pier a T-shaped column 43 ft. 3 in. high, Fig. 2, connects the top of the pier with the deck. The floorbeams are 48 x 15 in. in section, between the columns, and are cantilevered from the column to the sidewalk edge to carry the sidewalk. The roadway and sidewalk are divided longitudinally into panels 11 ft. 3 in. long by these floorbeams, thirteen per small span and eighteen per long span. Each small span has four transverse expansion joints of ½ in. elastite, which cut the deck work into sections averaging 38 ft. long. The long spans also have four expansion joints, averaging 51 ft. apart. The sidewalk slab is 4 in. thick, the roadway slab is 8½ in. thick, and two track girders at the center, and one railing girder on each side are the only longitudinal beams under the roadway.

Four river piers and one abutment pier on the Arkansas shore, were built in open cofferdams of light steel sheetpiling by M. M. Elkan, contractor, Macon.

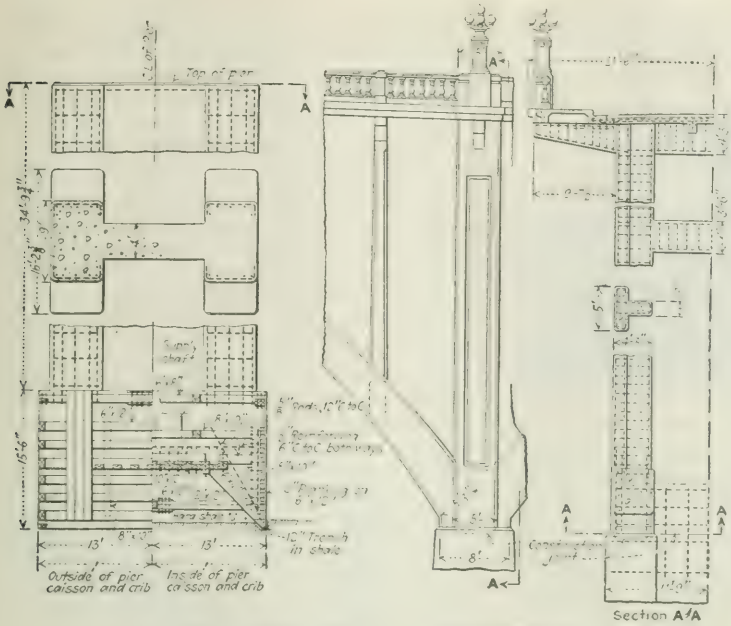


FIG. 2. TYPICAL PIER AND CAISSON DETAILS

Ga., who suspended work in April, 1920. In July, 1920, a new contract to complete the 75 per cent of unfinished work was awarded to the Missouri Valley Bridge & Iron Co., of Leavenworth, Kan. The remaining twelve river piers were then sunk by the pneumatic process, six piers through 32 ft. of sand and gravel on the sand bar, and the other six piers through water for one-third of the sinking depth. The twelve piers were sunk in 4½ months, averaging 7½ actual working days for sinking one pier, working three 8-hour shifts. An air compressor on the Oklahoma shore furnished air through a 4-in. iron pipe, carried across the river on a pile and timber tram trestle, and the maximum distance for piping was 2,000 ft.

The side walls of the caisson cribs were 6 x 12 in. timbers laid horizontally, and held together with ¾-in. iron drifts, 30 in. on centers, and covered on the outside with 2-in. friction planks, placed vertically, (Fig. 2). The cutting edge timber was covered with a 6 x 6 x ½-in. iron angle on the bottom, to act as the cutting edge of the pier. On the sand bar, the caissons were built directly on the ground, while in the river, they were built on a platform, supported by wood piling, and when built, were lowered to the river bed with six 2-in. screw jacks.

The most difficult pier work was where one of the steel pile cofferdams, that had to be abandoned on account of high water, was discovered almost full of sand and leaning downstream, distorted and at an angle, and partly in the site where the new pneumatic pier was to be sunk. Several 1-in. cable slings were passed through holes in the tops of the steel piling under water, by a diver. These cable slings were attached to wire rope rigging of double and triple blocks, fastened to the adjacent finished pier and the combined effect of several heavy dynamite blasts under water, and pulling on the piling, swung it aside so as to clear the pier site.

The steel falsework for each of the fourteen 146-ft. 3-in. arch spans consisted of one steel truss under each of the two arch ribs, with a pin connection at the center. These two trusses, when in place, were diagonally and laterally braced with rods, have a span of 136 ft. from back to back of shoes and are 46 ft. high. There was 7½ in. of oak blocking between the back of the truss shoe and the face of the concrete pier. The shoes rested on a 12 x 12 in. oak cap, supported by four 12 x 12 in. posts, on the top of the pier footing, and held to the side of the pier with bolts. The top chord of the trusses, on a radius 10 in. smaller than the intrados of the arch ribs were parallel to the arch rib bottom, thus requiring only 6 x 8-in. joists on edge, with 2-in. lagging on top of the joists, for the bottom form of the arch rib. The 6 x 8-in. joists were set perpendicular to the axis of the bridge, spaced 30 in. apart and held in place with ½ x 4-in. lag screws through the top chords of the trusses.

On the two 212-ft. 3-in. arch spans the clear distance between the face of piers, is 198 ft. The same steel centering was set in the center of the span, with each shoe resting on a cluster of nine wooden piles. With this set up, there was a clear space from the face of the concrete pier to the back of the truss shoe, of 31 ft. The falsework, therefore, consisted of the three steel trusses, braced diagonally and laterally, with the space between the top chord of the trusses and the intrados of the arch ribs built up of timber posts, caps and stringers, Fig. 4.

A layout was made on the floor of a barn hay loft, near the site of the work, of the arch ribs, the steel trusses, etc., on a scale of 1½ in. per foot, then the proper size stringers, posts, caps and sills for the design, were located on the layout. From the layout, full sized templets were made with the proper lengths, bevels and daps in the posts, sills and caps, and also the intrados curve on the joists for the arch rib. From these templets, all the timber was framed on the ground, properly marked, then erected in place and fitted together. This framing of all the timber before erection was a great saving in carpenter work.

The three steel trusses for the two long spans were erected in half sections. Three half trusses were assembled on pile bents on a level with the truss shoes, laterally and diagonally braced, then raised as one piece, by using two sets of four triple 14-in. iron blocks, Fig. 5. From each set of four triple blocks, there was one lead cable ⅞ in. in diameter leading to a two-drum hoist, which raised the three half trusses as one piece, by winding both engine drums simultaneously. The triple iron blocks were lashed to four 1-in. cable slings, rest-

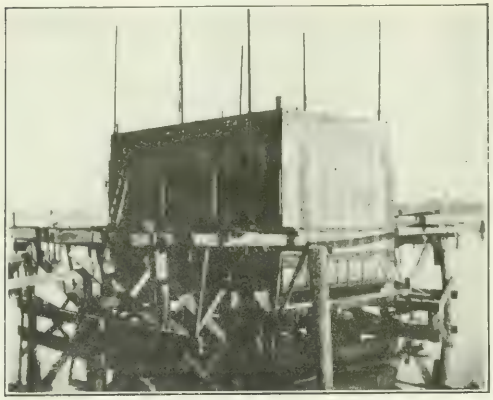


FIG. 3. CAISSON ON PLATFORM READY TO BE LOWERED

ing on a heavy timber bent, about 35 ft. above the truss shoes, this giving the necessary purchase to start the load of 25 tons, upward. After one half of the three steel trusses was raised and the cables clamped, the other half was similarly raised, and then the pin connection at the center was made. For the twelve shorter spans of 146 ft. 3 in. where the steel falsework consisted of only two complete trusses, the two half trusses were similarly raised in one piece, but the rigging consisted of four sets of one double and one triple blocks.

Plant for Concrete Work

A timber-trestle service railway was maintained across the two channels of the Arkansas River, respectively 570 ft. and 900 ft., during the construction of the piers. This tram track was 6 ft. above mean low water and was washed out by flood waters four times within six months, during the construction of the piers, but each time the piling and timber were salvaged by being held by wire rope. The tram track carried a 4-in. air pipe line from the compressor plant on the Oklahoma shore to the sand bar, which could be tapped at any pier site during the pneumatic sinking.

All sand and gravel for concreting was pumped out of the Arkansas River within a mile of the bridge site, delivered in barges to the Oklahoma shore and tested for the proper proportion of sand and gravel and then unloaded with a stiff-leg clamshell derrick, into a storage pile on one side of the derrick. On the other side of the derrick, a small mixing bin directly over a 1-cu.yd. mixer, on the edge of the Oklahoma shore, was kept supplied from the storage pile, when concreting.

The concrete for all the pier work was transported over the timber tram in two 1-cu.yd. bottom dump buckets, mounted on two 36-in. gage trucks and drawn by a 10-ton dinky steam locomotive, with a maximum hauling distance of 2,000 ft. For the river piers, a barge derrick lifted the bottom-dump concrete buckets from the cars, delivered on the tram, and deposited the concrete into the piers, directly. On the sand bar, an A-frame portable derrick, on one side of the track, lifted the buckets of concrete from the tram and deposited the concrete into the piers. After the pier work was complete, the arch ribs for the two long spans, near the Arkansas shore, were poured. The dinky locomotive hauled cars of concrete from the Oklahoma mixing plant, over the two river trams, and deposited the concrete into a hopper at the bottom of a 200-ft. tower,

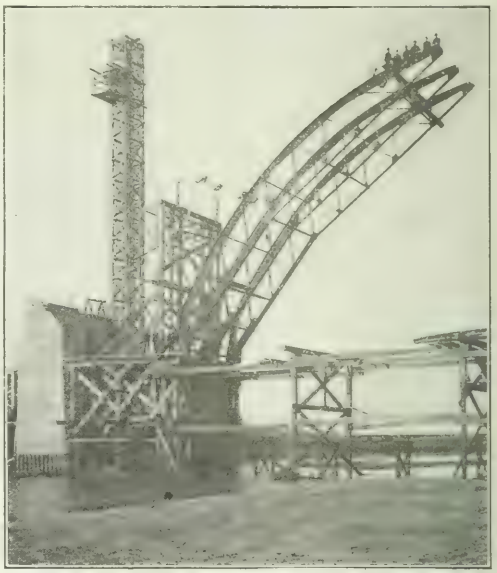


FIG. 5. RAISING STEEL CENTERS FOR 212-FT. SPAN

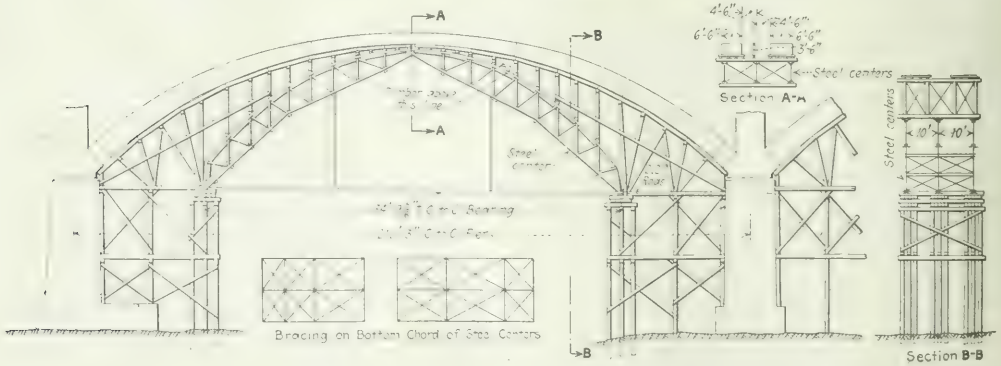


FIG. 4. STANDARD ARCH CENTER BUILT OUT FOR LONGER SPAN

centrally located between the two spans (Fig. 4). From the tower, the concrete was spouted into the arch ribs in four different pourings as shown in Fig. 3. The first pouring being adjacent to the haunches, the second adjacent to the crown, the third pouring covering the crown, and the last pouring being made at the haunches.

After the long arch ribs were poured, the river tram was abandoned and removed, and all the superstructure concrete above the tops of piers, was transported over an overhead tramway, resting on the forms for the arch ribs, and erected over the center line of the bridge, with its track 52 ft. above and parallel to the tops of the piers. The concrete in the 14 small arch ribs was poured in two operations only, of 215 cu.yd. and 16 cu.yd. respectively. The first pouring each time of 215 cu.yd., extended from a bulkhead 4 ft. from the haunch at the spring line, to the opposite bulkhead, similarly placed. This allowed the necessary settlement and shrinkage of about 97 per cent of the concrete in the full arch ribs, and 48 hours later, when the timber bulkheads were removed, the remaining 4 ft. of arch rib at the four haunches was poured.

The superstructure concrete was elevated in a 100-ft. tower at the Oklohoma shore, spouted 100 ft. to the center line of the bridge into two 1-cu.yd. cars, drawn by a gasoline tractor on a single 36-in. gage track. The tram track for the superstructure work was 4 ft. above the finished concrete roadway of the bridge, was maintained until all the superstructure concrete was in place, and after dismantling, the 8 x 8-in. holes in the 8-in. floor slab, through which the tram posts passed, were filled with concrete.

The original contract was awarded to M. M. Elkan of Macon, Ga., in February, 1919, for $537,000, for the entire work, but in April, 1920, work was suspended and the contract breached. In July, 1920, the contract to complete the unfinished work was awarded on a percentage fee basis. The structure will be ready for traffic about March 1, 1922, and the total cost will be approximately $850,000. The bridge was designed by Messrs. Hedrick & Hedrick, consulting engineers, of Kansas City, Mo., with J. M. Robinson, resident engineer. M. L. Wagner was superintendent and C. A. Prokes, resident engineer for the Missouri Valley Bridge & Iron Co., contractors.

Ban on Highway Advertising Signs

Advertising signs of all kinds are prohibited on state highways in California, according to the ruling of the California Highway Commission, and when found thereon are immediately removed by maintenance forces. While this policy keeps the right-of-way of the state highways free from obstructions, it does not prevent construction of billboards on adjacent private property.

Recently Kings County passed an ordinance prohibiting the erection of advertising signs on the county highways of that county and traffic officers have been instructed to remove all signs that remain on roads after a certain date. This action probably will be followed by other counties, as there is a growing sentiment against the disfiguring of highways with advertising contraptions.

The Farm Bureau centers in Butte County and in other sections of California are taking up the subject and it is quite possible, the commission believes, that sufficient sentiment will be aroused before the next legislature to make it possible to pass a general law prohibiting the disfigurement of the landscape by commercial appeals.

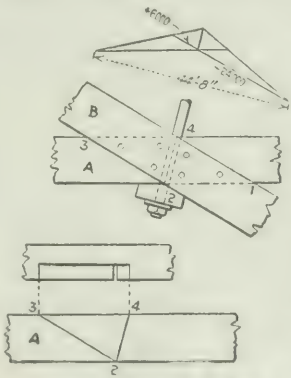
Hook Joint for Timber Chord of Scissors Truss

By David C. Coyle
Gunvald Aus Co., Consulting Engineers, New York

ORDINARILY a wooden scissors truss is used only for short spans, and the stresses occurring at the intersection of the bottom chords, being small, are easily carried by bolts. The special detail shown herewith was made necessary by the unusual size of the truss, which has a span of 44 ft. 8 in., and by the fact that it is exposed, and must have no unsightly connections.

The stresses in the bottom chord are 24,000 lb. tension below the point of crossing, and 6,000 lb. above, making a total force at the joint of 30,000 lb. in each chord timber. If a pair of steel splice-plates had been used they would have required about thirty ¾-in. bolts; whether so many bolts would work together satisfactorily is more than doubtful. Splicing with 2-in. plank was rejected as unsightly.

Finally a form of hook splice was adopted which combines neatness with positive action and sufficient strength. The total thickness of the joint, for two 6 x 8-in. chord timbers, is 9 in., so that each timber is 1½ in. off center. The top and bottom chords are framed flush at the end connection, and above the crossing the bottom chord is tapered to the point where it enters a mortise in the top chord. By cutting this taper from one side only, the required bend is obtained to bring the tapered end on center. To make the joint the chord-timber *A* is cut on its inner or near face on the lines 2-3 and 2-4, removing a triangular block 2½ in. thick. Piece *B* is cut exactly the same (*not* opposite hand). When assembled, the two pieces hook together on the surface 2-4, which is very nearly perpendicular to the grain and to the line of stress. Surface 2-3 need not be accurate. The compressive stress on surface 2-4, which is about 8 x 2½ in., amounts to 1,500 per sq.in. Part of this surface is cut by a hole for the 1¼-in. rod, but as this area is enclosed in 3 in. of wood and firmly bolted against splitting, it seems fair to count the whole projected area as bearing load. The net tensile section of 3½ x 5½ in. (2 bolts out), carrying 23,000 lb. (1,000 lb. deducted as load carried by first bolt), is under a unit stress of 1,240 lb. per sq.in.



TIMBER SCISSORS TRUSS, AND SPECIAL JOINT OF BOTTOM CHORD

Waterproofing a Leaky Reservoir at Nashville, Tenn.

Leakage Through Masonry Walls and Old Concrete Floor Necessitated Extensive Repair and Watertight Lining

A LINING composed of two layers of gunite with an asphaltic burlap membrane between them is the means adopted for waterproofing the masonry walls of a leaky reservoir at Nashville, Tenn. The membrane was extended over the concrete floor and covered with 4 in. of poured concrete. Both gunite and poured concrete were provided for in the specifications, the unit prices leading to the use of the former in the walls and the latter on the floor. Fig. 1 is a view of the waterproofing work in progress.

Water from the Cumberland River is pumped to a gravity reservoir of 50,000,000 gal. capacity on Kirkpatrick Hill, at an elevation of about 308 ft. above low water in the river. This reservoir is formed by 34-ft. walls of limestone blocks laid in natural cement, and in the middle of the wall is a vertical core of natural cement concrete about 15 in. thick. In plan the reservoir is oval, 603 x 463 ft. at the top, with a partition wall on the minor axis, as shown in Fig. 2.

Leakage has occurred through the bottom and walls since the reservoir was completed in 1889. A natural cement concrete floor was provided originally, but the water escaping through the bottom softened the earth and clay seams in the limestone rock so that in November, 1912, a section of the wall of the east basin collapsed. After rebuilding the broken section, the entire inner surface was covered with concrete applied by the cement gun, and new concrete floor with asphalt membrane was placed. At some later period the gunite was given an asphaltic coating applied by mopping. The construction, accident and repairs were described in *Engineering News* of June 16, 1888, p. 484; Nov. 14, 1912, p. 922, and May 6, 1915, p. 849.

Leakage again became evident in 1916, and in 1919 the city commissioners appointed a board of consulting engineers consisting of George W. Fuller, Leonard Metcalf and J. N. Chester. Investigation showed that thorough repair of the reservoir was necessary and plans were prepared under the direction of the engineers. These included not only a waterproof lining but the underpinning of the walls with concrete at points where leakage had affected the foundation. No lining was applied to the partition wall.

Work was started in the east basin, which had been empty for some time on account of the leakage. The first proceeding was to scrape from the wall the ⅛-in. asphalt coating. Then the old gunite, which in some places had not adhered properly, was removed by pneumatic chipping hammers, which also dressed the rock-face masonry to a regular surface. Large projections were knocked off with sledge hammers and chisels. This work was done by men on suspended platforms and the dressed surface is shown at the left in Fig. 1.

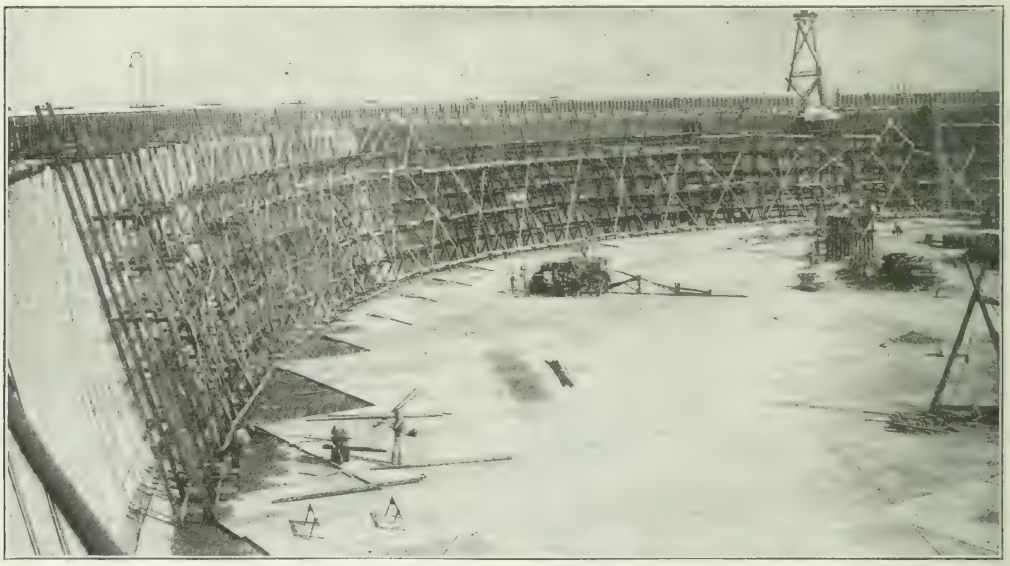


FIG. 1. LINING MASONRY RESERVOIR WITH GUNITE AND ASPHALT

Three rows of 1¼-in. holes were then drilled by pneumatic drills, one row about a foot below the coping, one about half way down the wall and the third near the foot. In these holes, 6 in. deep and 36 in. apart, railway spikes were grouted with a projection of about ⅜ in.; to which were fastened horizontal ½-in. reinforcing rods. Galvanized wire netting of 4-in. mesh was attached to these rods, being placed in vertical sheets 54 in. wide, wired together at the 4-in. laps. The sheets were straightened by pulling them through a set of rolls.

Gunite was then shot on the wall at 60-lb. pressure, giving an average thickness of 3 in., encasing the wire mesh and forming an even surface. Sheets of burlap were hung against the surface and kept damp for 24

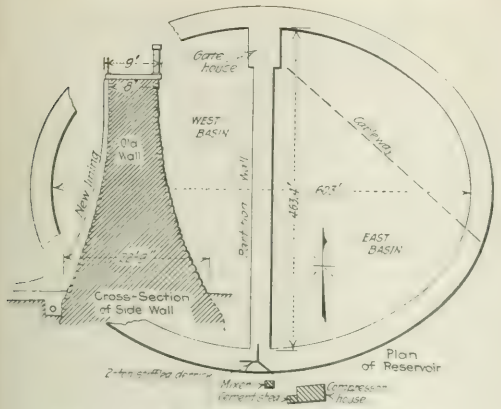


FIG. 2. PLAN AND SECTION THROUGH WALL OF RESERVOIR

hours, to prevent the gunite from setting too rapidly. As fast as the gunite became set and dry it was given a paint coat of asphalt. Sheets of asphalted burlap were then applied and mopped in place, the sheets overlapping so that the entire wall was covered with a three-ply membrane from just below the coping to a connection with the floor membrane. A coat of asphalt completed the membrane.

To carry the wire mesh for the outer or protective coating of gunite, holes 6 in. deep and 36 in. apart were drilled just below the coping and sloping downward. Into these were grouted the hooked ends of ½-in. rods extending down to the floor. When the wire mesh had been attached to these rods, a second 3-in. coat of gunite was applied, extending from the underside of the coping to the floor. Details of the lining are given in Fig. 3, and Fig. 4 is a view of the completed lining on the side wall, with the unlined partition wall at the right.

Test of Adhesion.—To determine the adhesion of gunite to the asphalt, a vertical concrete wall was covered with a membrane as used in the reservoir. Against this was placed a frame 1 ft. square and 3 in. deep, this being filled with gunite which was allowed to set for two weeks (see Fig. 5). A 550-lb. load was then suspended from the gunite block at 10 a.m. and at 3 p.m. the block had slipped down ¾ in. A heavy storm prevented further observation, but next morning the block was on the ground and the membrane had sagged. A similar test showed that with a load of 200 lb. per square foot there would be no movement of the gunite on the asphalt.

Wall Concreting Plant.—Three air compressors were used to operate the chisels, drills and three cement guns. Water was pumped from the west basin. The dry mixture of sand and cement for the guns was prepared in a continuous mixer and elevated to a bin from which it was taken by a tilting bucket and handled by the derrick hoist shown in Figs. 2 and 4. This bucket dumped its contents into a chute supplying a hopper on the floor, from which it was conveyed to the cement guns in wheelbarrows. A scaffold was erected for about 75 per cent of the length of the wall (see Fig. 1), to permit of continuous operation of the three stages of the new lining. As fast as the outer covering of gunite was placed the rear sections of the scaffold were removed and re-erected to close the gap.

Floor Reconstruction.—Before laying the new floor, the upper wedge block around the edge of the old floor was removed and concrete was filled into the old drain



FIG. 4. WALL LINED AND CONCRETE FLOOR BEING LAID

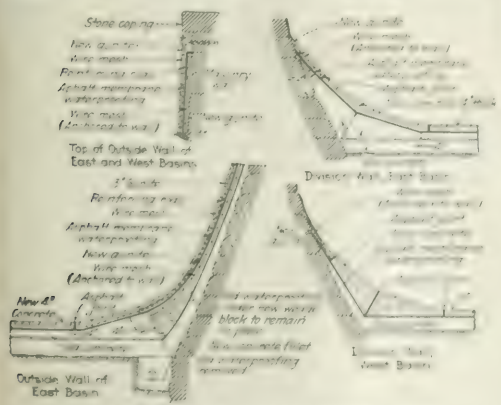


FIG. 3. DETAILS OF WATERPROOF LINING

trench and above the floor, forming a notch or recess as a footing for the first layer of gunite on the wall (see Fig. 3). This arrangement formed a smooth curve leading the membrane from the wall into the floor. After the old concrete floor had been cleaned, it was covered with a membrane composed of three layers of hot asphalt and two layers of burlap. Over this was laid the 4-in. protective covering of 1:2½:5 concrete, poured in place to form slabs 16 ft. square, as shown in Fig. 4. [illegible] was poured into the 1-in. joints between the slabs. This concrete was carried up at the sides to make a smooth junction with the gunite lining of the walls.

A cableway for handling material ran from a 55-ft.



FIG. 5. TEST OF ADHESION OF CONCRETE TO ASPHALT-BURLAP MEMBRANE

tower outside the reservoir, one end being anchored to a deadman and the other to a pipe in the floor under the gatehouse (see Fig. 1). A ½-yd. mixer adjacent to the tower delivered the concrete to a bucket which dumped it into a hopper supplying buggies which distributed the concrete over the floor. A portion of the reservoir with wall lining and new floor completed is shown in Fig. 4.

This repair work was carried out under the direction of J. N. Chester, one of the consulting engineers; W. W. Southgate, city engineer, and George Reyer, superintendent of waterworks. A general contract was let to W. S. Rae, of Pittsburgh, Pa. The waterproofing membrane was placed by the Ryan Sales Co. (agents for the Barber Asphalt Co.), Nashville, Tenn.; the concrete floor by the Gould Contracting Co., Nashville, Tenn., and the gunite by the Cement Gun Construction Co., Chicago. Work in the east basin was commenced July 1, 1921, and completed Sept. 1. After this basin had been filled with water, the west basin was emptied and cleaned of mud. Lining this basin was commenced Oct. 25 and completed by Jan. 1, 1922.

Stream Pollution Notice to Engineers

Under a law which went into effect in July, all plans for sanitary, land drainage and river improvement works in Illinois require approval by the State Department of Public Works and Buildings in regard to outlets into streams. A notice to this effect has been issued by the Division of Waterways of this department, since this provision of the law is not generally understood by engineers. There has been an impression that plans for sewerage and sewage treatment require only the approval of the State Department of Public Health, but if the outlet is to a stream a permit from the Department of Public Works must be obtained. Further, plans for drainage districts must be submitted to this department for approval, in order that outlets and stream improvements may be so arranged as to provide adequately for future demands of enlarged districts, instead of merely meeting present or local conditions.

Use of Centrifuges for Sewage Sludge Dewatering

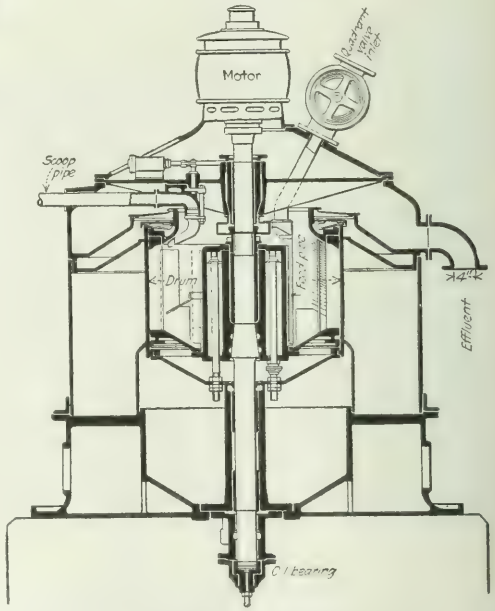
By T. Chalkley Hatton
Chief Engineer Sewerage Commission, Milwaukee, Wis.

Slightly condensed from a paper read before the Sanitary Section of the American Public Health Association, as printed in the *Journal* of the Association for November, 1921.

FOR many years—in fact up to the present—sludges produced by many of the English sewage disposal plants were deposited upon ground and ploughed in. After a few seasons of this practice, the tracts of ground set aside for this purpose became sour and unable to digest the organic matter. They were, therefore, abandoned.

The largest sewage disposal plant in England, the Birmingham plant, is now lagooning the sludge, monopolizing a large tract of most excellent ground which could otherwise be used for the production of foodstuffs of which the country stands so greatly in need. This method not only destroys the real value of the ground but constitutes a nuisance to the immediate neighborhood.

To sum up my impressions after a recent visit to many of the sewage disposal plants of England: There was



CROSS-SECTION OF CENTRIFUGE

none (except disposal at sea) where the disposal of the sludge was being handled so as to avoid a nuisance. In fact, it was creating a far greater nuisance than the clarification of the sewage.

I had an opportunity to compare the relative advantage of the methods employed in Germany and England.

The sludge problem, my observation showed, was studied with painstaking care and considerable skill by the German engineer. Recognizing that he had a product for which there was a market, he proceeded to make sure of this market by preparing and delivering his product so as to give satisfaction to the ultimate buyer.

The English engineer, on the other hand, starts with the assumption that the English farmer and truck grower will not use sludge in any form, no matter how well prepared and conveniently delivered. He ignores the requirements of his potential customers and produces his sludge in a form

best suited to himself. It is to be regretted that the American engineer has adopted the same negative point of view.

Modern agricultural chemistry shows that all sludges produced by sewage disposal plants contain sufficient fertilizer value in the form of nitrates (ammonia and humus) to warrant their use by the farmer or small truck gardner, provided the cost of handling is not too great. That the sludges produced from plain sedimentation may be profitably used by the agriculturist when the wagon haul does not exceed five miles, and providing the sludge contains not more than 75 per cent moisture, was demonstrated by the Agricultural Department of the late Imperial German Government as far back as 1912. The German Government from that time on prepared and distributed literature instructing farmers in the most approved ways of using sludge as a fertilizer.

What has been the result? Hamburg, Hanover, Frankfurt-on-the-Main and many other German municipalities are disposing of their sludge to the surrounding community so effectually as not to have a dozen wagon-loads left on hand any one night. In fact, the demand is so great that each customer is given his own day in the month when he must come for his apportionment, for which he pays a certain sum fixed by the government. While this sum is not sufficient to meet the cost of dewatering the sludge, it defrays at least a part of the expense. More important is the fact that the sludge nuisance is eliminated.

German Accomplishment

Now how has Germany accomplished what none of the rest of the world has been able to achieve? (1) By preparing its product to meet conditions under which the consumer can handle it; (2) by educating the consumer, through national and local government bureaus as to the value of the product and the best methods of using it. As a result of these two important services, a market for all the sludges produced has not only been found but is being extended more rapidly than the demand can be met.

That sludge which has been properly prepared need not look far or long for a buyer has been proved by at least one progressive English municipality. The city of Bradford, after extracting the excess grease from its sewage through filter presses, breaks up the cake by means of a disintegrator and thus finds a ready and profitable market for it among the fertilizer manufacturers. Notwithstanding the fact that Bradford's raw sewage is notoriously offensive, the neighborhood around the disposal works is free from unpleasant odors. This is due in part to the effective methods employed and in still greater part to the prompt shipment of the sludge to the consumer.

The Germans have prepared their sludges by partial dewatering through both filter presses and centrifuges and the sludges so treated are produced mainly from plain precipitation. The filter presses in use are quite similar to the types in common use in America from which about the same results are obtained. The centrifuges, however, are quite different from any the writer has heretofore seen, and are worth a brief description.

The machine is made by the "Hanomag" Works at Hanover-Linden, Germany. It was designed by Dr. ter Meer, director of the Hanomag plant, and George Froboese, his master mechanic. During the war, the American patents became the property of the Custodian of Enemy Property and were purchased by the Barth Engineering & Sanitation Co., of New York City, which changed the name of the machine to "Besco-ter-Meer."

Unlike most centrifuges, the machine is continuous and automatic in its operation and is devoid of all screens. It can be set to feed, discharge, post centrifuge and scoop at any cycle or combination without any manual control. It builds up its cake against a solid stationary plate and unloads it by dropping below this plate the depth of the bowl, the cake being thrown out of the bowl by centrifugal force into a chamber equipped with revolving scrapers which remove it to the point of discharge.

The important dimensions are as follows: Inner diameter of drum, 44 in.; drop of drum when discharging, 20 in. Depth of cake chamber to overflow [illegible] Thickness of cake formed, 9 in. Operating oil pressure to support shaft drum and motor, 210 lb. per square inch. Total height of machine, including motor, 10 ft. Diameter of outer housing, 6¾ ft. Weight of machine, approximately 10 tons, r.p.m., 1,000. Main drive motor, 35-hp. slip ring. Oil pump motor, 10 hp. Automatic control motor, 2 hp. Inlet wave designed to automatically control rate of feed.

Average records taken from two disposal plants where these centrifuges have been in use for several years will fairly illustrate the ability of the machine to dewater sludges from plain sedimentation. At the Herrenhausen plant, which treats the sewage from Hanover-Linden, amounting to 40 m.g.d., plain sedimentation only is carried out for clarification. The time of detention is two hours. Every two days one of the 12 sedimentation tanks is emptied and the precipitated solids, amounting to 70 per cent of the total suspended solids in the raw sewage, is run to sludge storage tanks.

This sludge, containing 96 per cent moisture, passes through a 9 m.m. mesh screen and into one of three 36-in. centrifuges, each of which delivers 11 cu.yd. of cake per hour, containing from 72 to 75 per cent moisture, the filtrate being returned to the raw sewage. The cycle of operation is four minutes, which embraces filling, centrifuging and discharging. Each machine requires a 25-hp. motor to operate and one man looks after the operation of all the equipment in the centrifuging house. Screw conveyors carry the cake from the machines to outside the building where it is loaded upon wagons and hauled away.

The sewage disposal method in use at Frankfort-on-Main consists of fine screening, ¾ hr. detention in sedimentation tanks and dewatering of sludge. Seventy-five per cent of the suspended solids are removed by sedimentation and these are removed from the tanks after about seven days, becoming quite septic before further treatment.

Eight 36-in. centrifuges are installed, each of which operates 1,200 hr. per month, producing 15,000 cu.m. of cake with 70 to 75 per cent moisture, or about 16 cu.yd. per hour, the filtrate being returned to the raw sewage. Each centrifuge is operated by a 15-hp. motor. Counting the screen, agitator and oil accumulator, each centrifuge requires 20 hp. to operate and one skilled laborer looks after all the plant inside the centrifuge house. The sludge is carried from the centrifuges by screw conveyors to direct-heat dryers where the moisture is reduced to 15 per cent.

Need for Sludge Reduction

During the war, the drying plant was cut out and the sludge cake from the centrifuges has since been conveyed by hand-pushed cars to a dump, from whence it is removed, as fast as deposited, by farmers and truckers who pay four marks per wagonload containing 2.6 cubic yards.

Compare this extremely sanitary method of disposing of sewage sludge, where no man handles it except to load the partially dried material in wagons, and where it cannot be seen from the time it leaves the sedimentation tank until it reaches the dump cars, with the present unsanitary and highly offensive method used in any of the modern plants.

It is the writer's opinion that the English and American engineers have failed to grasp the idea that satisfactory sewage disposal is not accomplished by merely treating the liquor so that the effluent shall not produce a nuisance to the body of water into which it is finally discharged. It is no less essential that the sludge produced from such treatment should be so disposed of as to reduce to a minimum the nuisance and danger to workmen engaged at the disposal plant, and to the adjacent neighborhood.

The tendency in most disposal plants is to get rid of the sludge in the cheapest manner possible regardless of the temporary or permanent nuisance resulting. Until this tendency is overcome, the disposal of sewage will not prove satisfactory from the public viewpoint.

The writer believes from his experience in operating and viewing the operation of centrifuges in dewatering sewage sludges and water-laden solids in the industries that centrifuges of the proper type can be economically used in a great many disposal plants in this country and in Europe to displace the crude methods now practiced; that centrifuging will prove far more sanitary; that it will dewater the sludges so that they can be easily and profitably handled, thus creating a steady market for all produced.

FROM JOB AND OFFICE

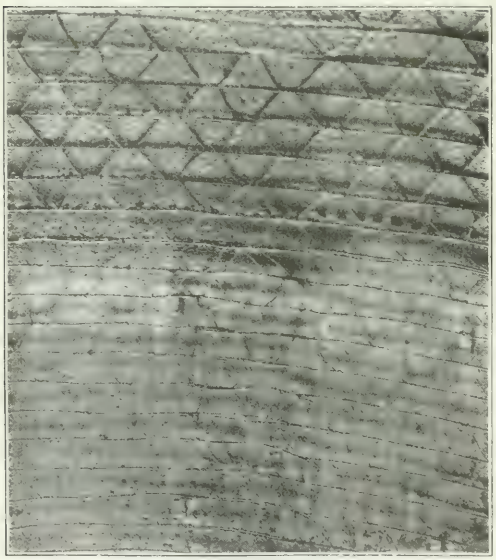
Hints That Cut Costs and Time — *For Contractor and Average Engineer*

Drill Sharpener Used for Cutting Reinforcing Steel

CONSTRUCTION forces of the Southern California Edison Co. working on Big Creek power house No. 8, finding a Leyner drill sharpener available on the job, set it up in a convenient location in the material yard and used it for cutting reinforcing steel. Special dies were made in the blacksmith shop to adapt the machine to this purpose. The speed and convenience resulting from the use of the sharpener are said to have been factors in completing the job in record time. Bars up to 1 in. in diameter were cut in this way, a single blow of the hammer being sufficient to cut the small steel. Five or six blows were necessary for the heavier sizes.

Steel Standpipe Cleaned and Reinforced by Cement Gun

IN THE recent cleaning and repair of a high steel standpipe on the estate of Daniel Guggenheim, Port Washington, Long Island, a cement gun was used both to sandblast the corroded metal and to coat it with a mortar lining. The standpipe, which is 20 ft. in diameter and 80 ft. high, has been in service 20 years and had become so corroded that the structure had weakened considerably. Some of the rivet heads were almost entirely rusted away and the steel plate had become so thin that in cleaning the sandblast cut small holes through it.



EXTENT OF CORROSION SHOWN BY POCK MARKS—FIRST GUNITE COAT BELOW

The standpipe was first cleaned inside and out by sandblast, the cement gun being used as a sandblast machine. A ½-in. nozzle tip was used for this purpose instead of the standard tip used for placing the gunite. After the cleaning, 1-in. x 1-in. x ⅛-in. angle clips placed on 18-in. centers were welded to the steel plates. A hole in the outstanding leg of each clip provided a means of fastening the heavy reinforcing wire mesh, used throughout. Although this mesh served as the principal reinforcing, where extra reinforcement was needed to restore the plates to their original strength, hoops made of ⅜-in. rods were used.

Gunite was then shot into place, forming a continuous sheet over the bottom and walls. No expansion or construction joints were used. The gunite was applied in three coats, each coat being permitted to set for from 12 to 24 hours. The thickness of the completed coat varied from top to bottom, the minimum thickness being 2 in.

The outside of the tank was sandblasted in the same way as the inside and then painted.

In placing the gunite a hollow octagonal scaffold with a diameter of about 18 ft. was used. It was suspended from the top of the standpipe by four double blocks and was handled quite easily by a crew of eight men.

Water was turned into the tank seven hours after the last coat of gunite had been applied and no leakage whatever occurred. The tank was then emptied and inspected for cracks or other defects, but none was found.

The contract for the repairs to the standpipe was executed by the Traylor-Dewey Contracting Co., Allentown, Pa. The work was completed in thirty working days.

Cap Stops Splitting of Treated Piles

DAMAGE to treated piles by the steam pile hammer was one of several kinds of trouble experienced some years ago in getting proper value out of these piles on the Atchison, Topeka & Santa Fe Ry., as noted in a paper read at a joint meeting of the Western Society of Engineers and the American Wood Preservers Association by A. F. Robinson, bridge engineer of the railway. Many cases were found where the heartwood had been broken loose from the sapwood. In the ordinary steam pile hammer the lower end, about 12 in. in diameter, projects through the driving lock and strkies the pile head. As a 12-in. circle has little more than 50 per cent the area of a 16-in. and only about 40 per cent that of an 18-in. circle, the blow from the hammer was being delivered into the piles over less than half the area of the pile head. Skin friction would hold the outer part of the pile and the hammer blows would drive the heartwood loose. In many cases the exterior ring of creosoted sap wood had been split vertically in driving, so that the piles were practically unprotected against decay. This trouble was overcome by means of a driving head or cap 18 in. in diameter, which rested squarely on the head of the pile and was so arranged that the blow from the hammer was distributed over the entire surface of the pile head.

Why Brickwork Estimates Vary

By Charles F. Dingman
Palmer, Massachusetts

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SEVERAL years ago a builders' supply dealer issued a catalog including a table giving the amount of materials required to make mortar to lay 1,000 brick. For a mixture of one part cement, one part lime putty and three parts sand, the catalog gave the quantities as: 0.36 bbl. lime, 0.75 bbl. cement, and 0.32 yd. sand. Use of these quantities was based upon ⅜-in. mortar joints.

I compared the table with the actual results reported from jobs upon which similar mortar and width of joint had been specified and found that the quantities used were as follows:

	Job 1	Job 2	Job 3	Job 4
Bbl. lime	0.94	0.65	0.50	0.81
Bbl. cement	0.53	0.57	0.37	0.19
Yd. sand	0.43	0.55	0.47	0.47

It will be noticed that none of the jobs completed furnished a very good check upon the figures given in the catalog. The small quantity of cement used on Job 4 is explained by the use of a local grey lime, rich in alumina, which produces a very strong mortar even when the major portion of the specified quantity of cement is replaced by lime.

The variation in the amount of lime used on the other three jobs is probably explained by the difference in the bulking capacities of the different brands used. For instance, three different brands show a production of putty of 2.50, 2.62 and 2.75 times the amount of dry lump lime, and authorities writing on the subject give an even wider variation. From the above, it would seem that, to get the actual proportions called for in the specifications, the quantity of dry lime used should never be more than 40 per cent of the quantity of cement used.

However the tendency is to exceed greatly the specified amount of lime whenever possible because it produces a smoother working mortar, which means a saving in labor cost of bricklaying even though the cost per cubic yard of mortar may be slightly increased.

Regardless of the amount of the cementing materials used, the quantity of sand used is what determines the quantity of mortar produced and the figures indicate a variation of practically 28 per cent between Job 1 and Job 2. Put in other figures, Job 1 used 400 cu.in. of sand per cubic foot of wall, while Job 2 used 510 cu.in.

If the sand contained 33 per cent of voids, 3 cu.ft. of sand and 1 cu.ft. of cement should produce 3 cu.ft. of mortar even if no lime were used, but, as the sand usually used will average from 40 per cent to 50 per cent of voids, the addition of a cubic foot of lime putty cannot increase the total volume beyond 3.70 to 3.80 cu.ft. In other words, the total volume of mortar cannot be over 1.27 times the amount of sand purchased. In actual practice, because of waste and other losses, the total quantity of mortar produced is very likely to be slightly less than the total amount of sand purchased.

So far all of our figuring has been upon the basis of twenty-one bricks per cubic foot. This means that the brick size must not be over 63.24 cu.in. to get the result obtained on Job 1, and 58 cu.in. to get the result obtained on Job 2.

In actual practice, we find estimators using an arbitrary figure for the number of bricks per cubic foot and that figure will range all the way from 18 to 22½, and, because they seldom know in advance what brick will be used, they figure almost every job on the same basis. This means that even if two men figured upon the same number of cubic feet of brickwork in a building, one might figure that he needed 100,000 bricks and the other might figure on 125,000, while the final quantities of brick and mortar materials bought for the job might not check either one. Brick actually used in the New England territory vary enough in size (from about 60 cu.in. to 76 cu.in.) to justify either estimate.

So much for the quantity of bricks themselves. The cost of the mortar materials is a very large factor in the cost of brickwork and may range from one-fourth to nearly one-half of the cost of the bricks.

If the quantity of mortar required could be accurately figured it should not be very difficult to determine the amounts of the ingredients and their costs. But, since the size of the bricks is not known in advance, the exact amount of mortar cannot be known in advance either, so common practice is to use an arbitrary figure per thousand bricks for each of the ingredients and these arbitrary figures vary greatly for the same kind of mortar.

Even if the amount of mortar per thousand bricks were determined accurately for a given size of bricks, it would only be absolutely accurate for a given thickness of wall. For instance, if a thousand bricks laid in a 12-in. wall require 0.55 cu.yd. of mortar, varying the thickness of wall would affect the quantity of mortar approximately as follows:

8-in. wall, 75%	0.41 cu.yd.
12-in. wall, 100%	0.55 cu.yd.
16-in. wall, 125%	0.69 cu.yd.
20-in. wall, 150%	0.82 cu.yd.
24-in. wall, 175%	0.96 cu.yd.

These differences are small, it is true, and on a small building would average up so as to balance one another if costs were reported for a job having all 12-in. walls and these costs were used for estimating another one

This Issue Explains

A new use for a drill sharpener
The repair of a standpipe with a cement gun
How to keep treated piles from splitting
Why brickwork estimates vary
Spacing of mesh reinforcing with pipe grid
How to make large titles for plans and maps
How Arkansas drainage districts are surveyed
Some features of a heavy-duty cableway
How to clean pavements with motor truck exhaust
How to interest a foreman in specifications

having all 24-in. walls, the difference might be appreciable. If a cubic yard of mortar costs $12, then the mortar for a thousand bricks in a 12-in. wall would cost $6.60 and in a 24-in. wall it would cost $7.08. On 1,000,000 this difference would be $480, well worth taking into consideration.

The accompanying tables will be found helpful in estimating the quantities of materials required to make a cubic yard of lime-putty, cement and sand mortar and to compute the cost of mortar per one thousand bricks, the size of bricks and width of joints being known. Having determined the cost of a cubic yard of mortar and the quantity required, the cost of mortar per thousand bricks is readily ascertained.

TABLE I—QUANTITY OF INGREDIENTS PER CUBIC YARD OF MORTAR.

(In the proportions column, cement is given first, lime-putty second, and sand, third)

Proportions	Barrels Cement	Barrels of Dry Lump Lime 180 lb. Basis	Barrels of Dry Lump Lime 280 lb. Basis	Cubic Yards Loose Sand
1–1–3	2.28	1.21	0.82	0.94
1–1–2	3.02	1.58	1.07	0.91
1–1½–3	2.28	0.61	0.41	0.94
1–1½–2	3.02	0.80	0.54	0.91
½–1–3	1.19	3.12	2.11	1.00
½–1–2	1.76	4.61	3.11	0.99
1–3 with 10% lime-putty	2.28	0.12	0.08	0.94
1–2 with 10% lime-putty	3.02	0.17	0.12	0.91

TABLE II—NUMBER OF BRICKS REQUIRED TO LAY ONE CUBIC FOOT OF WALL.

Average Volume of One Brick in Cu.In.	¼-in. Joint	⅜-in. Joint	½-in. Joint	⅝-in. Joint
60	23.7	22.4	21.1	18.6
61	23.5	22.1	20.8	18.4
62	23.3	21.9	20.4	18.2
63	23.0	21.7	20.0	18.0
64	22.4	21.3	19.9	17.8
65	22.2	21.1	19.8	17.6
66	21.9	20.8	19.6	17.4
67	21.6	20.6	19.3	17.2
68	21.3	20.3	19.0	17.0
69	20.9	20.0	19.8	16.8
70	20.6	19.7	18.6	16.6
71	20.5	19.5	18.5	16.4
72	20.3	19.2	18.2	16.2
73	20.0	18.9	17.9	16.0
74	19.8	18.7	17.7	15.8
75	19.5	18.4	17.5	15.6
76	19.1	18.2	17.3	15.4

TABLE III—VOLUME OF MORTAR, IN CUBIC YARDS, REQUIRED TO LAY ONE THOUSAND BRICKS.

(12-in. wall basis. Full joints)

Average Volume of One Brick in Cu.In.	¼-in. Joint (Cubic Yards Mortar Required)	⅜-in. Joint	½-in. Joint	⅝-in. Joint
60	0.28	0.35	0.42	0.56
61	0.28	0.34	0.41	0.55
62	0.27	0.33	0.40	0.53
63	0.26	0.33	0.39	0.52
64	0.28	0.35	0.41	0.55
65	0.28	0.35	0.41	0.55
66	0.28	0.35	0.41	0.55
67	0.26	0.33	0.39	0.52
68	0.28	0.35	0.42	0.56
69	0.30	0.37	0.43	0.59
70	0.28	0.35	0.42	0.56
71	0.29	0.36	0.43	0.57
72	0.28	0.35	0.42	0.56
73	0.29	0.36	0.43	0.57
74	0.29	0.36	0.43	0.57
75	0.30	0.37	0.45	0.58
76	0.31	0.39	0.46	0.62

Some of the figures in Table III may be seen inconsistent at first sight but, by comparing these figures with those in the Table II and noting the volume of wall produced by one thousand of a given size of bricks, the apparent inconsistency will be explained.

Slag-Concrete Highway Mileage

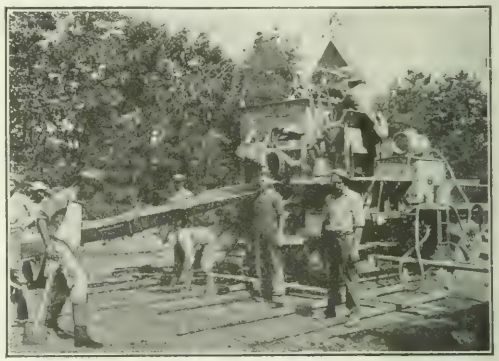
According to a report issued in January, 1922, by the National Slag Association, there are in service in the United States 132 sections of slag-concrete highway, totaling 212.65 miles in length, with an area of 2,392,899 sq.yd. The largest amount of construction of this type has been performed in Ohio, where 44 sections of slag-concrete highway, with a length of 91.87 miles and an area of 760,312 sq.yd. are in service.

FROM JOB AND OFFICE

Hints That Cut Costs and Time

Pipe Grid Behind Paver Spaces Mesh Reinforcement

REINFORCED-concrete paving slab was placed full depth in one operation on highway work on Long Island in 1921 by carrying the mesh reinforcement on a number of pipes trailing behind the mixer, as indicated by the illustration. The pipes were bent and hooked to a bar extending transversely across the mixer. They



PIPES PULLED BY MIXER SUPPORT REINFORCEMENT

were 3 in. in diameter and they held the mesh this distance above the subgrade until the concrete was in place to hold the reinforcement. The pipes, of course, were buried when the concrete was placed, but as the mixer moved ahead often, the concrete remained soft enough to flow in and fill the spaces left by withdrawing the pipes. Incidentally very good progress was made on this road. In 75 days worked, 47,290 lin.ft. of 20-ft. pavement were laid daily. Wm. J. Porter & Co., New York, were the contractors.

Making Titles for Maps and Plans

By Clair V. Mann

Head of the Department of Engineering Drawing, Missouri School of Mines and Metallurgy, Rolla, Mo.

MAKING ELABORATE titles for large maps or for cover sheets for engineering plans is becoming a lost art. To make old Roman, Egyptian or other letters in large size requires time and peculiar ability, neither of which is generally possessed by the average practising engineer. Though the writer is not an advocate of the general use of large or fancy titles, there are occasions when their use is necessary. In order to avoid tedious handwork, black gummed letters, such as appear on office doors, may be used to advantage. Use of them is also quick and inexpensive.

First, secure the desired quantity of letters to be used in the title. Then lay the title letters, properly spaced, on a sheet of cross-section paper and draw a vertical line through the middle of the space occupied by the letters. Mark a horizontal line upon which each row of words rests, and outline each word.

Then place over the cross-section paper a sheet of tracing paper, fastening one side of it to the drafting

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For Contractor and Average Engineer

board. Transfer, in turn, each of the words from the cross-section to the tracing paper, sticking the letters in the positions marked from the cross-section paper beneath. The letters can be handled deftly with a pair of tweezers, and, with a little practice can be lined up and placed accurately and speedily. Proceed thus until the title is complete. By such a method there is produced a tracing from which may be made attractive blue-print covers for sets of plans.

Surveys for Drainage Districts in Arkansas

By O. G. Baxter
Baxter Engineering Co., Little Rock, Ark.

THE MAJORITY of drainage districts in Arkansas are located in the eastern part of the state, in the Mississippi River bottoms, with areas varying from 10,000 acres to 300,000 acres and averaging about 25,000. Most of the land is covered with timber or has been cut-over and has a heavy growth of underbrush and cane. The surface is broken by many lakes, sloughs, bayous and rivers, and the land is usually subject to overflow during the winter and spring.

In order to plan the survey intelligently the engineer must make a complete reconnaissance either on horseback or by walking. A boat can be used to advantage in some districts. The number of camp parties to be used is governed to a large extent by the time available before the wet season. Each camp party consists usually of the following members: Chief of party, 1 draftsman, 3 instrumentmen, 3 rodmen, 6 axemen, 1 teamster and one cook. When two or more camp parties are used, a field engineer is required to supervise the entire survey.

Equipment for each camp should consist of a cooking and dining tent, three sleeping tents and an office tent. Kitchen utensils, cots and mosquito bars are also a part of the equipment. The malaria mosquito does its work mostly at night and is not such a nuisance as the ordinary mosquito, so that it is possible for a man to sleep without being disturbed by the attack of the malaria mosquito. For this reason the chief of party should see that each man has a mosquito bar and that he uses it.

Personal equipment of each man should be limited to a bed roll and necessary toilet articles that may be packed within the roll when camp is moved. The moving of camp is generally left to the cook and teamster after the men have packed the equipment before starting on the day's field work. Camp is moved as the work progresses in order that the maximum distance to the point of work will not be more than four or five miles. It is rarely that the team and wagon can be used to advantage in transporting the men to the work, as roads are scarce and are usually winding trails that are almost impassable in wet weather. Many times a trail has to be cleared for moving camp.

Camp sanitation should not be overlooked. The camp grounds should be policed daily and all rubbish and garbage should be carried a safe distance from camp. The teamster should be required to keep his horses not nearer than 300 ft. from the camp, and if there is any slope he should select a site that will drain away from the camp. Human excreta becomes a nuisance and is dangerous to the health if a proper system is not followed. Trench latrines may be constructed but usually camp is moved too often to justify this amount of work. A simpler and safer method is to require each man, as soon as a new camp is established, to dig a hole about 3 ft. deep at least 300 ft. distant from the camp, and on the slope away from the camp. These holes can be dug in a few minutes with a 6-in. post-hole digger. Each time after these holes are used a few inches of the excavated earth is kicked into the hole. Water is usually obtained by sinking a well pipe, but this water must be boiled before being used for drinking purposes.

Subsistence.—It is possible to furnish better food in camp than can be obtained in small hotels, and the cost will be from 50 to 75 per cent of the hotel rate. During the past 15 years on surveys aggregating more than 4,000,000 acres, I have observed that the party that had the best cook, the best food, and naturally the highest cost per man, turned out more work (other conditions being equal) than the parties that tried to cut down the cost of subsistence to the average contractors' camp cost. For long walks that field men are compelled to take the morale of the party must be good, and I believe that subsistence affects the morale more than any other one factor.

It is not desirable to have standard specifications as to food and rations, or to limit rations in kind and quantity. A good balanced diet should be aimed at, with the food prepared as near as possible to home cooking. It has been my experience that a good high-class cook who also has the ability to buy the food and manage the subsistence department of the survey is the best and cheapest in the long run.

Although the method of conducting the field survey depends to a great extent upon local conditions, the following general plan is suitable for the preliminary survey in many districts.

While the camp parties are being assembled a base or control line is run and closed around the boundary of the district by a transit and level party. The transit line is an azimuth and compass line with stadia distances, using a Philadelphia level rod with two targets. The transit party ties to all land lines and corners and also

If you have hit upon a method

of doing your job quicker and easier than others, let them know of it through these columns. Once a month the "Job and Office" section of this journal will exchange valuable bread-and-butter information among its readers. What short and concise contribution can you give your brother engineer or contractor that may save him time, labor and expense?—*Editor.*

rotes the topography. The base level party follows the transit party. Each day's run is checked back upon itself and the circuit should close by checking within the allowable error $0.05\sqrt{M}$, where M is the length of the control line in miles. The levelman records high-water marks, ground-surface elevations, bank and bottom elevations, and the size of sloughs, bayous and other drains. He also sets bench marks at not more than half-mile intervals. These bench marks are usually on tree roots, the tree being blazed and scribed with the recorded number of the bench mark. Bench marks are also established on bridge piers and other permanent structures where possible.

For the interior survey, level lines are run across the district at intervals of from 660 ft. to one mile (depending upon the topography), and meanders with channel sections of all sloughs, bayous and other channels. The cross-level party takes high water elevations, surface readings at all changes in the ground slope, at instrument points and turning points, and also takes bank and bottom readings at all channels and sloughs. The larger channels are cross-sectioned and the top and bottom width of the minor channels are recorded. All ridges and swales are noted, with their general direction.

Survey Methods

Notes are taken as to the timber, vegetation and soil. Ties are made to land lines and corners wherever possible. Root bench marks are set at half-mile intervals and at channel crossings. These cross-level lines are run by compass bearings and stadia distance by the use of ordinary wye or dumpy levels equipped with stadia hairs and an attached 4-in. compass. The lines all begin at some point on the control line at one side of the district and are tied to the control line on the opposite side of the district. With ordinary care these cross levels check upon the base line within the allowable limit noted above.

The meander party meanders and takes cross-sections of all water courses and makes notes as to their condition regarding drift, growth and other obstructions. Data upon existing bridges are also obtained. Ties are made to the cross-level lines and to land lines and corners. Levels are carried in combination with the meanders unless the interval between cross-level lines is small. The topography between the cross-level lines may be sketched in by the use of a sketching case or some similar method.

Soil borings should be made at enough locations to give a general idea of the soil that may be expected during construction. When the improvements are located in the field, other soil borings are made on the line of improvement to give more detailed and definite information upon the material to be handled. The watershed, outside of the district, can usually be located and its characteristics determined by a reconnaissance survey supplemented by existing maps and data. Current meters should be included in the equipment in order that flow measurements may be obtained during storm periods.

It is necessary that all work be plotted and shown on the detail maps, to a convenient working scale, as soon as possible. If each instrument man uses two books alternately, it will be possible for the camp draftsman to map all the work, by the use of a drafting machine, the next day after it is taken in the field. In addition to the advantage in thus showing up any errors or omissions in the field notes it materially advances the design of the improvement, since the engineer can have earlier and more detailed information upon which to base his study. It has been found from experience that a map showing the elevations in figures is more convenient and more easily understood by landowners and contractors than if contour lines are used. In this respect it should be understood that the fall in the average eastern Arkansas drainage district is about 1 ft. per mile.

If the preliminary survey has been complete, as outlined above, the improvements can be projected upon the map with very small errors in location or in estimated quantities. Progress of surveys in timbered or cutover lands can be computed on the basis of 20 miles per month per instrument. The method of locating proposed improvements in the field does not materially differ from that used in the location of railroads and other improvements.

FROM JOB AND OFFICE

Hints That Cut Costs and Time

Heavy-Duty Cableway Carriage Has Novel Features

IN conveying heavy equipment across the Kern River Canyon, in connection with recent power-house construction, the San Joaquin Light & Power Corp. had need of a cableway that could handle a 29-ton load. In order to get such a cableway in operation quickly



CARRIAGE ABOUT TO PICK UP 29-TON LOAD.
(Note position of main sheaves giving bearing on deflected cable.)

and at low cost a carriage was designed and built on the job which fulfilled these requirements and is reported to have needed no repairs or maintenance.

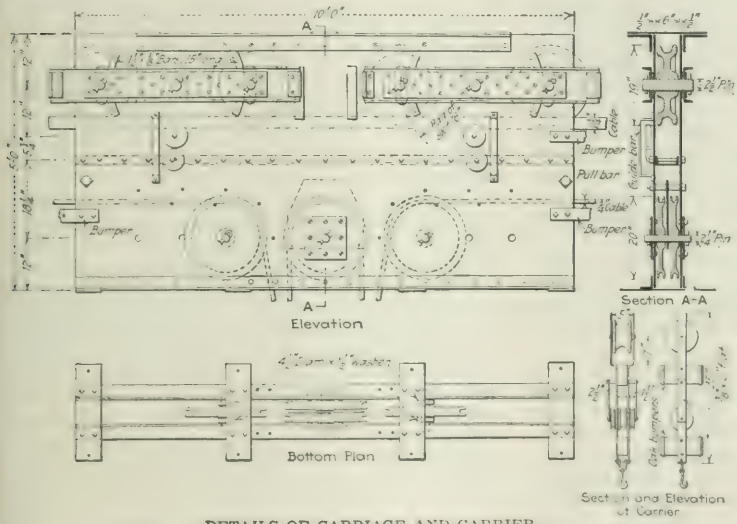
The general arrangement of the carriage is shown in the accompanying drawing. Simplicity and ruggedness were made primary requisites and use was made

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of materials available on the job. Features of its design were: (1) A box or framework with sides made up of heavy plates to give a rigid carriage; (2) an arrangement of main sheaves so each would take equal bearing on the cable under any load deflection of cable; (3) wide separation of sheaves carrying load line to prevent twisting of block and cable; and (4) self-adjusting bumper.

The arrangement of the main sheaves in pairs made it possible to connect rigidly each pair as a single unit which could be attached to the carriage by means of a shaft. Thus load transferred to the main cable through this shaft would be divided between the two sheaves for any position of the cable. Curved bars provided a bearing between the shaft of each sheave and the walls of the carriage to take any thrust due to the load pulling sheave units out of alignment.



DETAILS OF CARRIAGE AND CARRIER

Motor Truck Exhaust Cleans Pavement Cracks for Filling

JOINTS and cracks to be filled with bitumen on concrete roads in Warren County, Pennsylvania, were successfully cleaned with a hose attached to the exhaust of a small motor truck. About a 30-ft. length of ordinary ¾-in. rubber hose, provided with a ½-in. diameter gas pipe nozzle was attached to the exhaust pipe of the small motor truck used for hauling the tar kettle and other tools. The end of the gas pipe nozzle is drawn down to ¼-in. diameter. The crack or joint to be cleaned is first freed from any tightly packed dirt, by means of a metal "cleanout hook." The material thus loosened is then dislodged by directing the exhaust pressure of the motor, by means of the hose and nozzle, into the joint. The motor is speeded up to produce the necessary pressure at the nozzle. The method, it is stated, leaves a perfectly clean crevice. The exhaust gases, being warm, evaporate any moisture that may be present in the edges of the concrete, thus insuring a good bond between the concrete and the hot bituminous filler. The method is stated to be much quicker and more effective than the commonly used street broom, especially in getting rid of the fine dust, which if left in the crevices, may prevent the bitumen from adhering to the concrete. Burgess & Dorrier, Scottsville, Va., were the contractors.

How to Interest a Construction Foreman in Specifications

By Ray S. Blinn
Locating Engineer, Mt. Vernon, Ohio

SUB-CONTRACTORS, grading contractors and many principals do not read word for word long specifications or even understand the lines and figures on an ordinary cross-section. Consequently, they get only a hazy idea as to the relative importance of certain things and, after the job is under way, they too often claim with great gusto and emphasis that certain things were not understood or the contractor was not told to do this or that. The result is that the engineer lays down the specifications and law before the poor man's eyes, and walks away. Friendly relations are severely strained.

There is a better way to handle such a case. Remember the man who is doing the objecting is a grading boss and not a philologist. The specifications are long and tedious and he just can't understand them.

When you hand such a contractor a bid blank and contract form, give him also a few high points—important things—on the first page, on the cover page if you like, possibly something like the following that will be noticed:

1. Grade 18 ft. Wide on Fills.
   Grade 20 ft. Wide on Side Hill Work
   Grade 24 ft. Wide on Cuts
2. Ditches 2 ft. Deep, Sloped
3. No Extras for Rock
4. No Stumps One Foot Under Grade
5. Bank and Widen Curves
6. Engineer to See and Pass on All Sand, Etc., Etc.

Of course these are merely high spots or pointers to be looked up in the specifications and drawings. But the method is a sure device to get men with limited literary training to read specifications and be interested in them.

Try it.

Practical Hints on Selection, Operation and Maintenance

Paving Mixers and Finishing Machines

CONCRETE paving is a machine operation and skillful selection, operation and maintenance of the machines are required to insure large production at low cost. This article contains instructions gathered from manufacturers and users of concrete paving machines and determined by field observations on many operations.—EDITOR.

CONCRETE pavement construction is virtually a field factory process. Paving mixers do more than mix concrete, they perform a succession of pavement fabricating operations. Where their work stops the finishing machine begins and by another succession of operations continues and completes fabrication.

In sequence the operation of a paver and finisher are: (1) *Charging,* which involves lifting the batch of proportioned materials and emptying it into the mixer, and, in some operations, also involves a preliminary operation of unloading batch containers from cars or trucks into the mixer charging skip; (2) *Mixing,* which involves automatic control of the speed of rotation, count of the number of revolutions, determination of the mixing period and measurement of the mixing water; (3) *Discharging,* which includes taking the batch away from the mixer and depositing it, spread roughly to thickness, anywhere within the zone of pavement width; (4) *Spreading,* which includes leveling the placed concrete to thickness; here hand labor is required to aid the mechanical strikeboard; (5) *Tamping,* which involves shaping the pavement to exact crown, and (6) *Finishing,* where again hand work is required to remove surface lumps, sticks and stones and to trowel edges, joints and rough spots.

Generally also the finishing machine cannot wait to do final belting, requiring either a special machine or else hand belting. Final belting must be done two or three hours after the first tamping and belting. The exact time depends on: (1) whether the cement is fast or slow-setting; (2) weather conditions, (3) amount of water in the mix which has to rise to the surface and be wiped off and (4) the ideas of the inspector. Again some highway engineers require a finer finish than is given by machine belting, or a special finish, like brooming, and these involve additional hand work. In some instances also, as with certain aggregates, machine belting does not give a satisfactory finish and hand finishing is necessary. Ordinarily the operations enumerated complete the pavement from raw materials at the mixer to the surfaced slab ready to be cured. They constitute, as previously stated, a field factory process. Emphasis is given to this fact because it is a factor in selecting, operating and maintaining paving mixers and finishing machines.

Selecting Paving Mixers

A mixer which will, as a machine, return the maximum profit is looked for by the contractor. The most profitable machine is the one the sum of whose operating, maintenance and overhead costs is the least. The machine factors which contribute to low operating cost are: (1) Endurance, which lessens the number of breakdowns; (2) speed and ease of operation, which give large output, and (3) mechanical simplicity, which makes repairs easy. Overhead is reduced by a machine having a large total output before being scrapped; a large capacity per day with a minimum number of operators and attendants, and a low first cost. The machine factors which keep maintenance costs low are: (1) Endurance; (2) mechanical simplicity and (3) good service on repair parts.

Putting like factors together, the machine requirements for profitable paving mixer service are, in the order of importance: (1) Endurance; (2) speed of operation; (3) mechanical simplicity, (4) operating simplicity, (5) service in repair parts and (6) first cost. These are fundamental requirements. With them always in the background, the details to be considered in selecting paving mixers are: (1) Size, (2) power, (3) traction, (4) discharging and distributing mechanism, (5) batch transfer mechanism, (6) quality of mix in a given time, (7) accuracy of water measuring, (8) fabrication, (9) manufacturer's service.

A paving mixer has to be large enough to maintain the specified progress. Its size must also be proportionate to the capacity of the other plant units. On isolated two- or three-mile contracts, with wheelbarrow charging from stockpiles on the subgrade, a 7-cu.ft. or 10-cu.ft. mixer is about the right size. Incidentally it should be kept in mind that stockpiling on the subgrade is being every year prohibited by more state highway departments specifications because: the materials get dirty; wheelbarrow proportioning is not accurate, and perfect subgrade conditions are impossible. For normal paving operations of five to ten miles a working season, practice recognizes both 14-cu.ft. and 21-cu.ft. mixers but the 28-cu.ft. mixer has been used by a few contractors with great success.

The volumes given are wet batch capacities and must be increased one-half to obtain the volume of dry materials measured separately. A 21-cu.ft. mixer, therefore, must be large enough to hold 32 cu.ft. of loose material, plus a sufficient quantity of water, plus enough surplus space to allow for out-of-level position while mixing. There must be no slopping even with a wet mixture. A 14-cu.ft. paver is correspondingly smaller but it requires about the same crew, has about 50 per cent less output and costs more per unit of capacity.

Assuming that a mixer is not bought for one particular operation and that concrete materials are delivered and charged mechanically, practice favors a 21-cu.ft. machine. A 21-cu.ft. paver will mix concrete as fast as ordinarily the contractor will be able to get the materials to it by truck, or industrial railway. A 28-cu.ft. paver is distinctly a large contract proposition.

Power for paving mixers has been steam as being more dependable and flexible and as being in the past better known to available machine operators. Recently gas engines have gained favor and the four-cylinder gas engine offers enough possible advantages over steam engines to be well worth consideration. It eliminates bad water troubles, the handling of heavy fuel, the extra

man for firing, injector troubles and time spent in getting up steam, cleaning boilers, etc. The four-cylinder gas engine, properly governed and of excess power, has eliminated practically all the troubles experienced with the old style single-cylinder engine, and the automobile has made more men capable of operating gas engines than can operate a steam engine.

Any motor for a paving mixer must be able to absorb load quickly as the load on the mixer changes rapidly. There is a variation from maximum to minimum power once for each batch or once every 1½ to 1¾ minutes and the change is instantaneous. Simplicity of design, full power, and flexibility are required of any paving mixer motor. In addition look for good balance; protection from dust and slopping concrete; mechanical lubrication; a low hung boiler, in case of steam power, to make firing easy and to keep the center of gravity low.

Mixer Types

Crawler traction is preferable for paving mixers. It does away with planking on soft subgrade and increases the manoeuvering ability of the mixer. Half-length crawler tractions, with truck wheels on the light end, and also full-length crawler tractions, have their advocates. The full-length crawler excels in mobility on the job. For swift movement from job to job, crawler traction is inferior to wheel traction. Ordinarily, however, the mixer had better be hauled or else carried on truck or car, from job to job, to save time and also to reduce wear and tear on the rather complex mechanism of crawler tractions.

With the tendency toward dry concrete firmly established, boom and bucket distribution is rapidly displacing chute distribution, because the dry mixture will not flow down a chute unless it is so short as to be impracticable. Also the boom and bucket gives a wider distribution from one position—up to 20 ft. in a half-circle about the discharge end. Except for lack of range and inability to handle dry concrete the chute has the advantage; it is cheaper in first cost, has greater output capacity, and has fewer operating parts. Two things require to be looked out for in boom and bucket distribution. One is that the boom can be swung when out of horizontal when working up or down hill and the other is that the bucket is full-batch capacity, or even larger, since the dry concrete piles up and requires more room than a wet mixture which spreads level.

With batch box carriage of proportioned materials either by trucks or by industrial railway cars, power is required to handle the boxes to the charging skip and then replace them. A mixer-mounted crane is the usual power appliance. The requirements for this crane depend on whether trucks or industrial cars carry the batch boxes. With trucks a longer boom and greater lift are necessary and a separate hoist is essential while in unloading from low industrial cars the weight of the descending mixer skip is enough power to operate the crane.

There are three principal requisites for a batch box crane: It should be adjustable to grades; it should be transferable from one side to the other of the mixer, and its weight should be supported independently of the mixer traction or truck wheels.

Observation of the details noted, with generally good fabrication and a reputation of the manufacturer for service, will guide the selection of a paving mixer. Reputation of the manufacturer for giving service counts more even than does past performance of the mixer. This fact is emphasized in the following section on mixer maintenance.

Paving mixers are usually delivered with the overhead frame dismantled and the charging skip and boom and bucket disconnected. There are some differences in the practice of different manufacturers. With an inclined runway built from the car floor to the ground the mixer should be moved off the car using its own traction. The runway should be at least 20 ft. long, the car wheels firmly blocked and the moving conducted slowly, with blocks ready to check any possible chance of a runaway.

With the mixer on the ground, the head frame is erected placing the marked members in order and bolting them loosely. When the whole frame has been assembled the bolts are tightened. A truck is advantageous for installing the charging skip and the bucket boom. They are often lifted and blocked up to be connected, but by loading them on a truck and backing the truck up to the mixer much hard work is eliminated.

All parts being in place, the installation of the sheaves and cables, adjusting them to tension, etc., calls for particular procedure which is specified in the detail erection instructions furnished by the manufacturer. Ordinarily the manufacturer provides a service man to direct erection and the final adjustment and tuning up of the whole mechanism. With a trained operator to receive the machine there will be no difficulties in particular but the machinery of a paving mixer is rather extensive and has to be closely correlated and no chances can be taken with jack-mechanics.

Wherever the service can be had and it nearly always can be, a large size paving mixer should invariably be erected and put in operation under the direction of the manufacturer's expert service men. This not only helps to insure perfect installation but it puts the responsibility for satisfactory installation on the mixer manufacturer.

Operating Paving Mixers

With certain general requirements common to good machine operation satisfied, efficiency in operating paving mixers is the result of skillful correlation of machine operations. Not including automatic operations, such as timing the period of mixing and counting the drum revolutions, there are fully ten machine operations in producing a batch of concrete dumped on the subgrade. As all these operations have to be accomplished in two minutes' time, or less, including one minute mixing time, their correlation so as to take advantage of every moment is plainly vital, if high efficiency is to be secured.

Important general requirements for good mixer operation are trained operators, convenient means for operation and care not to overload:

1. Trained paving mixer operators, whatever their wages reasonably may be, will save the contractor money by keeping the machine tuned up; by forestalling breakdowns by making repairs and replacements before failure occurs, and by pure skill in manipulating the mixer.

2. Convenience of operation requires that the control levers be arranged so that the operator need do little moving about and located where he can watch the operations he is directing.

3. Overloading is universally uneconomical in operating any construction equipment. In the case of paving mixers it not only strains the machine but it

retards the mixing action with positive danger to the quality of the construction.

In producing a batch of concrete dumped on the subgrade the following manually directed machine operations are required: (1) Unloading batchbox into charging skips, (2) raising the skip, (3) admitting the water, (4) shutting off the water, (5) lowering the skip, (6) opening the discharge spout, (7) closing the discharge spout, (8) manipulating boom and bucket and (9) moving the mixer along the work. Operations one and eight are in part independent of the others in time and of course moving the mixer, (operation nine) occurs only once about every 10 to 18 ft. depending on whether distribution is by chute or by boom. The frequency of moves depends on: (1) Size of mixer and batch, (2) width of road and (3) thickness of slab. Time co-ordination is required, then, chiefly in operations two to seven inclusive. Analysis by specific figures shows how close this time co-ordination is.

Time for Various Operations

The absolute time required for each of the essential mixer operations is: (1) Loading skip, 20 to 30 sec.; (2) mixing, 60 sec. (The specified mixing time in most states is 1 min. but Pennsylvania specifies 1¼ min., and North Carolina 1½ min. The Joint Committee on Concrete and Reinforced Concrete recommends 1½ min. and it is quite likely that state highway departments will adopt this time more generally); (3) raising skip, 12 sec.; (4) discharging skip, 5 to 10 sec., depending on the shape of the skip, its angle of inclination and the wetness of the sand; (5) lowering skip, 5 sec.; (6) discharging mixer, 15 to 30 sec. depending on the mixer and the consistency of the batch; (7) distributing batch, 10 sec.

From this schedule the actual minimum possible time per batch equals time discharging skip plus mixing time specified plus discharging time plus about 10 sec. lost by even the most skillful operators. Using the figures assumed, this summation gives a batch time of 1½ to 2⅓ min. During this same period the skip is being lowered, loaded and raised for a coming batch, and the boom and bucket are distributing the previous batch.

Such close correlation of mixer operations, as has been indicated, requires high skill in operation and perfectly conditioned mechanism. These are both furnished by trained operators and can be had by no other means. A skilled operator by overlapping operations will add 10 to 20 per cent to the number of batches produced per hour by unskilled operation. The operator's skill shows in (1) having one batch start flowing out of the charging skip at the moment the discharging of the previous batch is completed (2) opening the discharge without loss of time after the specified time for mixing has elapsed and (3) closing the discharge as soon as the drum is empty and having the charging skip ready to start emptying into the drum at the same time.

Maintaining Paving Mixers

Maintenance has two purposes, one is to keep the machine, by repairs and replacements, always in condition for operation and the other to keep it tuned up to high efficiency. The more simple the machine and the fewer its moving parts, the easier both kinds of maintenance is, but the chief factor in keeping shutdowns few and repair costs low is the care and skill of the operator.

Two operating conditions which increase maintenance are overloading and dirty water. Overstrain in the machine, increases wear and failures. Clean water reduces boiler repairs and cleaning and the cutting of valves. With these conditions looked after, there are no maintenance requirements, barring accidents, which can not be met by making periodical inspections and keeping the machine clean.

Fifteen minutes a day after quitting time is enough to keep a mixer reasonably clean. In addition, an occasional half day, when the mixer is shut down, can be very profitably spent in a general cleaning. Unless a paving mixer is clean it is difficult to judge the conditions of the working parts; grease cups may be covered and go empty and bearings be cracked and worn without discovery until they fail. Also when a break occurs it may be necessary to spend valuable time removing concrete before repairs can be made. A half-batch of stone rotated a few minutes after the last concrete at noon or night has been mixed, will keep the drum scoured and a good brooming at night will clean the outside parts easily, particularly if they have been greased to prevent the dirt from sticking.

Periodical inspection to determine the condition of every part of the mixer and prompt replacements of worn parts are the requisites of good maintenance. A careful inspection should be made once a week besides the general examination given daily when the mixer is cleaned. With reasonable foresight in ordering replacements, delays can, by periodical inspections, be reduced way below what they are ordinarily.

Care of Equipment

Perhaps the most important maintenance factor in prolonging the life of a mixer, except periodical inspection, is its proper storage when shut down for the winter. The following procedure will meet the requirements:

Drain all water from the boiler and engine and also from the piping and water tanks. This should be done also when there is danger of freezing overnight. Pour about one gallon of cylinder oil into the boiler and a quart of oil into the tanks; fill again with water, then drain. It would be well to add a little white lead to the cylinder oil, just enough to give it a little body.

If the mixer is equipped with steam power, remove the hood from the boiler and clean the tubes out thoroughly with a wire brush and swab carefully with oiled waste or rags. Cover the top of the boiler with canvas and tie it down securely, then coat the inside of the fire box with heavy oil, and paint or oil the outside of the boiler.

Whether gasoline or steam engine is used, take off the cylinder heads and coat the inside of the cylinders with white lead and oil.

All hard working machinery, especially concrete machinery, must wear; therefore, examine the entire machine carefully and try out all the working parts and replace with new parts, those parts, if any, which are worn enough not to work properly.

By overhauling the mixer and replacing all worn parts when the mixer is shut down, no delay will be occasioned by having to make repairs when ready to restart the mixer in the spring. This should not be neglected for worn machinery decreases results, and increases delays and consequently labor.

After the machine has been thoroughly inspected and overhauled, coat all bright parts with heavy machine

oil, or, preferably, cylinder oil containing a good heavy body of white lead. Paint the rest of the mixer.

Grease all bearings carefully and turn the machinery over a few times to insure that the inside of the bearings are thoroughly coated. Take off the cables and clean them thoroughly with kerosene, then pass them through a bath of warm lubricant.

Clean the traction chain with kerosene and coat it with heavy oil. If possible house the mixer and in any circumstances cover it with tarpaulin.

Finishing Machine Practice

A finishing machine strikes off or spreads the concrete, tamps it and then gives the final finish by mechanically belting the surface. The essential considerations in selection and operation are:

(1) Does the particular type of machine meet with the approval of the engineer under whom the work will be done? Many state specifications say that finishing shall be done by an *approved* type of machine. The contractor should be sure that the particular one which he buys has the approval of the State Highway Department or of the engineer who has supervision of the work.

(2). The weight of a finishing machine is important; if it is too heavy, it may cause some deformation of the forms and produce an uneven surface. It must be remembered that the machine produces a surface in conformity with the top of the side forms, and any irregularity in these will show in the finished pavement; hence it is necessary that good forms be used and that they are properly set and braced. Wood forms are not recommended for machine finishing. The proper setting of wood forms to carry a machine satisfactorily means a greater cost in the long run than the purchase of the proper steel forms. In buying steel forms, however, it should be remembered that there are the heavy and the light forms the light forms being used only for hand finishing and the heavy forms being used for both machine and hand methods.

(3) For efficient operation, the finishing machine should be controlled from either side of the road; that is, duplicate controls should be provided so that the operator can run it from either side.

(4) Power for moving the machine along the forms both forward and backward should be supplied by all four wheels.

(5) The machine should be built so that if it is purchased for one width of road and later on the contractor secures a road of different width, the finisher can be changed to the new width at the minimum expense by securing only the cross members. In other words, the trucks, transmission, motive power, and operating mechanism should be standard for all widths of machine. In purchasing a finishing machine, it is of course necessary to specify the crown of the road for which the machine will be used. The strike off and tamper are cut to give this required crown on the finished pavement.

Adaptability of the machine for a special type of pavement such as striking off both courses of two course roads, and striking off and tamping concrete base for bituminous or brick pavements, is another feature which a contractor may well consider in buying a machine.

The capacity of the machine to finish concrete is in lineal feet rather than in square yards. The machine finishes the entire width of the road at one operation, and it requires practically the same amount of striking and tamping to finish one lineal foot of 10 ft. road as it does one foot of 20 ft. road, although the latter represents twice as much yardage. As a general rule, one finisher has ample capacity to take care of the largest paver. There are some conditions, however, which might make it necessary to use two machines, where the rate of progress in lineal feet per day is abnormally large, or where specifications require a greater amount of tamping than usual.

Street Railway Used for Freight Container Service

Innovation in Cincinnati Promises New Use for Trolley Lines, Better Freight Delivery and Lowered Highway Maintenance

REHABILITATION at slight cost of existing interurban street railways which have fallen into disuse through a variety of causes, in order to fit them for a new commercial service, and release from highways of a certain amount of destructive motor-vehicle traffic, thereby lessening highway maintenance, are highly possible if a system of moving package freight recently inaugurated in Cincinnati becomes widespread.

Through the establishment of a small off-track station in down-town Cincinnati, linked with the outlying rail transfer by the unit-container motor-truck system, the Cincinnati, Lawrenceburg & Aurora Electric Street R.R. Co., whose line extends from Cincinnati to Aurora

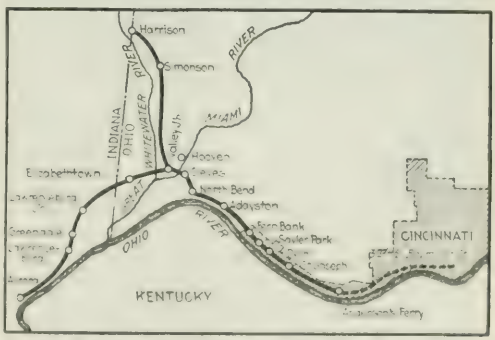


FIG. 1. MAP OF TERRITORY INCLUDED IN ELECTRIC RAILWAY PACKAGE-FREIGHT SERVICE

and Harrison, Ind., is handling package freight expeditiously through the use of demountable containers carried on flat cars. The motor-truck equipment and service are furnished by the Cincinnati Motor Terminals Co., which utilizes practically the same system as employed by that company in the interchange of less-than-carload freight between the twenty-eight main and sub-stations of the railroads entering Cincinnati. This system was described in *Engineering News-Record*, March 11, 1920, p. 508.

The essential features of the new package-freight service are the off-track freight station which is located at Third and Baymiller Sts. in the Cincinnati originating zone, a group of motor trucks with chassis designed especially to carry demountable containers, and a street railway car reconstructed to carry demountable containers.

The off-track station is equipped with a simple steel superstructure carrying an electric hoist for handling



FIG. 2. MOTOR TRUCK WITH CONTAINER LEAVING OFF-TRACK STATION

demountable containers. Here freight is received from and delivered to shippers. It is conveyed between this station and Anderson's Ferry (see Fig. 1), the terminus of the street railway and the rail transfer, in containers carried by trucks. At the rail transfer the containers are mechanically interchanged between the motor truck and the flat car by an electric hoist, which is carried on the steel superstructure of the station.

From Anderson's Ferry sixteen stations on the electric railway are reached in a territory previously served largely by long-distance motor trucking, steam-line l.c.l. service and river transportation. By the new service freight is received at the Cincinnati downtown station at noon and is delivered at the end of the line 30 miles distant three hours later.

The freight received at the off-track station platform is run into the containers by hand trucks through end doors, and stowed in line-station order, allowing quick side-door unloading of individual consignments at the various rail destinations. The lading and way bills are made out at the off-track station for each consignment and an abstract of the shipments in each container is made out from the way bills. The terminals' company truck driver receipts for his container load, as represented by the abstract, taking two copies of the abstract, together with the corresponding way bills, to the rail transfer. There he retains one receipted copy of the abstract when his load is received by the container-train crew. All the freight carried in the containers by the terminals company is under the railroad's seal.

According to the schedule being followed at the present time two truck chassis arrive at the off-track station at 11:55 a.m., and leave with container loads five minutes later, one container loaded with freight for the main line and one with outgoing freight for the Harrison branch. At 12:40 p.m. the trucks arrive at the transfer where the demountable containers are exchanged for return-load containers, loaded with incoming freight, from the flat car. The distance between the off-track station and the rail transfer is 6.1 miles and the route lies through 1½ miles of city traffic.

Before the trucks arrive at the rail transfer the two-man crew of the container flat car has already mechanically unloaded the incoming containers from the flat car and placed them on wooden horses, awaiting the trucks. The use of horses increases the operating flexibility. Upon the trucks' arrival, the flat-car crew loads the outbound containers from the trucks to the flat car and trailer, and then loads the incoming container from the horses to the trucks. Five minutes is sufficient time in which to make each of these mechanical interchanges. The trucks with their return load are due at the off-track station at 1:30 p.m. The chassis are then released to the Cincinnati steam-line freight-interchange service and the containers are returned to the downtown station and set upon horses to be loaded for the next day's trip.



FIG. 4. SUPERSTRUCTURE WITH ELECTRIC HOISTS AT RAIL TRANSFER

The flat-car container is operated by a motorman and a conductor, who handle the containers at the rail transfer and unload freight from the containers at the proper line destination. They also make store-door deliveries to and collections of light consignments from shippers adjacent to the rail stations.

At Valley Junction (see Fig. 1) the trailer is dropped off for a haul over the Harrison branch by a passenger car. The self-driven container car proceeds along the other branch to Aurora. Both termini are reached before 3 p.m. On the return trip freight consignments are loaded into the containers without regard to line-station order, since all consignments are segregated at the Cincinnati off-track station. If there is but one container for Aurora and one for Harrison the second



FIG. 3. INTERCHANGE BEING MADE AT RAIL TRANSFER

container on the motor flat car leaves Anderson's Ferry empty, but is used to receive volume commodities at local way points.

In addition to the regular business, retail dealers along the rail line use the service to secure emergency shipments from Cincinnati to cover shortages. The dealer telephones the nearest rail station from which the order is relayed by the railroad's private wire to the Cincinnati station. From there the agent transmits the call to the wholesaler and the consignment is delivered to the off-track station. It is possible for a shipment requested by a retailer at the end of the line before 11 a.m. to reach him by 3 p.m. the same day.

The amount of freight now being handled is considerable. By Jan. 10, 1922, a sustained daily average of 9,000 lb. outbound freight had been reached, in addition to a fluctuating inbound agricultural commodity movement of from 1,000 to 12,000 lb. daily. Thus it has been necessary occasionally to use an additional truck chassis. However, the service usually requires but two of the three containers provided.

At both the off-track and rail-transfer stations the superstructures, provided to carry the motor terminals' electric hoists, are of standard I-beam and channel sections with 10-in. channels serving both as beams and rails for the hoists. One departure from the construction at the off-track station is noted at the rail transfer. The channel trolley rails extend over the loading track. For this provision it was necessary only to raise the roof of the old passenger shed slightly.

The outside platform at the off-track station contains 382½ sq.ft. and the platform under cover 748½ sq.ft. exclusive of the small office at the rear. This floor area is extended to 1,028½ sq.ft. by the addition of the floor area contained in the two demountable bodies. An estimate is made that this fixed plant is capable of passing 160 tons of freight per 8-hr. shift.

Mobile Equipment

The mobile equipment consists of a five-ton truck chassis, six unit containers, a flat car and a trailer. The truck and containers are of the same standard as employed in Cincinnati for steam-line l.c.l. interchange service, except that the bodies are provided with sliding side doors. For this purpose angles are extended back from the side doors of the container at the top and bottom, the door is divided at the center, and a door-stop arrangement similar to that found in the ordinary box car is used. The containers are 17 ft. 6 in. long, 8 ft. wide, and 7 ft. 3½ in. high, inside dimensions.

The electrically-driven container flat-car has controls and trolleys at both ends. An old passenger car was remodeled for the purpose at a total cost of about $500. The body was removed, the car was cut in two, and extended about 3 ft. to provide the platform length for two containers. Steel angles, 3 x 3 in., are secured to the floor of the car laterally and longitudinally to hold the containers securely. The car is 59½ ft. long overall. The trailer is a simple steel frame 20 ft. long.

It is pointed out by B. F. Fitch, president of the Motor Terminals Co., and chairman of the board of the Cincinnati Motor Terminals Co., that the next logical extension of the service is the establishment of famers' off-track stations near stations along the rail line. Such platform stations would serve as receiving and assembly points for farm products and also as delivery points for unit-load consignments of shipments destined for rural delivery. Emphasis is placed upon the fact that the establishment of these platform stations would doubtless remove from highways a large percentage of long-distance heavy haulage, thereby lessening highway maintenance charges.

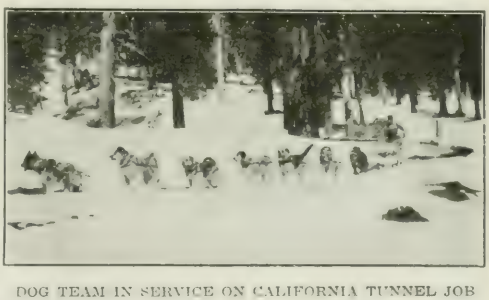
It is further pointed out that off-track station operation is possible in handling freight on any interurban railroad whether or not the rails reach the central traffic originating area of the city.

Rates charged shippers for the Cincinnati, Lawrenceburg & Aurora freight service average about 45c. per 100 lb., according to the distance and the commodity classification. Such rates are identical with steam-line rates for a service that has proved faster than express.

The motor-truck service, containers and hoists are leased to the Cincinnati, Lawrenceburg & Aurora R.R. by the Cincinnati Motor Terminals Co.

Dog Team Part of Tunnel Job Equipment

IN ORDER to carry on all-year-round construction on the 13.6-mile tunnel that is to bring additional water supply to Huntington Lake for power purposes, the Southern California Edison Co. operates camps on both sides of the mountain range through which the tunnel passes. The road to the adits on the far side of the range leads through a pass at elevation 9,300 ft. and is, of course, not passable during the winter



DOG TEAM IN SERVICE ON CALIFORNIA TUNNEL JOB

months. In fact it has not even been found desirable to attempt to maintain a telephone line and all communication is carried on by means of radio.

To afford means of winter transport in emergencies and to regularly carry the mail when the wagon road is impassable, the company brought a dog team and driver from Alaska which is now operating through the pass for the second season. The psychological effect on the considerable number of men in the remote camps has been found to fully justify the maintenance of the dog team. Seven dogs are ordinarily used and the regular schedule is a one-way trip daily over the ten miles between camps 60 and 61. In either direction this trip includes a climb of about 2,000 ft. to cross the high pass. When snow conditions are not unfavorable, the team can take a load of 500 or 600 lb. over this route. Although complete hospital equipment is maintained at the remote camp headquarters, a comfortable litter for the injured can be arranged on the sled.

The dog sledge is not used for carrying in ordinary camp supplies, these being taken in by trucks before the snow flies. As an example of the quantities required when camp 61 was visited by a representative of this Journal in November, 112 dressed beeves were hanging in the meat house.

Plan to Bridge Hudson River at Anthony's Nose

Highway Crossing to Be Built by Company—Will Have 1,650-ft. Suspension Span—Tolls and Recapture Provisions

A 1,650-ft. suspension highway bridge across the Hudson River 40 miles above New York is projected by the Terry & Tench Co., contractors, and associates. A bill now in the state legislature proposes to charter a company under the name Bear Mountain & Hudson River Bridge Co., to build the bridge and operate it for thirty years as a toll structure, the bridge to become the property of the state at the end of that time.

Fig. 1 herewith indicates the relation of the proposed crossing 3 mi. above Peekskill, to New York City and the lower section of the Hudson lying between New York and Poughkeepsie, together with the main roads of this region. Opposite Peekskill lies the central part of the Interstate Palisades Park; Bear Mountain, rising from the west bank of the Hudson directly opposite Anthony's Nose on the east bank, is the main resort point of the park. The proposed crossing is at one of the narrowest points of the Highlands sections of the river, and is described by Mr. Sherwin as the most southerly location along the Hudson for a highway bridge of reasonable cost.

At the same site a railway bridge was projected fifty years ago, under the name of Hudson River Suspension Bridge & New England Railway Co., though the projectors of the present highway bridge scheme were not aware of this prior location and rights until they learned of it in the course of working out the details of their project. It is said that construction of the highway bridge will not render impossible the future construction of a railway crossing alongside under the originally acquired right-of-way easements.

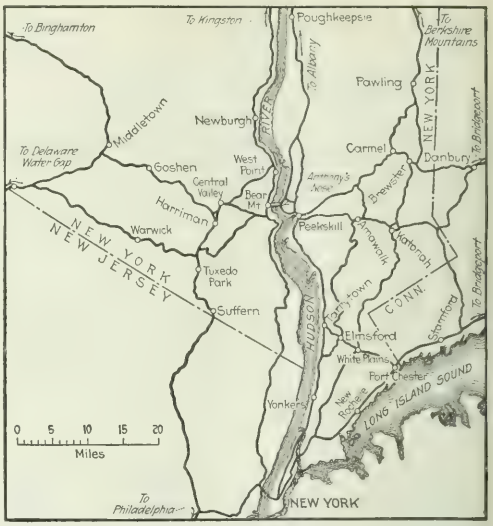


FIG. 1. MAIN HIGHWAYS CONNECTING WITH PROPOSED PEEKSKILL BRIDGE

No highway bridge now crosses the Hudson in the 150 miles or more south of Albany, and the active passenger and vehicle traffic is handled altogether by ferries. These are badly crowded in summer, and in fact are greatly inadequate for the service required. While estimates of the probable traffic across the bridge have not been made in definite figures, it is believed certain that the bridge will easily pay for itself.



FIG. 2. SKETCH OF BRIDGE; LOOKING DOWNSTREAM
Anthony's Nose at Left, Bear Mountain at Right

Features of the Structure—Rock lies exposed at the shore line on either bank, and the hillsides rising directly from the water's edge provide direct anchorage. The span between towers located at the water's edge will be 1,650 ft. The clearance height will be 135 ft. The chartering bill fixes the minimum roadway width at 22 ft. with two 4-ft. sidewalks in addition, but the floor may be made considerably wider than this, as the long span requires a wide deck. Wire-cable construction is specified in the bill. The structure is to be proportioned for a loading of 70 lb. per sq.ft. on the roadway and 50 lb. per sq.ft. on the sidewalks and for a concentrated load of 30 tons. The design sketched in Fig. 2 is subject to modification.

Tolls and Recapture—Maximum toll rates are to be fixed in the charter at figures corresponding to present ferry charges. The figures range from 15c. for foot passengers to $1.75 for automobile trucks.

Thirty years after its completion the bridge is to become the property of the state. The state may acquire the property before this time by condemnation, or at five-year intermediate periods by paying stipulated sums ranging from $4,500,000 at the end of the first five years to $2,000,000 at twenty-five years from completion.

The total cost is estimated at $5,000,000. The project includes building a road about 2½ miles long running eastward from the east end of the bridge to connect with the Albany Post Road, which at this point is some distance back from the river, and a road 300 yd. long at the west end to reach the state highway running north and south along the west bank of the river.

Lesson of Chicago Grain Elevator Explosion; 1921

Dust to be Excluded and Not Merely Removed —Bins Covered—No Basement—Light Walls Used for Superstructure

By David J. Price and Hylton R. Brown
Engineer in Charge Development Work and Assistant in Grain Dust Explosions, Bureau of Chemistry, U. S. Department of Agriculture

THE dust explosion in the 10,000,000-bushel Northwestern grain elevator at Chicago, in March, 1921, was marked by such extreme violence as to give special interest to the investigation made subsequently by the Bureau of Chemistry, U. S. Department of Agriculture. The property and grain loss approximated $3,750,000, but only six lives were lost as the accident occurred on a Saturday night, when only the night force was at the plant. This elevator and the accident were described in *Engineering News-Record* of March 31 and April 14, 1921, pp. 560 and 634. The cause was noted in the issues of Nov. 3 and 24, pp. 719 and 847, in extracts from a paper by David J. Price ("Journal" of the Western Society of Engineers, December, 1921).

Swamp gas, presumably containing marsh gas or methane, was detected during the foundation construction, but there is no indication that this was a factor in the extent of the explosion. However, the U. S. Bureau of Mines has found that a small proportion of methane increases the inflammability of coal dust and this would be true probably of grain dust. In rebuilding the elevator, this gas was again noted, suggesting the desirability of definite control by ventilation.

Dust conditions at the Northwestern elevator are assumed to have been about the same as at the average terminal elevator. There was dust collecting equipment, but as commercial regulations prohibit the removal of dust before grain is weighed it is impossible to prevent dust accumulation in a large elevator.

Men were at work cleaning the driers and undoubtedly a large quantity of dust had been thrown into suspension. It is believed that the explosion was caused by fire in one of the driers, and the cleaning of the garners above the driers created the dust cloud through which the flame propagated to the basement of the working house, where the first heavy explosion occurred. There were at least two distinct explosions, the second and heavier one about ten seconds after the first. The first explosion must have been quite heavy, although small in comparison with the second blast which wrecked the greater part of the plant. An engineer living near the elevator reported that he heard a number of small explosions between the two heavier explosions.

From the results of previous explosions and considering the fact that this was probably the most violent dust explosion in this country, it was felt that the terrific shock had probably weakened the entire structure. However, the foundations and sections of the walls seem to have been undamaged and this will make possible the rapid repairing of the plant. For several years the Bureau of Chemistry has been recommending light wall construction for plants where it has been impossible to adopt sufficient precautions to effectively guard against explosions. At the time this elevator was being built the cement gun process of building walls on wire mesh or steel frames was coming into general use, and the use of 180,000 sq.ft. of exterior wall of this type was one of its construction features, as noted in *Engineering News-Record*, April 25, 1918, p. 819. One of the novel features of this work was the use of spring washers to attach the wire mesh to the steel frame work. This proved to be satisfactory, for when the walls were blown off many of the washers remained fastened to the steel beams. This explosion proved that light wall construction is advisable under certain conditions and prevents the building up of high pressures when an explosion occurs. The destruction of the light walls relieved the pressure and prevented serious injury to the structural steel framework.

An excellent opportunity was presented to observe the protection which covered bins afford. The storage section of the elevator and the river house where the bins were not covered were heavily damaged, but the working house, in which the bins were floored over, was damaged less than any other section of the elevator proper. In the storage section, where the bins were open and the flames could spread from one tank to another, at least fifteen of the concrete bins were completely destroyed. All storage bins should be covered and vented to the open air, with no direct communication between them.

The tremendous violence evidenced in the basement of the storage section of the elevator bears out the recommendation previously made by the Bureau of Chemistry that grain elevators should be constructed without a basement and with light walls or curtain doors to prevent the building up of excessive pressure underneath the bins in case an explosion occurs. The drier house and the track shed, practically a part of the working house, were a total loss. After the explosion scarcely a piece of structural steel which helped to form the framework of this part of the plant could be found in its original shape.

Vents should be provided on all elevator heads to permit the release of any pressure built up within the lofter legs, should an explosion occur. All ledges or surfaces where dust may accumulate in the building should be inclosed or beveled at such an angle that it will be impossible for large quantities of dust to accumulate on them. Electric lamps in dusty atmospheres should be protected with vapor proof globes and heavy guards. In large plants it is often advisable to use several small separate dust collecting units instead of one large system. The complete destruction of the large dust settling chamber installed between the working house and the storage section at the Northwestern elevator indicates that such installations should be at some distance from the main plant.

Good housekeeping is essential for the prevention of dust explosions and cleanliness is the most *important recommendation in guarding* against such disasters.

Letters on the Knickerbocker Theater Failure

Comments by Correspondents on Cause of Collapse and on Means of Assuring Safety of Engineering Structures—North End Joint of Main Truss Buckled

Responsibility and Pay

Sir—Your editorial in the issue of Feb. 2, p. 179, headed "Responsibility and Pay," is to the point. In this city the building inspector's office has no engineer connected with it, and consequently structural engineering designs receive only the most elementary checking.

I might add that I think 25 lb. per sq.ft. too light for roof loads, especially for buildings used for public assembly. I have had some experience with downspouts clogging up or freezing, and water backing up. F. M. WEAKLEY,

Norfolk, Va., Feb. 4. Civil Engineer.

* * *

Defective Wall Construction

Sir—It seems to me from the information given concerning the Knickerbocker Theater disaster that the failure is from the same cause that has produced a number of minor failures, or from a combination of this cause with another which has some major failures to its credit. In fact I know of very serious failures caused by each of these faults. The faults to which I refer are both faults in design; that is, they are due to conditions for which the designer is responsible. One fault is the use of hollow tile or blocks as the material of a bearing wall, particularly when the hollows are placed in a vertical position. The other fault is a composite bearing wall of a yielding and a rigid layer.

In *Engineering News*, Mar. 31, 1910, I referred to two chimney failures that seemed to be due to the use of perforated blocks, the hollow spaces being vertical. I called attention to the practical impossibility of securing any continuity of the compressed portions of the wall since it is not possible to make the ribs come over one another in a wall, and it is further impossible, in the ordinary way, to get any mortar between these narrow ribs if they were over one another. In *Architecture and Building*, July, 1912, in a series of articles on failures in building construction and their lessons, I referred to a number of failures of a minor character that were due to these causes. In one case a brick wall had a cast-stone veneer; the veneer cracked and spalled, showing that the wall load was being carried by the veneer. In another case a concrete column or pier had a cast-stone veneer. In another case a rubble stone wall had a cut-stone veneer. In another case a brick wall had a terra cotta veneer.

Some time ago I was called in on a case where a large section of reinforced-concrete work collapsed. The concrete beams and slabs were supported on walls that in part were built of two layers, a facing of hard brick with thin mortar joints and backing of common brick with thick joints. Some walls were a combination of brick and tile. I came to the conclusion, with good reason to substantiate me, that this particular failure was due to the yielding of the brick backing under the load and the consequent buckling of the wall and its collapse.

The walls of the Knickerbocker Theatre were composed of tile presumably faced with brick. The tile seems to have been laid with hollows vertical, judging by the photographs. The main truss supporting the roof rested on the tile portion of the wall on bearing beams and made a sharp or acute angle with the wall. A little yielding of his support would give the seat a slant that would account for the truss slipping off laterally, and the kick of the truss would account for the outward lean and for the crack in the corner of the building where the curved wall is broken away.

A large truss such as this without a pilaster or pier under it is bad construction. Supporting heavy loads on the inner tile shell of a well is also bad construction.

Pittsburgh, Feb. 7. EDWARD GODFREY.

* * *

Curved Wall Displaced by Expansion

Sir—In your descriptions of the Knickerbocker Theater you show that one of the walls was built on a curve.

Some years ago the Lighthouse Department built a high brick wall around its property at St. George, Staten Island, and though it was built amply thick a great deal of trouble was experienced with that part of the wall that was built on a curve, on the street line. In spite of heavy anchors which were put in to hold it, the wall shoved out at the curve and leaned over the sidewalk to an alarming degree, so much so that it was really surprising that it did not topple out into the street.

This displacement of the masonry was explained by progressive expansion: as the wall expands with the rise in temperature, it shoves out at the curve, but the succeeding contraction does not pull the wall back into place, because the masonry has not sufficient tensile strength. The same action can be seen to a greater degree in heating furnaces in forge shops and steel mills. It occurs to me that such action may have shoved the theater wall out, and permitted the trusses to become unseated.

In any case where trusses are seated on masonry walls instead of being directly connected to steel columns, the trusses should be secured by means of rods running through the walls and fastened to clamps on the outside.

East Aurora, N. Y., FRANK C. BOES,
Feb. 8 Engineer.

* * *

Buckling of End Gusset of Main Truss

Sir—An independent investigation of the Knickerbocker Theater roof collapse, which the courtesy of Col. Charles Keller, Engineer Commissioner of the District of Columbia enabled the writer to carry out, has led to the discovery of some important findings of fact and deductions differing from those presented hitherto. They point to a decidedly unusual type of failure and give warning of a structural danger rarely thought of. Apart from this particular danger, the wreckage showed many inexcusable digressions from accepted engineering practice in the detailing and fabrication of trusses and column connections, to say nothing about radical departure from the truss dimensions indicated on final stress sheet and framing plans.

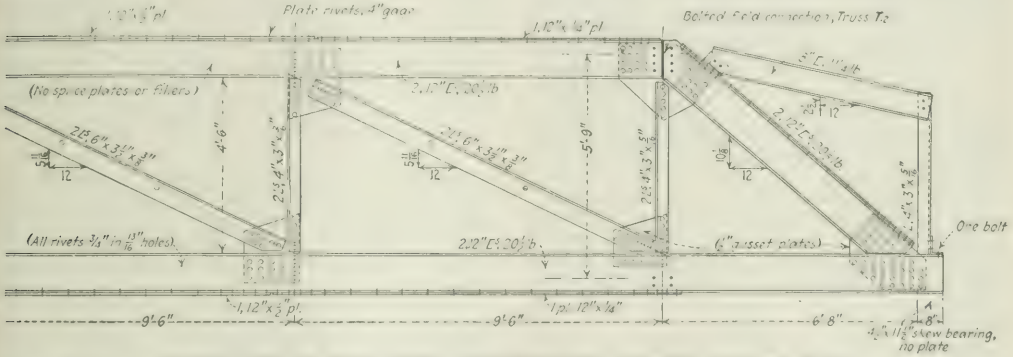
One vital fact has been determined and almost universally acknowledged by the engineers who have investigated this disaster: the separation of the north end of Truss T-11 from its bearing on the Columbia Road wall occurred very early in the sequence of events leading from the initial failure to the general collapse of the truss system and superposed construction. Professional opinions differed only in the development of intricate combinations of circumstances and hypothetical local failures at various points in the structure that might conceivably have brought about this separation.

A trus concentration in excess of 100,000 lb. upon a 45° skew bearing was seated on the top flange of a single 20-in. I-beam with no intermediate bearing plate to protect the flanges of the relatively light 12-in. channels of the truss chord. Cover-plate joints were not spliced in either chord

of Truss T-11 but had at least ¾ in. clearance, and at both ends of the same truss the batter-post members, comprising two 12-in. channels back to back and a 12 × ¾-in. cover plate, depended wholly upon the strength and lateral stiffness of a single ½-in. gusset plate for their connection with its upper and lower chords. A preponderance of evidence indicates that the disaster was primarily caused by *the buckling of an an unsupported gusset plate* and the torsional failure, in its first panel length adjacent to the skew bearing on the Columbia Road wall, of the lower chord of Truss T-11.

Examination of the bearing beam revealed two deeply rust-marked pressure lines directly across its top in a diagonal direction corresponding with the original axis of Truss T-11 but measuring § in. apart at the front edge of bearing and exactly 1 in. apart where they become obscure just 6 in. further back on the beam. These pressure marks were caused by the concentration of load on the inside edges of the lower flanges of the two 12-in. channel sections making up the lower chord of truss T-11, and as ½-in. gusset plates were used throughout those lines should have been exactly ½ in. apart and parallel instead of widely divergent in both directions from the original truss axis. The evidence is conclusive that this marked distortion or spreading of the flanges of those lower-chord up. The gusset plate in question was of adequate size to carry the entire truss load imposed upon it in direct axial compression, but owing to its location in the central plane or axis of the truss it had practically no lateral stiffness. As the adjacent channel sections in both upper and lower chords and batter posts were fabricated with at least ¾ in. clearance between them and probably more, there was apparently no provision made against the buckling or the bending of the gusset plate at either of these critical points in structure.

Hence, a load in excess of 100,000 lb. transmitted through the batter post at the north end of truss T-11 was balanced practically on a knife edge that was slowly turning over toward the east or in a clockwise direction on its skew bearing. Just as soon as an appreciable bending moment was created in the gusset plate, it reacted first as a column 5 in. in height and ¾ in. in least diameter (computed as practically unsupported between centers of adjacent lines of rivets in the two members it connected), and then buckled to the east under the rapidly increasing bending moment produced by the truss load. These forces of over 100,000 lb., acting in opposite directions but not in the same straight line by reason of the increasing inclination of the lower chord members and the increasing bend in the gusset plate,


Plate rivets, 4" gage
Bolted field connection, Truss T-12
1.10" × ½" pl
(No splice plates or fillers)
2-15" C. 33 lb
2-12" C. 20 lb
2-15.6" × 3½" × ⅜"
2-12" C. 20 lb
2-12" C. 20 lb
2-15.6" × 3½" × ⅜"
2-15" C. 33

confirmed and supported in detail by the present condition of the chord members themselves, by the direction and character of distortion in the gusset plates at both ends of the batter post, by the slight westward deflection at all upper-chord panel points of Truss T-11, by the condition of all subsidiary truss bearings on the 18th St. wall, and finally by the indicated direction of fall of the trusses and roof construction, scoring the east wall of the auditorium diagonally towards the rear as each subsidiary truss in falling released its corresponding bay length of purlins and roof-slab in progressive failure from the stage to the rear. Hence this analysis of the failure is confirmed in every detail by the material evidence and it is also in full accord with the testimony of witnesses.

Washington, D. C. ROBERT C. WALKER,
Feb. 8. Architectural Engineer.

* * *

Thrust Due To Truss Deflection a Possible Factor

Sir—In connection with the excellent article in the *News-Record* relative to the lamentable failure of the roof system of the Knickerbocker Theater, I drew the conclusion that the generally accepted explanation of the disaster, which finds currency at the present time, is to the effect that various vibrations and disturbances had caused a slow progressive movement of the end of the main truss upon its seat; that such movement was possible owing to the fact that the truss was not anchored to the wall; that the load upon the roof at the time of the failure had little or nothing to do with the determination of the time of the disaster, the fact that the roof was sustaining a load of about 12 lb. per sq.ft. in excess of its usual load being merely an unfortunate coincidence.

This explanation, extraordinary as it is, would seem the most plausible one were it not for two facts: (1) no defects in the plaster ceiling had given any warning of any progressive movement of the roof system in relation to the walls; (2) the fact that the roof was sustaining a load in excess of the usual, which fact should not be lost sight of even though such load was far inferior to the designing live load.

In the light of the first fact, it seems probable that the truss slipped off suddenly, and in the light of the second it seems not improbable that the loading had something to do with it.

One thing further should be taken into account, namely the fact that a truss under load deflects and that the deflection is greater the greater the load. In the present case the deflection under the slightly unusual load would probably have two effects, namely: (1) the end of the truss would "cock up," and the entire loading would be placed on the *edge* of the truss bearing, thus largely eliminating the friction between the bearing plate and the truss, and (2) the reaction of the truss would no longer be vertical, but would be inclined slightly toward the outside of the wall, thus putting the horizontal component of the reaction in the position of being a horizontal thrust at the top of the hollow-tile wall.

Is it not worthy of investigation to determine whether or not this horizontal component of the truss reaction (a force which exists in theory at the bearing of every unanchored and loaded beam or truss) was of sufficient magnitude to push out the hollow-tile wall and allow the truss to drop? In view of the fact that a wall constructed as was this one has practically no resistance to internal tension developed in bending, I believe it would be profitable to investigate this matter.

Of course, I am basing this discussion entirely upon the matter which has appeared in *Engineering News-Record*, and I have no dimension diagram which would enable me to determine the angle which the end of the bottom chord, and, consequently, the reaction, passed through from a condition of no load, to a condition of loading such as existed at the time of the collapse. However extraordinary it may seem that this small horizontal component of the truss reaction could produce the movement of the top of the wall which led to the disaster, it is no more extraordinary than the explanations which have been heretofore hazarded; it presupposes a sudden movement, and explains such movement; it explains the fact that the wall is now somewhat out of the perpendicular, leaning toward the street.

The lesson of the necessity for anchorage is plain, although in this case anchorage would have transformed a cantilever moment in the wall to another sort of bending moment of, probably, lesser significance; but it is vitally important to determine whether or not walls built of the material and in the manner of this one are so weak in bending that they should not be placed in positions of structural responsibility.

Des Moines, Feb. 14. PAUL E. WYLIE.

* * *

Effect of Skew Truss Bearing

Sir—The writer was formerly assistant engineer in the Engineer Department of the District of Columbia, and computed the lines on which was established the ground plan of the Knickerbocker Theater. The following considerations based on this work indicate the cause of the collapse, in the writer's opinion.

The main truss was supported at its northern extremity by an I-beam built into a hollow-tile wall. The axis of the truss formed a horizontal angle A with the axis of the I-beam. Deflection (or sag) in the truss due to the unusually heavy snow load would introduce a vertical angle B between the bearing faces of the truss and the I-beam. But owing to the angle A, stress would be transmitted (theoretically) from the truss to the beam-seat at the point of intersection of the lower west edge of the truss with the upper southeast edge of the I-beam. The angle B introduces a horizontal thrust equal to the load L of the roof times the sine of B, and parallel to the axis of the truss. At the bearing edge of the beam-seat this horizontal thrust is resolved into two components, one parallel to the axis of the I-beam, the other perpendicular to it, and equal to $L \sin B \cos A$ and $L \sin B \sin A$ respectively. The former component is balanced by the friction of the bearing parts of the truss and the I-beam only.

As the snow load increases the horizontal thrust increases, and at the same time the deflection in the truss and consequently sin B likewise increase. That is, the horizontal thrust increases faster than the load. At the moment when the horizontal thrust overbalances the friction, the truss slips along the edge of the beam-seat, thus increasing cos A, still further accelerating the process of collapse, while the base of the truss moves from its location and the truss tilts, thus introducing another horizontal thrust cumulative with the others. The slipping continues until the truss is clear of the beam-seat, when it drops to the ground.

Thus the support at the beam-seat of the main truss in the Knickerbocker Theater roof was in a condition of unstable equilibrium, in that each destructive factor increased with the process of collapse. Whether the failure could have been prevented by anchoring the truss to its seat, as suggested, depends upon the value of the angle A and the extent of permissible deflection of the truss. The difficulty of framing this structure occurred to the writer while engaged in computing the ground plan, and led to the above analysis, from which he concluded that in such cases the beam-seat should be built into a triangular pier, perpendicularly to the truss.

Examination of the northerly truss seat after the collapse of Jan. 28 shows distinct markings where the west edge of the face of the lower chord came into contact with the upper face of the I-beam. The southeast edge of the upper flange of the I-beam was considerably depressed to the northeast of these markings, and for a considerable distance was burred, and for the extent of several inches beveled. The tiling was torn away from the northeast end of the I-beam, while that southwest of the truss was undisturbed. This is what might be expected if the truss had slipped from its support in the manner described. The lintel remains solidly fixed in the wall, and the latter bulged 5 in. at this point, according to reports of the Engineer Department of the District.

P. H. SKINNER,
Washington, Feb. 10. Consulting Statistician.

Discuss Concrete Products and Specifications at Convention

American Concrete Institute Meeting at Cleveland Mainly Concerned With Committee Reports —Few Papers Presented

DISCUSSION of current practice, as represented in committee reports, rather than final action on standards or presentation of papers, was the outstanding feature of the annual convention of the American Concrete Institute at Cleveland, Feb. 13-16. One committee presented a specification but a strong opposition minority report accompanied it and the convention referred the specification back for further study. Half-a-dozen papers were presented also, but most of the time was devoted to a discussion of concrete products and houses and to criticisms of the tentative specifications of the Joint Committee on Concrete and Reinforced Concrete. One morning session was given over to a practical demonstration, by Stanton Walker, of the methods used by the Structural Materials Laboratory of the Lewis Institute in designing concrete mixtures. This demonstration was most favorably received, particularly as most of the audience had never seen in practice the proportioning methods advocated by Prof. D. A. Abrams in his many papers on the subject.

In a partial reorganization of the Institute, started last year, it was decided that more attention should be paid to the concrete-products industry, which is experiencing a new lease of life after some years of quiet. Accordingly, three of the sessions were devoted to this subject, including one on concrete houses. In the latter session Miss Kate Gleason, well known as one of the few women engineers, gave a most interesting talk on the group of concrete houses which she has for some years been building at Rochester, N. Y. These houses, of the six-room and garage type, are built to sell for $4,000, and are distinguished by a grace of line uncommon in the quantity-production house. They are of beam-and-girder construction, slightly reinforced and of a sand concrete, using metal forms of Miss Gleason's designing. Several other papers described other types of small house, particularly a cement-gun type built near Boston and described by H. Whittemore Brown and concrete-block houses built in Youngstown, Ohio, described by B. E. Brooke.

Committee Reports

Committee S-5 on Reinforced-Concrete Houses submitted a proposed recommended practice for concrete-house construction, which was accepted as a progress report. J. A. Ferguson, of the committee, presented a lengthy revision of the recommendations as an individual contribution to the subject.

A radical division in Committee P-1 on Standard Concrete Building Units was revealed in the discussion of the report of that committee. New standards for block, brick and structural tile were presented by the committee, but a substantial minority were in opposition. The controversy was mainly about the requirements for concrete tile, which the minority contended would put that material out of the market. The committee was so nearly equally divided that the convention voted to refer the whole report back.

Other committee reports, with an abstract of their contents, are given below. None of the reports required any other action than acceptance by the convention.

S-6 on Concrete Roads.—Progress report. Committee will wait until the many current road tests are nearer completion.

S-2 on Highway Bridges.—Review of some current problems in bridge design, mainly waterproofing and expansion and construction joints. Abstract to be given in early issue of *Engineering News-Record.*

E-3 on Research.—Citation of research work now going on in United States and Canada. Programs of tests proposed on concrete mixers and theory of proportioning.

P-5 on Fire Resistance of Concrete Building Units.—Program of proposed fire tests on concrete block and tile walls. Convention voted to approve committee's recommendation that $6,000 be raised to carry on such tests.

C-1 on Contractors' Plant.—Addition to last year's analysis of comparative economies of different types of building construction plants.

C-4 on Metal Forms.—Analysis of some of the economic consideration in the use of metal forms.

The flexural strength of plain concrete was discussed in an elaborate paper by Prof. D. A. Abrams, who submitted results of a series of tests on that subject. He finds that flexural strength does not follow compressive strength uniformly. The modulus of rupture does not rise as rapidly as does compressive strength with the increase of cement content nor is it so seriously impaired by the increase of water, though the size and grading of aggregate, the curing conditions and the depth of the beam have about the same effect on both properties. The average modulus of rupture was found to be about 20 per cent of the compressive strength.

Prof. W. K. Hatt reported preliminary results on two series of tests now being conducted at Purdue University, one on the application of the ball test to concrete surfaces and the other on the fatigue of concrete. Each test has gone far enough to promise interesting results though nothing conclusive has yet been learned. They were reported, Professor Hatt said, because of the feeling that it is a good thing to make public the trend of new investigations even though they had not been brought to a conclusion.

A paper entitled "An Accurate Mechanical Solution of Statically Indeterminate Structures by Use of Paper Models and Special Gages" was given in remarkably clear abstract by Prof. George E. Beggs, of Princeton University. Prof. Beggs has developed a method of reproducing in paper and celluloid models indeterminate frames and by actual measurement of the deflection of critical members under applied loads has been able, with very simple calculations, to check the results of the complicated theoretical analyses of such frames by the slope-deflection method.

Joint Committee Discussion

One day was devoted to a discussion of the Joint Committee report. Nothing very different from the criticisms developed at the American Society of Civil Engineers discussion in December was brought forward. The main opposition to specification centered around Section 28, on Proportioning, and was mainly directed toward the second alternative of that section which requires that the contractor be responsible for the strength of the concrete. As a part of the criticism an attack was directed on the cylinder test as a measure of structural strength. Members of the Joint Committee repeatedly asked the critics for a substitute proportioning clause but none was given. Those opposed to the strength specification seemed willing to allow proportioning to continue on its present volumetric

basis. A good many criticisms of detail provisions were advanced, but they apparently were largely a matter of interpretation, indicating the necessity of revision to insure clearness in the specification.

COST OF BUILDINGS ANALYZED

A. R. Lord, a member of the Joint Committee, presented an analysis of the cost of concrete buildings as designed under the building codes of different cities and under the Joint Committee tentative standard. This showed that for the concrete work in flat-slab buildings the tentative specification would cost 8 per cent more than the average of six cities and for beam-and-girder buildings 10 per cent less, assuming a 2,000-lb. concrete in all cases. This would mean for the whole building 1.6 per cent more and 2 per cent less, respectively. The opposition, however, contended that the requirements for strength, in other words the proportioning specification, under the Joint Committee's ruling, would materially increase any purely structural analysis. A committee of New York contractors presented a comparative analysis of a building under the New York code and the Joint Committee specification which showed increases higher than the averages of the six cities but apparently not much higher than those given by Mr. Lord for New York. The committee, however, contended that the specification is decidedly punitive in its effect on concrete.

The Wason Medal for the most meritorious paper presented to the previous convention was presented to Prof. H. M. Westergaard, of the University of Illinois, for his part of the paper on "Moments and Stresses in Slabs" entitled "Analysis of Homogeneous Elastic Plates."

The American Concrete Institute is growing rapidly. It was reported that the membership at the end of the convention had reached 873 and that the finances were satisfactory. William P. Anderson, of the Ferro-Concrete Construction Co., of Cincinnati, was elected president. Harvey Whipple, Friesma Building, Detroit, Mich., is secretary.

Experimental Study of Continuous Arches Proposed

Study of concrete multiple arches by full-size tests has been proposed to the Engineering Foundation by A. C. Janni. The object of the study is to confirm or correct the theory of stresses in such elastically continuous arch spans. It is understood that the collapse of three spans of the Palm Beach bridge stimulated the proposal. It is known that an arch in a continuous series, supported by relatively slender piers, cannot be considered as having unyielding supports as promised in the ordinary analysis of an arch. Both the yield of the pier and the elastic reaction of the adjoining arch affect the stresses in the arch in question. Current methods of designing do not take account of this effect, and while a rather complex method of stress calculation exists there has been no experimental verification of its correctness. A test on three or four spans of arch, of say 70 or 75-ft. span, might be expected to furnish such verification. Fixed end abutments and slender intermediate piers would be provided, and deflection and strain measurements would be made under various loads. The Engineering Foundation has referred the subject to its advisory committee on civil engineering research, and has suggested that if the proposed test is considered desirable the co-operation of the American Society of Civil Engineers will probably be asked for.

The British Water Supply Shortage and Emergency Treatment Measures

(London Correspondence)

BRITISH authorities have now become thoroughly alarmed at the shortage of water throughout the country and are taking steps to insure that all supplies are conserved. The seriousness of the position is revealed in the decision of experts to recommend to the Minister of Health that: (1) Water must be utilized which in normal circumstances might not be regarded as suitable for consumption. (2) Existing sources of supply might become polluted owing to the drought, and measures will have to be taken to destroy the impurity. Such measures might demand the action of Parliament.

The survey made last year of the available supplies of the country show that 126 important districts have a pronounced shortage, and that in 52 of these districts the supply has fallen 50 per cent below the average.

January of this year is the first month since January, 1921, when Britain has had her normal rainfall, so that the position at the end of last year, when there was an all-round deficiency in rainfall of about 40 per cent, is in no way relieved. In fact, in many important districts—as Bristol and Bath—water rationing has been resorted to, and in many villages water is being retailed at so much per pail.

Several rivers have dried up altogether, and the Kennet, from which large supplies are normally drawn, is bone dry for several miles. In addition many of the deep-seated chalk springs throughout the country have completely dried up. Thus, even if February should prove an abnormally wet month many of the chalk springs and smaller rivers will not be available for water until July, provided subsequent months are normally wet.

In many districts, where the water has been derived from hills, the rivers will be resorted to and chlorination, so effectively applied in foreign theaters during the late war, will be employed.

In the meantime the Littleton reservoir, under construction for some time, is being pushed forward. This reservoir is to hold 6½ billion gallons (Imp., or 8 billion U. S.) will cover 800 acres and will keep London going for a month. Water for this reservoir will be drawn from the Thames by centrifugal pumps lifting 300 m.g.d., (Imp.) per day. A thousand men are now employed on it but it is doubtful whether it will be available for use inside two-and-a-half years.

According to the London *Engineer*, the Ministry of Health recently created a technical committee of nine members to advise it on the best method of treating water, possibly from polluted sources. On the committee are four representatives of the Ministry of Health, including L. G. Gibbon, assistant secretary, who serves as chairman; E. A. Standford Fawcett, chief engineer; a medical man, and one other. Other members are Sir Alexander Houston, director of water examinations to the Metropolitan Water Board; T. W. Davis, a waterworks engineer, representing the British Waterworks Association; Raymond Ross, public analyst for Burnley, and two local medical officers of health.

An article on the British drought appeared in *Engineering News-Record*, Nov. 17, 1921, p. 820.—EDITOR.

NEWS OF THE WEEK

New York, February 23, 1922

Federal-Aid Road Bill Delayed Pending Soldier-Bonus Policy

(*Washington Correspondence*)

Due to the uncertainties aroused by the soldier bonus situation, it has been decided not to start hearings on the federal-aid road bill until something more definite is known as to the sources to be relied upon for that revenue. It seems certain that the proposal to raise a part of the money needed for a bonus from a gasoline and automobile tax is dead. Some very influential members of Congress, however, attach such importance to the need for bonus legislation that they are willing to suspend all road work and certain other public improvements so as to provide the necessary funds with the smallest possible increase in taxes. It is becoming increasingly apparent that increased road appropriations for a period of years or even for the next fiscal year will not be forthcoming without a legislative fight.

Kenyon Business-Cycle Bill Returned to Committee

(*Washington Correspondence*)

Such determined opposition met Senator Kenyon's business-cycle bill, when it was called up for consideration on the floor of the Senate, that the bill was sent back to the committee on Senator Kenyon's own motion. He took that action when the Senate by a vote of 29 to 26 adopted an amendment restricting the application of the measure to public buildings.

That Congress is very jealous of its perogative to indicate when and where expenditures of public funds are to be made was demonstrated again by the action taken on this bill. To vest even limited control over these funds in the executive met with little favor.

Senator Kenyon championed the bill vigorously. He said it would be no panacea, but that it certainly would tend to counteract the extreme swings of the business cycle if public works could be stimulated during times of industrial depression and held back during times of great industrial activity.

Despite the admitted strength of Senator Kenyon's arguments, little sympathy for the proposal was aroused, and it is admitted that a different type of proposition must be evolved before there is any hope of securing legislation of this character.

In connection with the failure of the bill, Commerce Secretary Hoover stated that he feels the subject should have more illumination before legislation is attempted.

Demand Higher Motor Fees

The Board of Supervisors of San Bernardino Co., Cal., last month passed a resolution protesting against the further issuance of licenses or franchises to trucking and stage lines until fees charged or taxes paid "are sufficiently high and do bear a just proportion to the expenses in maintaining our highways."

Booth & Flinn Bid $19,331,723 on Hudson Vehicle Tunnel

Booth & Flinn, Ltd., 17 Battery Place, New York City, with an offer of $19,331,723, were the low bidders Feb. 15 on the contract for the construction of the Hudson River vehicular tunnel, involving twin tubes of cast-iron, 29½ ft. in diameter, to be constructed by the shield method. Two other contractors submitted figures as follows: Patrick McGovern, $20,917,267; Keystone State Engineering Co. and Holbrook, Cabot & Rollins (a joint bid) $22,191,635. (For unit prices see construction news section of next week's issue.)

The work is under the joint administration of the New York Bridge and Tunnel Commission and the New Jersey Interstate Bridge and Tunnel Commission for which Clifford M. Holland is chief engineer.

New Jersey's $40,000,000 Road Bond Issue Passes House

The $40,000,000 bond issue for the completion of the New Jersey state highway system has been adopted by the House of Assembly by a vote of 41 to 15. Assemblyman Pierson sponsors the bill for a referendum on the bond issue at the November election. The plan proposes the expenditure of $8,000,000 annually for five years. The measure continues the 1-mill direct state tax.

Federation Membership Opposed by New York Section, Am. Soc. C. E.

With an attendance of about 135 at its meeting in the Engineering Societies Building Feb. 15, the New York Section of the American Society of Civil Engineers, by practically a unanimous vote, disapproved the proposal that the parent society should become a member of the Federated American Engineering Societies. The vote was taken at the request of the Board of Direction in an effort to discover the sentiment of the various local sections on the federation question.

The decision of the New York Section was expressed in the passage of a resolution offered by G. L. Lucas, which pointed out that the proposal to join the federation had been defeated by letter ballot Nov. 8, 1920; that the receipts of the parent society are not now adequate for the support of the local section; that the expense of joining the federation would be $10,000 for the first year; and that the internal welfare of the society should receive first consideration. The payment of dues to the federation, the resolution stated, could only be done at the expense of the welfare of the society's local sections.

Equalize Transit Facilities, Says D. L. Turner

Consulting Engineer to Transit Commission Outlines Plan for N. Y. District

Extension of rapid transit facilities into new territory, instead of more intensive development of existing congested areas, was the solution to New York's transit problem offered by Daniel L. Turner, consulting engineer to the New York Transit Commission, at the Feb. 15 meeting of the New York Section, American Society of Civil Engineers. Present transit facilities, Mr. Turner stated, do not provide an equality of service for all residents of the city and this end can never be achieved as long as transit facilities trail behind traffic requirements. Rapid transit, it was emphasized, should precede, not follow, population. The routing of lines should be based on the area of the city served and not on the traffic immediately in sight.

Private ownership and operation, Mr. Turner believes, produce an unbalanced and undesirable development. He prefers municipal ownership with a monopoly of operation by a single private company under public control. In developing a plan of municipal ownership and private operation, according to Mr. Turner, several operators of the transit lines may be necessary at first, but ultimately a single company should exercise all of the operating functions.

In spite of the fact that New York City has been building subways since 1900, the work has gone along intermittently and is now ten years behind actual transit requirements.

Discussion

The discussion was opened by Edward A. Roberts of the staff of John A. Beeler, consulting engineer, who confined his remarks to the operation and equipment of surface lines. The two chief problems of the street railways at present, he said, are to reduce operating expenses and at the same time give better service. These ends are being met in some cities by the use of a new type of light safety car, operated by one man and moving at higher speeds than New York City's present types of street car. Increase in headway, Mr. Roberts pointed out, is a great factor in operating economy. Tests in a Middle-Western city showed that with an 8-min. headway the daily earnings were $21 per car, which increased progressively until with a 2½-min. headway earnings of $40 per car per day were recorded. Irregularity of street-car service was cited as one of the chief causes of public distrust of this type of transportation. Time can be saved, Mr. Roberts said, and revenue increased by the use of loading platforms and the adoption of the step-stop. If the average speed of street cars on Manhattan Island could be increased by 1 mile per hour, there would be available an additional 13,000,000 car-miles per year.

Utilization of New York City's existing rapid-transit trackage to the limit by the employment of proper equipment and operating methods was a remedy which Frank J. Sprague recommended as a means of immediate relief. The subway's maximum operating capacity can best be realized, he suggested, by having a motor drive on each axle of each car and a brake on every wheel. Under present operating conditions trains must run on a greater headway than would be the case if the car units composing the trains were so equipped as to make possible the maximum acceleration and deceleration.

Exception was taken by Mr. Sprague to Mr. Turner's advocacy of the universal transfer principle; he pointed out that this practice causes congestion by people who, to avoid only a short walk, will invariably secure a transfer, thus increasing the number of passengers to be handled.

As seen by Henry M. Brinckerhoff, the transit problem in New York is essentially one of the delivery end of the line rather than the home or starting point of the route dealt with at length by Mr. Turner. The danger in providing additional transit facilities, he said, lies in the bringing of all lines into the heart of Manhattan Island.

Dayton $3,000,000 Public Works Bond Issue Illegal

The $3,000,000 bond issue voted for various municipal improvements in the city of Dayton (Ohio) in April, 1920, the legality of which has been questioned since that time, was declared illegal by the Supreme Court of the State of Ohio Feb. 14. The issue received a majority vote, but a state law requires a two-thirds majority, which was not attained. The city commissioners contended that a provision of the city charter permitted an issue of bonds if a bare majority was received. The proceeds of the issue were to have been used as follows: Street and sewer improvements, $1,738,500; storm sewers, $643,000; parks and playgrounds, $283,000; bridges and culverts, $202,000; fire equipment, $263,700.

Would Pool Railway Rolling Stock and Terminal Facilities

A plan to pool the 2,500,000 freight cars of the country with one central agency under railway auspices has been proposed to the Interstate Commerce Commission by S. Davies Warfield, president of the National Association of Owners of Railroad Securities. The purpose of this plan is to coordinate the control, inspection, repair and rebuilding of all interchange freight cars in order to meet more effectively the regional and seasonal freight car requirements of the country. It is suggested that the National Railway Service Corporation, organized by the association of security owners, might perform this function in collaboration with the American Railway Association for the railroads and the Interstate Commerce Commission.

To avoid costly duplication of capital investment, the security owners' association advocates also a more general joint use of terminal facilities and announces that under its auspices a committee of engineers is now studying this problem.

N. J. Sewage-Works Operators Hold Experience Meeting

The annual meeting of the New Jersey Sewage Works Association, held at Trenton on Feb. 17, was largely devoted, as were the six preceding ones, to an exchange of experiences on the part of sewage-works operators and of engineers in private practice and connected with the State Department of Health. In a neighborly way, engineers engaged on City of Philadelphia sewage-works design are included in these meetings. The association now has 79 members.

In the course of a paper describing the Pennypack (Philadelphia) sewage-works and their operation for ten years, Harry Beaumont stated that the hypochlorite disinfection of the Imhoff-tank-sprinkling filter effluent had been successfully used throughout, except during 1916, when the war made it necessary to substitute liquid chlorine. The latter was less satisfactory than the hypochlorite.

Prof. R. O. Smith, of the New Jersey State Experiment Station, New Brunswick, N. J., outlined the research studies being made jointly by the Station and the State Department of Health, with the co-operation of the Research Committee of the Sewage Works Association, headed by John R. Downes, of the Plainfield joint sewage-works. These studies have included some phases of the biology of sewage treatment and experiments with sulphuric acid and with sulphate of alumina to facilitate sludge dewatering.

S. F. Miller, of the Pacific Flush Tank Co., was elected president and Myron E. Fuller, assistant engineer, Fuller & McClintock, New York City, was re-elected secretary-treasurer.

Ulen & Co. Formed to Construct South American Projects

To co-ordinate the activities of three groups of American engineering interests which have been working together in South America as voluntary partners, the firm of Ulen & Co. has been incorporated under the laws of the State of Delaware with an authorized capital stock of $5,000,000 preferred and 100,000 shares of common stock of no par value. The American International Corp., the Ulen Contracting Corp., and Stone & Webster, Inc., are subscribers to the stock to be issued immediately.

The company was formed to finance and carry out all construction contracts now under negotitation and all prospective business which has been developed in Latin-American countries during the last five years by the Ulen Contracting Corp. This corporation has already completed various engineering works in South America, including water and sewerage projects in cities in Uruguay and Bolivia, and is now engaged in constructing 128 miles of railroad in Bolivia, for which Fred Lavis is acting as engineer, and J. B. Cameron in charge of construction.

The directors of the company are Matthew C. Brush, Gordon H. Balch, Harry A. Arthur, Howard L. Rogers, M. J. Whitson, Frederick P. Royce, Henry C. Ulen, Thomas S. Sheppard and C. M. Bounell.

The officers are: President, Henry C. Ulen; vice-presidents, C. M. Bounell and Thomas S. Sheppard; treasurer, T. F. Devaney; secretary, Earl C. Ulen.

Designers and Builders Blamed for Knickerbocker Collapse

Following the brief summary of the coroner's jury findings on the Knickerbocker Theater roof collapse of Jan. 28, reported p. 294 of last week's issue, the full text of the findings is quoted below. The jury primarily blames the architect, the engineer, and the general contractor and steel and masonry subcontractors, although the administration of the building department, its current methods of work, and the building code of the District of Columbia are also held to be faulty. The verdict was returned on Feb. 14. It reads:

"Mary E. Atkinson came to her death Saturday, January 28, 1922, from fracture of the skull, hemorrhage and shock caused by the collapse of the roof of the Knickerbocker theater, Eighteenth street and Columbia road, Washington, D. C., due to faulty designing and construction and inadequate supervision and inspection, and we hold Reginald W. Geare, John Howard Ford, Morris Hacker, Donald Wallace, Frank L. Wagner, Richard G. Fletcher, John L. McDonald, Thomas L. Costigan and Julien R. Downman for the action of the grand jury.

INSPECTOR QUALIFICATIONS LOW

"It is noted that no special qualifications are essential in filling the position in the office of building inspector; that the testimony of witnesses from the office of building inspector, with one exception, shows a lack of knowledge of conditions and proper supervision of buildings erected in the District of Columbia; that the reports made by field inspectors were unintelligent and that little or no attention was paid to them, they apparently being made only as a matter of form and not with any idea of following up or checking any defects, showing the lamentable lack of appreciation of responsibility.

"It is also noted that many of the witnesses testifying in this case have done so with much evident unwillingness and mental reservation.

"We recommend a through revision of the building code in the District of Columbia, with a heavy penalty for violation of any of its clauses.

"We also recommend that all theaters and places where the public assembles be closed and kept closed until such time as their safety is assured.

"We further recommend that the city fire department be equipped with oxyacetylene torches and tanks, jacks, searchlights and such other equipment as would be needed by a wrecking crew in an emergency, the lack of which equipment seriously handicapped the rescue of the victims of the Knickerbocker disaster."

Would Study St. Lawrence Project Before Congress Takes Action

The Merchants' Association of Greater New York has filed with the House Committee on Interstate and Foreign Commerce a request for delayed action upon the St. Lawrence ship-canal project until the report of the International Joint Commission can be studied and analyzed. The memorandum, signed by James Gilbert White as acting president of the Merchants' Association, has been sent to every member of Congress, to President Harding and other officials.

Fourth Offer Made for Taking Over Muscle Shoals Plant

The Alabama Power Co. of Birmingham, Ala., represented by Thomas W. Martin, president, has submitted the third rival to the Henry Ford offer for the completion and operation of the Muscle Shoals water-power and nitrate manufacture project begun by the federal government during the war. In contrast with the Ford requirement of a large government expenditure and a 100-year lease, the Alabama Power Co. would require no government outlay (except a small allowance noted further on) and would accept a 50-year license, with federal recapture clause at the end of that time, all as provided in the federal water-power act.

The company offers: (1) To complete the dam, locks and power house known as Wilson Dam or Dam No. 1, with an initial installation of about 240,000 hp., with provision for future extensions; (2) to furnish free to the Government or its designated agent 100,000 hp. for the manufacture of fertilizers and war munitions and for related research, and to buy this amount of power from the Government in case of discontinuance of its use for the purposes stated because of "changes in the act," this horsepower to be the second 100,000 hp. "available from the normal flow of the river"; (3) to buy the Government's interest in the steam plants of the company's Warrior extension and of Nitrate No. 2, and in certain transmission lines and housing facilities, the company to pay the Government $5,000,000, less an amount to be agreed on to cover the cost of locks and navigation structures at Wilson dam; (4) the company offers to operate and maintain the power plant, dam and gates, the Government "to operate and maintain the locks," but the company to supply the necessary power without cost to the Government; (5) the Wilson Dam property and construction plant to be transferred to the company and the locks and navigation structures to be conveyed to the Government on completion; (6) the Government to have the right to take over and operate the plant in case of war necessities, as provided under the act.

H. L. Cooper Opposes Ford Proposal for Muscle Shoals

Strong opposition to the acceptance by the federal government of Henry Ford's offer to purchase and lease the Muscle Shoals properties in Alabama was made at a hearing before the House Military Affairs Committee Feb. 17 by Hugh L. Cooper, consulting engineer to the government on the Muscle Shoals development. Col. Cooper said that to remove the super-water-power project of the South from use by public utilities for 100 years would be a calamity. He declared that the maximum length of lease of government lands carrying water-power rights should be 50 years, and only that long when the license is subject to the regulations of the water power act.

Col. Cooper also maintained that, based on U. S. Army Engineer data, acceptance of the Ford proposal would cost the government $1,275,000,000 "in order that Mr. Ford may secure sole, unregulated possession of the greatest water power" in the South. The entire $83,175,475 expended and estimated as to be spent on the project should be made interest-bearing, Col. Cooper said, adding that the government was paying 4 per cent and more on the money it had borrowed.

Illinois Central R.R. Plans $50,000,000 Improvements

To provide funds for reconstructing its freight and passenger terminals and electrifying its lines in Chicago and for otherwise improving its property in that city the management of the Illinois Central Railroad Company will ask its stockholders at the annual meeting to be held on April 19 to authorize an issue of $50,000,000 preferred stock. Plans are now in preparation for the contemplated improvements which, it is expected, will be spread out over a period of eighteen years.

National Research Council Opens Fight on Marine Borers

An immediate investigation looking to an organized campaign against the activities of marine borers, or ship worms, is announced by the National Research Council, which has appointed to undertake the work a Marine Piling Committee consisting of:

R. T. Betts, chief engineer, Robbins-Ripley Co., chairman; George J. Ray, chief engineer, D. L. & W. R.R., vice-chairman; Dr. A. L. Barrows, assistant secretary, National Research Council, secretary; George M. Hunt, U. S. Forest Service; Prof. C. A. Kofoid, University of California, and Dr. Hermann von Schrenk, consulting engineer, N. Y. C. R.R.

Col. W. G. Atwood, has been appointed director for the investigation and will have his office in the Engineering Societies Building, New York City.

San Francisco Approves $2,467,000 Municipal R.R. Extension

At the Feb. 6 meeting of the San Francisco board of supervisors it was definitely decided to proceed with construction on the Duboce Ave. extension of the Municipal Ry. which will give direct access to the Sunset District. The total cost is to be $2,467,000 of which $1,900,000 is needed for a 4,200-ft. tunnel. Of the total cost, $1,967,000 is to be raised by assessments on property of the district and the city is to pay $500,000.

The primary object of the new extension is to pierce the Twin Peaks ridge and so open up the north Sunset region between Golden Gate Park and Parkside, made in the same way as Ingleside and St. Francis Wood were opened up by the Twin Peaks tunnel.

The proposal of better transportation for this district has been under consideration for four years. Recently four alternative routes were studied and reports were submitted on each by the city engineer who attached to his report a recommendation in favor of the Duboce Ave. route. The boundaries of the assessment district are yet to be fixed, but it is understood that property owners who were assessed for the Twin Peaks tunnel will not be included in the new assessment.

Michigan Engineers Discuss Business Topics

Building Strike Prevention Measures Outlined — Sewer Reconstruction Needed—Drainage Laws

(Engineering News-Record Staff Report)

The Michigan Engineering Society, state assembly of the American Association of Engineers, is finding itself. A greater feeling of harmony among all members of the profession in the state was evident at the annual meeting, Feb. 8-10, at Kalamazoo, than has been observed at any time since A.A.E. went into Michigan. While all the irreconcilables have not joined, they are no longer belligerent. Tolerance is the watchword. Work, accomplishment, and a less radical feeling in the organization itself, have broken down many of the former barriers. The wholehearted way in which the local chapter has entered into the co-operation with existing organizations in Detroit to form the Associated Technical Societies has been no small factor. A minimum discussion of detailed engineering and a maximum amount of time spent on the business side of engineering characterized the program.

Scope of Program

The topics included ethics, co-operation in the building field, the highway situation, municipal problems, from zoning and planning to administration by the city-manager form of government, and the working of the registration law. There were inspirational addresses on vision and fellowship, and a mock court before which the chapters appeared to recite their achievements and receive a relative rating.

Perhaps the most interesting single feature to A.A.E. members over the country was the launching of the candidacy of Clarence W. Hubbell for the presidency of the national organization. Mr. Hubbell has recently resigned as city engineer of Detroit, effective March 1, to return to his consulting practice, having practically completed the carrying out of the sewer construction program for which he went into the office. Mr. Hubbell was a candidate last year but withdrew.

The assembly is growing; three new chapters were formed during the year at Pontiac, Kalamazoo and Jackson. Finances reflect the depression, but despite the fact that only 42 per cent paid their dues the assembly has money in the bank and the quarterly magazine made a substantial profit. Financial relations with headquarters, the greatest bone of contention a year ago all over the country, have apparently been straightened out satisfactorily.

"Engineering Ethics" by Dean M. E. Cooley, University of Michigan and president of the Federated American Engineering Societies, who could not attend because of a speaking tour in the Southwest, was treated by Prof. H. E. Riggs.

To Prevent Strikes

"Co-operation Between Architects, Engineers and Builders," a subject handled by Fred Larkin, president of the Association of Building Employers of Michigan, presented problems which have prevented success in the past. The principal feature of the evening's program, which climaxed the

American plan, was to call in all parties to any controversy, particularly the owner who paid the bills and the engineer or architect. Many specifications now have a clause requiring the contractor to use the American plan of employment and Mr. Larkin requested the engineers to insert it in all of their contracts. Actual costs during the past year have been 8 to 16 per cent lower in Michigan than elsewhere, but in many cases the wage scale was higher than the union rate.

Frank F. Rogers, state highway commissioner, outlined the progress of road building and indicated that the state's 1922 budget of $14,400,000 called for nearly 1,000 miles of trunk-line construction. Of this mileage about 275 miles will be hard surface and one-third will receive federal aid.

In the discussion of Prof. Arthur H. Blanchard's paper on "Highway Transport" it was brought out that the rural taxpayers need to realize that 68 per cent of the taxes for roads are paid by city residents. Gasoline taxes, he said are now levied in twelve states; many more are considering them and Prof. Blanchard stated that it was a reasonable measure of use taxation.

Prof. W. C. Hoad, University of Michigan, in his talk on "Sewer Surveys and Reconstruction" stated that growing cities all over the country are considering reconstruction because of outgrown systems. One of the greatest difficulties arises from the fact that sewers and sewage treatment often absorb more money than any other municipal utility and produce no revenue. He made a plea for the beautification of sewage works, grounds for the psychological effect upon attendants and citizens. In discussion, Patrick Keating, consulting engineer, Detroit, inquired as to why pure-iron corrugated pipe was not oftener used in comparatively temporary storm-water drains. No one seemed in favor of this expedient. To an objection to the high friction coefficient, N. R. Macklen, civil engineer, Bay City, replied that not much was known, but $10,000 was being expended at Berkeley, Cal., on hydraulic experiments on corrugated pipe.

Chapters in "Court"

In the recital of chapter activities before the "court," which was handled by L. E. Ayres, national director, A.A.E., the basis was a questionnaire of 30 questions relating to meetings, attendance, programs, civic activities, committees and financial operation by budget or otherwise. Reports were submitted by Ann Arbor, Detroit, Flint, Jackson, Kalamazoo, Lansing, Muskegon, Pontiac, Port Huron and Saginaw chapters and the districts of Grand Rapids, Bay City, Cadillac and the Upper Peninsula.

The report on the working of the registration law presented by C. R. Olmsted, office manager, State Board of Examiners, indicated 1,419 registrants, including 523 architects already registered under a previous law. The classification of engineers is as follows: Civil engineers, 595; mechanical engineers, 111; electrical engineers, 39; chemical engineers, 20; mining engineers, 50; marine engineers, 3, and surveyors, 143. Some engineers are classified in several of the classes. No work on violations has begun but the board expects to handle some clear-cut cases soon.

C. F. Lang Retires as President of Lakewood Company

Charles F. Lang has retired as president of the Lakewood Engineering Co., Cleveland, following a general reorganization which the company has undergone. Mr. Lang's retirement dates from the recent annual meeting.

Despite general business conditions reports from the field force of the Lakewood company indicate a general betterment and increase of business in all departments, particularly in the paving and general construction fields. It has already been necessary to increase the factory force to meet the improved demand.

Erie R.R. Awards Contract for Pier of Unusual Design

A contract for the construction of a freight pier at Weehawken, N. J. to replace one that burned last fall has been awarded by the Erie R.R. to Foley Bros. of St. Paul, Minn. The pier will be of two stories, 96 x 842 ft. in plan and will be divided into two equal sections by a transverse fire-wall. It will be served by two tracks and equipped with eight elevators.

The superstructure will be framed of Douglas fir designed in accordance with the slow-burning mill building principle and will be provided with automatic sprinklers. The sheathing will be of corrugated zinc and the gutters, leaders and window casings of plain sheets of the same metal. Zinc was selected for this purpose with a view to securing greater permanence than would otherwise be possible under the peculiarly corrosive conditions that result from the combination of salt air and locomotive gases.

Hold Conference on Highway Engineering at Michigan

The eighth annual Michigan conference on highway engineering was held at the University of Michigan, Ann Arbor, Feb. 13 to 17. The program, arranged by Prof. Arthur H. Blanchard, included papers and discussions.

Drainage legislation has been a thorn in the side of the engineering profession in Michigan for years. Drain commissioners are elected. Some are paid as high as $60 annually! Secretary Hunter, of the Michigan Association of Drain Commissioners, explained the difficulties and asked for—and obtained—an endorsement of legislation promulgated by his associates toward the establishment of a state drainage bureau under the agricultural department of the state.

Resolutions and Officers

Resolutions passed included a request for the appointment of committees to investigate motor bus and other highway transportation from the financial angle, to look into the question of a proposed state department of public works and to assist chapters in putting engineers in engineering positions.

The officers chosen for the ensuing year are as follows: President, L. H. Neilsen; vice-president, Ross J. Buck; treasurer, H. A. Shuptrine; director at large, Charles E. Wood. C. B. Huff, Detroit, the half-time secretary, was chosen by the board of directors.

Los Angeles Sewer Overflow Problem Serious

Objections to Nuisance from "Sewage Floods"—Flow Diverted into Creek Temporarily

The prediction of an early overcharge in the Los Angeles ocean outfall sewer, with resulting overflow and nuisance, made by the engineering department of the city in its report advocating the bond issue for a new sewer and sewage-works (voted down by the people last year) came true on schedule time and led to palliative measures on the part of the city that gave rise to protest and brought the matter before the State Board of Health. There was a public hearing before the board on Jan. 27, while on Jan. 31 residents of Culver City, Venice and other districts along Ballona Creek applied for an injunction to prevent Los Angeles from continuing the Ballona Creek discharge.

From statements made at the Board of Health hearing it appears that the capacity of the trunk sewer conveying city sewage to the ocean has been overtaxed to such an extent that the daily peak flow in the sewer is sufficient to put the main line under pressure and cause the sewage to escape from the manholes in certain residential districts.

Release Flow Into Creek

As an expedient to prevent this nuisance the city tapped the trunk sewer and released a flow of about 10,000,000 gal. daily into Ballona Creek, whence it finds its way to the ocean near Venice. Until a permanent means of disposal can be provided the city proposed to put in a temporary screening plant at the point where the sewer was tapped and after screening to chlorinate the effluent. It was estimated that about 18 to 20 per cent of the solids could be removed in this way and the bacterial count reduced about 90 to 95 per cent. The State Board of Health refused to sanction the discharge of sewage into the creek, even with treatment, as outlined.

Property owners in the residence districts subject to the sewage floods vigorously defend the Ballona Creek relief measure. Residents of the area along the watercourse as vigorously protest. The city engineer believed that the only permanent solution is the voting of bonds for a disposal plant or new outfall to the ocean.

Asphalt Association Opens Branch Office at Albany

In line with its recent action in opening branch offices at Raleigh, N. C., and Atlanta, Ga., the Asphalt Association, New York City, carrying out its policy of expansion, has moved its Canadian office from Toronto to Albany, N. Y., where Germain P. Graham, formerly deputy city engineer of Albany, will be in charge as district engineer.

Mr. Graham graduated from Rensselaer Polytechnic Institute in 1908 as a civil engineer. From 1909 to 1917 he was in the city engineer's office at Albany where he had charge of river front improvement and intercepting sewers. During the World War he served as Captain and Adjutant in the 20th Engineers. At the conclusion of his army service he returned to Albany as deputy city engineer.

Propose $5,000,000 Bond Issue for Norfolk Port

A proposed bond issue of $5,000,000 by the City of Norfolk, Va., for the construction of waterfront improvements, was passed, 6 to 1, by popular vote Feb. 7, 1922. The preliminary plans provide for piers and sheds with 500,000 sq.ft. of warehouse space, two open pier berths and a grain elevator of 750,000 bu. capacity with a berth to serve it, at a total cost of approximately $3,800,000. The remainder of the proposed appropriation is for the establishment of a sinking fund for maintenance, etc.

Memphis To Build Subway Under Railroad Tracks

Mayor Paine of Memphis, Tenn., has reached an agreement with the Nashville, Chattanooga & St. Louis R.R., the Frisco R.R., the Southern R.R., Union Railway, and the Louisville and Nashville R.R. under the terms of which a subway will be constructed under the tracks of these five railroads where they cross South Bellevue Boulevard. Negotiations have been under way for more than two years between Memphis and the railroads in an effort to agree on building the subway.

The estimated cost of the subway is $300,000, of which 80 per cent will be paid by the railroads and 20 per cent by the city. Plans will be rapidly completed so that work can start by the middle of 1922. About a year will be required to complete the subway. Reinforced concrete will be used and the street approaches will be widened to 60 ft., the present street being only 45 ft. The Memphis Street Railway will extend its tracks under the subway and connect the southern part of Memphis with the northern section.

Memphis was granted power by the last state legislature to sell bonds to pay for its share of the cost.

Middle West Practising Engineers Form New Association

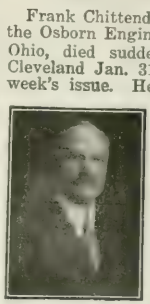
At a conference Jan. 18 of practising engineers from Iowa, Nebraska and South Dakota, held during the convention of the Iowa Engineering Society at Sioux City and sponsored by the Iowa Section of the American Society of Civil Engineers, it was decided to form a new association with membership limited to engineers either wholly or in part in private practice. The objects are similar to those of the American Institute of Consulting Engineers.

To raise the standards of ethics of the profession, to bring about a higher degree of professional co-operation between the engineers of every state and to perfect the standard contracts for engineering services are some of the immediate problems it is proposed to attack. One suggested name is the Missouri Valley Association of Engineers. Engineers from Illinois on the east, Colorado on the west, Kansas on the south and Minnesota and North Dakota on the north are to be asked to support the association.

The temporary officers elected to lay the groundwork for the proposed association are as follows: President, Prof. John H. Dunlap; vice-president, George T. Prince; secretary-treasurer, E. K. Mather, Mitchell, S. D.

Frank Chittenden Osborn

Frank Chittenden Osborn, founder of the Osborn Engineering Co., Cleveland, Ohio, died suddenly at his home in Cleveland Jan. 31, as reported in last week's issue. He was born in Greenland, Mich., in 1857 and after graduation from Rensselaer Polytechnic Institute, entered the employ of the Louisville (Ky.) Bridge Co. as assistant engineer. In 1885 he became principal assistant engineer for the Keystone Bridge Co., of Pittsburgh, Pa., and in 1887 joined the firm of G. W. G. Ferris & Co., inspectors and designers of structural-steel work in that city. In 1889 he accepted the position of chief engineer of the King Bridge Co., of Cleveland.



Foreseeing a wide field as a private practitioner, he resigned in 1892 and proceeded to establish an engineering practice which grew to such proportions that in 1900 it was incorporated as the Osborn Engineering Co. The Osborn Company designed and constructed nine portland cement plants, with a producing capacity of about 17,000 barrels of cement each day, a large number of bridges of steel and reinforced concrete for counties, cities, electric and steam railways.

In 1908 Mr. Osborn was appointed a member of the Cuyahoga County Building Commission, having charge of the construction of the new court house at Cleveland, involving an expenditure of about $5,000,000.

He was an active member of the Cleveland Engineering Society, and had been director, secretary, vice-president and president, and at the time of his death was a member of its City Plan Committee. He was for three years (1901-03) a director of the American Society of Civil Engineers and in 1909 he was appointed a member of its Special Committee on Steel Columns and Struts, and served on this committee for several years. He was a member of the Association of Railway Superintendents of Bridges and Buildings, American Society of Testing Materials, and the Institution of Civil Engineers of Great Britain.

South Carolina Proposes Big Road Improvement

A proposal to spend $34,000,000 within six years and to complete within that time 4,000 miles of the state highway system, more than 600 miles of which would be hard-surfaced and the remainder surfaced with sand-clay, top soil, or gravel, is to be urged before the present session of the legislature of South Carolina. In order that this proposal should conform to the federal-aid acts the state highway officials recently held conferences with representatives of the U. S. Bureau of Public Roads.

If the greatly expanded program is carried out, the state will match all of the federal-aid money now available and any future appropriation that may become available. Funds will be raised by automobile licenses, by continuing the state-wide 2-mill property tax, a 1-cent-per-gallon motor fuel tax, and a bond issue of $10,000,000.

Santa Fe Ry. Plans Improvements To Cost $45,000,000

The budget of the A., T. & S. F. Ry. System for 1922 contemplates the expenditure of about $45,000,000 for improvements, betterments, equipment, double-tracking and new branch lines, as compared with $35,000,000 in 1921. According to W. B. Storey, president, prospective demands of the territory served by this system would call for a much more extensive program, probably $60,000,000 annually for three years, but such an outlay is not possible under present conditions.

Of the 1922 expenditures, $11,750,000 will be for the completion of work in hand; $22,000,000 for new work, including 75 miles of new second track from Yampai to Griffiths, Ariz.; $8,000,000 for new equipment; $1,400,000 for a 55-mile branch from Satanta, Kan., and $1,150,000 for a 35-mile branch from Owen to Pawhuska, Okla. In the construction of the Arizona second track there will be a grade reduction from 95 ft. to 75 ft. per mile, which will save from 20 to 25 per cent in freight train mileage, amounting to upwards of $500,000 a year.

Following are some of the larger items in the budget:

Addition to main lines	$6,662,298
New branch lines	2,550,000
Bridges, trestles and culverts	1,512,892
Rails and other track material	1,101,868
Stations and office buildings	1,056,639
Shop buildings	1,041,350
Additional yard tracks and sidings	946,148
Shop machines and tools	724,281
Assessments for public improvements	533,633
Widening cuts, fills, etc.	459,701
Signals and interlocking plants	466,288

A. A. E. Employment Survey Finds Conditions Improving

That the demand for engineering services is on the road to recovery is reported by the employment department of the American Association of Engineers, which has received reports from more than 200 widely separated localities. Many million-dollar projects are in progress or contemplated at an early date. Although a lull in engineering employment was experienced at the end of the year, the number of unemployed was less than it had been for several months. The following table shows the trend of employment:

	Dec., 1921	Nov., 1921	Dec., 1920
Applicants for employment	1877	1691	191
Positions received	[illegible]	[illegible]	[illegible]
Men referred	[illegible]	[illegible]	[illegible]
Men placed	[illegible]	[illegible]	[illegible]

The average monthly salary of positions filled in December was $178 or $14 less than the month previous. For the same month last year the average salary was $200. The highest salary position filled was $6,000 per annum; the lowest salary $90 a month.

The greatest number of engineering positions was in the East and the South Atlantic states. The principal demand was for engineers in designing offices, with architectural firms coming first. There was a small demand for construction engineers and general sub men. Most of the men employed are engineers with railroad experience, a field which has been quiet for some time. The main demand at this time is for highway engineers, designers, sales engineers and a fair demand for teachers and engineers.

Transit Line's Value $465,680,154

As a preliminary to the proposed unification of the transit system of New York City the Bureau of Valuation of the Transit Commission has announced a valuation of $465,680,154 for the operating properties of all of the transit companies in the city. This amount is less than had been expected, the companies' own valuation of the properties being $791,450,839.

Load Limit in Shasta County

Shasta County, Cal., has recently enacted an ordinance limiting loads that may be hauled over the roads from Nov. 1 to April 1 to 5,000 lb. weight of the vehicle included.

The Supervisors have given the Pacific Gas & Electric Co. a permit to exceed that limit, but it has to give a bond of $2,000 that all damage to the roads and bridges will be made good immediately, and it undertakes to guarantee that no heavily laden trucks will go on the roads during a storm or immediately after a heavy rain.

Baltimore May Convert Reservoir Into Municipal Stadium

A favorable report on the conversion of the Mount Royal reservoir of the Baltimore water-works into a municipal stadium has been made by Henry G. Perring, chief engineer of the Department of Public Improvements of that city. At a conference held by the Mayor of Baltimore, William F. Broening, recently, at which members of the Public Athletic League of Baltimore and other interested citizens were present, unanimous support was given to the project.

The reservoir, 550 ft. in diameter, was built 70 years ago for low service but its use was given up ten years ago. Mr. Perring proposes to remove the cobblestone lining of the inner slope and construct concrete seats. The cost of five different schemes, designed to seat from 14,000 to 60,000 people, is estimated at from $100,000 to $375,000 with a possibility of seating 70,000 at an estimated cost of $500,000. These costs cover structural requirements, no allowance having been made for architectural features that may be added later.

Associated Industries Establish Technical Information Service

The executive committee of the Associated Industries of Massachusetts recently voted to establish a technical information service. The technical adviser named to conduct the department is Hervey J. Skinner, of the firm of Skinner, Sherman & Esselen, Inc., chemists, biologists and engineers, Boston.

The new section will answer inquiries on fundamental processes employed in manufacturing operations and will supply members with information relating to problems of construction, properties of building materials, selection of more important types of equipment for specific operations, erection of machinery, and the like. It is also in a position to direct members to sources of information on technical subjects, and to places where materials or equipment can be obtained to the best advantage.

Indiana Adopts Lugless Brick and Asphalt Filler

The state highway commission of Indiana, through Lawrence Lyons, director, has just announced a radical change in specifications for vitrified brick pavements. Under the new specifications, the state, while continuing the construction of rigid base, permits the change from a rigid to a flexible brick surface by specifying asphalt filler.

Previous to the change, Indiana's brick specifications called for monolithic construction. The new specifications call for a 5-in. concrete base, 1-in. cushion, 3-in. brick and asphalt filler.

15 States Tax Gasoline

Figures Issued Feb. 15 by the National Automobile Chamber of Commerce show that 15 states now have a tax on gasoline. Two cents a gallon is the charge in Oregon while a 1-cent-a-gallon tax is collected in Arizona, Arkansas, Colorado, Connecticut, Florida, Georgia, Kentucky, Louisiana, Montana, New Mexico, North Carolina, Pennsylvania, South Dakota, and Washington.

Gasoline-tax bills are impending in six other states—Massachusetts, Maryland, New Jersey, South Carolina, and Virginia—the amounts varying from 1 to 3 cents per gallon.

Super-Power Advisory Board To Meet

Now that ample time has been given to secure the reactions of the electrical industry to the super-power report, the members of the Advisory Board are to be called together in the near future for further discussion of the project.

Dr. George Otis Smith, the director of the U. S. Geological Survey, under whose direction the super-power report was prepared, believes that the showing of economies presented in the report has stimulated interconnection between existing systems throughout the country The nation-wide interest that has been taken in the report is indicated by the fact that the entire edition of 10,000 copies of the report has been exhausted. The exact date of the meeting of the Advisory Board had not been fixed.

Secretary of Commerce Hoover states that the super-power report has stimulated the desire for similar studies in the Pittsburgh-Chicago area and in other sections.

Indiana Announces Bridge Plans

The bridge program of the Indiana state highway commission for 1922 which includes new structures and the repair of many old ones, embraces fifty-five state-aid projects, and sixty-five federal-aid jobs. All are to be grouped into six divisions with a resident engineer in direct charge of each division.

The state aid bridge projects, to cost $370,000, are situated in twenty-six counties. The smallest project is a 16-ft. span and the largest a 600-ft. crossing of six spans. The latter is a viaduct over the Big Four Railroad tracks west of Covington.

Of the sixty-five federal-aid bridge projects the smallest is a 20-ft. span, and the largest an 1800-ft. crossing. The latter is the bridge across White River at Hazelton.

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Spring Society Meeting, Dayton, Ohio, April 5-6; Subject, "Flood Problems."

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago; Annual Convention, Chicago, March 14-16.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, Philadelphia, May 15-19.

The New York Section of the American Water Works Association will hold its last regular meeting until the fall on Thursday, March 2, at 12:30 p.m. The speaker will be Beekman C. Little, superintendent of the Rochester water-works and past president of the association.

The Colorado Society of Engineers has elected the following officers for the ensuing year: President, R. M. Hosea; vice-president, W. M. McMechem; and secretary-treasurer, C. M. Lightburn.

The Engineers' Club of Philadelphia will hold a joint meeting with the following societies on March 6, at the clubhouse: Am. Soc. C. E., Illuminating Engineering Society, Am. Soc. M. E., and the American Society of Municipal Engineers. The subject for discussion will be, "Zoning and Its Relation to City Development."

Personal Notes

THOMAS BOLES, chief engineer of the Fort Smith & Western Ry., has been appointed superintendent of the government reservation at Hot Springs, Ark.

HERBERT TALLEY, chief engineer of the Hercules Powder Co., Wilmington, Del., has resigned to become an executive of the United States Powder Co., Terre Haute, Ind., in which company he is financially interested.

PERRY O'NEIL, until recently president of the O'Neil Engineering Co., of Dallas, Tex., is now representing the Elrod Engineering Co., of Dallas, and Los Angeles, Cal., as contracting engineer.

B. L. G. REES, civil engineer, has joined the advertising selling staff of *Engineering News-Record*, and will operate in the New York territory. He was graduated from Princeton in 1907 and after serving in the engineering department of the Pennsylvania R.R. for several years he engaged upon the New York Barge Canal work, which he left to take up harbor terminal construction at Brunswick, Ga. Subsequent engagements were on the New York subways; at Antofagasta, Chile,

on nitrate developments; and, during the war, on construction work at Camp Merritt and the Port Newark terminal. Recently Mr. Rees was civic manager for the city of Nitro, W. Va., for the Charleston Industrial Corp.

WILLIAM P. GRAHAM, formerly dean of the L. C. Smith College of Applied Science, Syracuse University, has been appointed acting vice-chancellor of the university. LOUIS MITCHELL, professor of civil engineering, will succeed Mr. Graham as dean.

F. J. NEVINS has been appointed valuation engineer of the Chicago, Rock Island & Pacific Ry., with headquarters at Chicago.

WILLIAM H. HOFFMAN, until recently structural engineer for the Case Crane and Engineering Co., Columbus, Ohio, has become chief engineer of the Hughes-Keenan Co., at Mansfield, Ohio.

ARTHUR ST. LAURENT, assistant deputy minister of the Canadian Department of Public Works, has been appointed chief engineer, succeeding the late E. D. Lafleur.

JOHN MACCUTCHEON has been appointed superintendent of bridges for Bridgeport, Conn.

LYMAN T. BANKS, formerly steel expert of the U. S. Shipping Board, has been elected secretary of the Engineers' Club of Seattle.

ARLINGTON M. SMITH, EVAN FISHER, HENRY R. HAINES and HENRY FISHER, JR., who have been connected with the construction department of the Southern California Edison Co., have left that organization to open offices in Bakersfield, Cal., under the name of Western Engineering Co. Special attention will be given to construction and supervision of mining, irrigation and hydraulic work.

CHARLES F. PUFF, JR., has resigned his position as secretary and general manager of the associated Pennsylvania Highway Contractors to engage in the private enterprise of establishing the contractors Service Bureau, covering a territory within a 30-mile radius of Philadelphia. At a special meeting of the board of governors resolutions were passed expressing regret at Mr. Puff's loss to the association and appreciation of his services. Mr. Puff, before becoming associated with the Pennsylvania contractors organization, was assistant chief engineer of the highway department of Philadelphia.

JAMES M. FOURMY has been appointed state highway engineer of Louisiana. He is a graduate of the Louisiana State University, class of 1905, and has been engaged in highway work within the state for the past 10 years. Before he entered the highway field he planned and supervised the building of the electric railway to the top of Signal Mountain, near Chattanooga, Tenn. and later served as assistant city engineer of New Orleans.

W. F. COOPER, who has been with the Louisiana State Highway Department since 1917, has been appointed assistant state highway engineer, with headquarters at Baton Rouge.

PHILLIP DEAN, building commissioner for Madison, Wis., has resigned to enter private practice as an architect and engineer in Madison.

P. T. ROBIN, formerly connected with the Terry Manufacturing Co. in New York as sales and cost engineer, has been appointed contracting engineer for the Penn Bridge Co. at the New York Branch.

A. H. ROBBERT, formerly chief designing engineer for the Terry Manufacturing Co. in New York, has joined the staff of the Penn Bridge Co. as contracting engineer for the New York Branch.

WILLIAM CRAVEN, bridge engineer, North Carolina State Highway Commission, has been appointed senior bridge engineer.

W. F. COCKE, assistant state highway engineer of Virginia, has resigned to become state highway engineer of Florida.

W. H. DE FRANCE, who has been with the Texas & Pacific R.R. for the past few years, has been appointed superintendent of wharves and docks for the Board of Park Commissioners, New Orleans, La., succeeding Hayden Wren, resigned.

J. F. MALINE, engineer and vice-president of the E. F. Hauserman Co., Cleveland, Ohio, has been appointed Director of Public Service for Cleveland by Mayor-elect Kohler.

W. RICHMOND TRACY has been elected engineer-secretary for the Union County Park Commission, with headquarters in Newark, N. J. Mr. Tracy is at present engineer in charge of bridge construction for the Bronx Parkway Commission.

GEORGE F. SYME, supervising engineer, North Carolina State Highway Commission, has been appointed senior highway engineer.

OBITUARY

WILLIAM C. SARGENT for 22 years secretary and also a director of the Chain Belt Co., Milwaukee, Wis., died suddenly Feb. 5. He was 73 years of age.

JOHN G. TAIT, contractor, of Lima, Ohio was killed in an automobile accident, Feb. 14. At the time of his death Mr. Tait was manager in Ohio for the Willite Construction Co. He had served formerly on the construction of the Hudson River tubes in New York.

RICHARD R. RICE, manager of the Lynn (Mass.) works of the General Electric Co., died suddenly at Lake George, N. Y., Feb. 10. He was a graduate of Stevens Institute of Technology (class of 1895) and specialized in the design of steam turbines and engines.

R. M. DEGARMO, assistant engineer on the Florida East Coast Ry., died Feb. 14 at Key West, following injuries received when the railway motor car in which he was inspecting structures over the Florida Keys became derailed. Mr. De Garmo was thirty-six years of age, a graduate of Cornell University, and a member of the American Society of Civil Engineers and the American Association of Engineers. Mr. De Garmo served with the 17th Engineers overseas, first as a first lieutenant and then captain and major, respectively, serving under Col. C. S. Coe. He had been connected with the Florida East Coast Ry. since September, 1909.

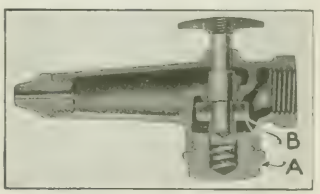
BUSINESS NOTES

THE PENN BRIDGE CO., with main offices at Beaver Falls, Pa., and shops at Claysville and Beaver Falls, will open a New York branch office on March 1 at 101 Park Ave., with P. T. Robin and A. H. Robbert as contracting engineers, in charge. The company's bridge and structural work in the east will be taken care of by the new branch and all the crane and derrick business formerly carried on at Beaver Falls will be transferred to New York. The Penn Bridge Co. was recently awarded the contract for the construction and erection of a Strauss trunnion bascule bridge over the Shark River Inlet between Avon and Belmar, Monmouth County, N. J.

EQUIPMENT AND MATERIALS

Air Gun With Renewable Valve Disk

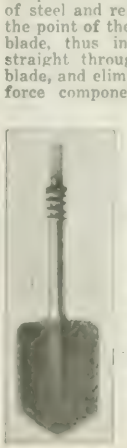
Air waste is eliminated, in a new air gun developed by Jenkins Bros., New York, by means of a renewable disk



with which the valve is fitted. In the illustration the disk, a ring through which the valve stem passes, is indicated by the dark shading. To replace the disk the cap *A* is unscrewed and the disk holder *B* is removed through the opening. The air gun is cast brass.

Improved Pneumatic Spade

To reduce failure by fatigue, the Chicago Pneumatic Tool Co., New York, has developed a special design of pneumatic spade. The spade and shank complete are forged from a solid piece of steel and reinforced on the inside at the point of the shank connection to the blade, thus insuring impact of blow straight through to the point of the blade, and eliminating to a large degree force components, that may produce fatigue and cause the shank to break. The back of the spade has a curvature, so calculated from experiments, as to reduce digging friction to a minimum and permit easy and accurate guiding. Another feature is the retaining device fitted with a spring shock-absorber, which absorbs the shock occasioned by the piston striking the [illegible] shank when the spade is not against the clay. The spring has been so arranged it will absorb more energy than the piston can [illegible]



Business Side of Construction

Facts and Events that Affect Cost and Volume

Harding Sees Cause for Optimism in Treasury Statement

"The most satisfactory turn in the financial affairs of the country since the conclusion of 1919" is the view taken by President Harding in a recent statement issued from the White House which comments upon the report of the Controller of the Currency based on the last bank call—that of Dec. 31, 1921. The President reviewed some of the most important of the statistical points in the Controller's report, concluding that the peak of liquidation had been passed some time between Sept. 6, and Dec. 31, 1921. The bank call of the national banks showed that, between these two dates the cash in vaults was reduced only by $15,987,000; that, excluding government deposits there was an increase of $322,811,000 in individual deposits, whereas they fell over $1,500,000,000 during the nine months previous to Sept. 6, 1921; and that the national banks had lawful reserve with Federal Reserve Banks of $1,143,000,000, or $87,000,000 in excess of legal requirements.

The Controllers' statement shows a considerable increase in available resources. Improved banking conditions are also evident, especially as regards rediscounts and cash on hand. Deposits have also shown surprising gains. Payments on some of the outstanding "frozen credits," may be realized.

Next week a cement manufacturer discusses uniform bids.

How High Are Cement Prices?

Compared with Steel, Lumber and Common Labor from 1913 to Date

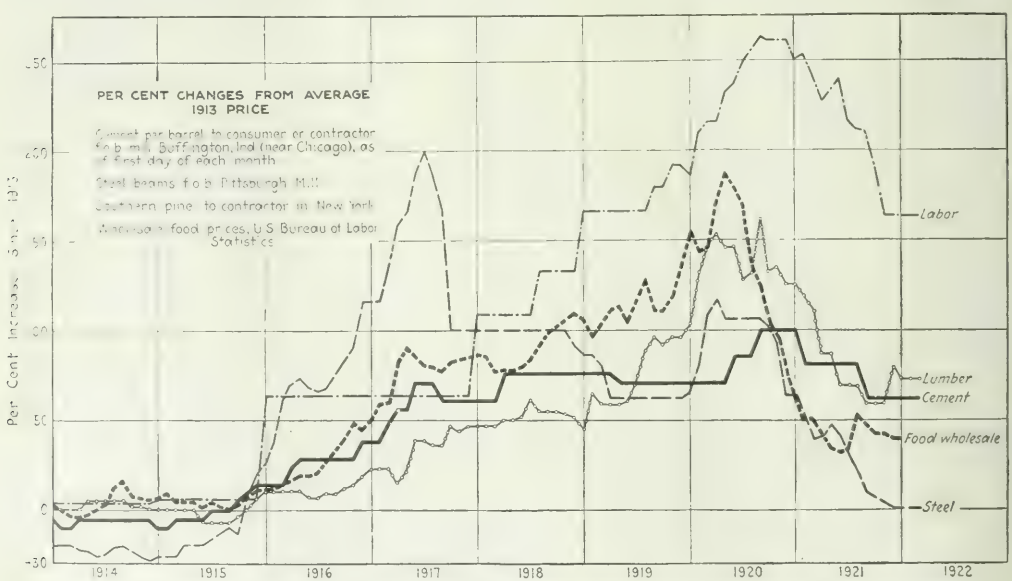
Eight of the Middle West state highway departments have put a boycott on the purchase of cement for road work, declaring that the price of cement must be brought down "in harmony with the reduced price now in effect for all other basic commodities." This action prompts the inquiry whether cement prices are high and also demands a comparison with the price fluctuations of other construction materials.

The showing in the case of cement is apparently unfavorable upon this basis. It does not take into consideration the extent to which these materials increased in price at the peak from their 1913 basis. It is conceivable that one of them might have increased to a very much greater extent than others and consequently be under the necessity of falling by a greater amount than the others. To be able to judge of the fairness of construction material prices today, comparison should be made not merely between the price drops from the peak between the present level and that of 1913. Table II shows in detail the changes in cement price of each year from 1913 to-date.

TABLE I PRICES OF PRINCIPAL CONSTRUCTION MATERIALS AND COMMON LABOR COMPARED

	Today	Six Months Ago	One Year Ago	Peak 1920	Per Cent Decline Since Peak
Cement, Chicago	$1.97	2.17	$2.00	$2.37	17
Cement, mill	1.70	1.70	1.80	2.10	19
Steel, Pittsburgh	1.50	1.85	2.70	4.00	62
Lumber, New York	49.00	45.00	66.00	72.00	32
Labor, United States	0.45	0.53	0.53	0.621	28

Comparisons with prices of steel, lumber and labor, which, in addition to cement, are the basic factors in construction costs are made in Table I. This shows basic prices of cement at mill and f.o.b. city; steel shapes at mill; lumber f.o.b. city, and the average common-labor rate for the country. The prices given are those now current, prices six months and a year ago, at the peak in 1920, and the per cent price decline since the peak. In all cases the price of cement is *exclusive of bags.*



PRICE TRENDS OF PRINCIPAL CONSTRUCTION MATERIALS AND THE WHOLESALE COST OF FOOD AS PERCENTAGES OF 1913 PRICES

Table III. Here are given the yearly average prices of these materials and the per cent change from the 1913 level for

Comparison of the price movements of cement with the price trends of steel, lumber and labor is possible by Table

each. It will be seen that steel—the distinctly war material—beginning at $1.50 per 100 lb. in 1913, did not exceed this figure until 1916 when it shot up to $2.55, continuing up to $3.70 for 1917. Government regulation then fixed the price at $3. Since 1920 the descent has been rapid, to the present low level of $1.40@$1.50. Steel rose to a maximum of 147 per cent above the 1913 price and is now 7 per cent below that price.

TABLE II. PRICES OF CEMENT AT MILLS AND F.O.B. CHICAGO WITH PER CENT CHANGES FROM 1913

	All Mills		Midwest Mill		F.O.B. Chicago**	
	Average Price	Per Cent Change	Average Price	Per Cent Change	Average Price	Per Cent Change
1913	1.005	...	$1.05		$1 19	..
1914	0.927	−8	0.99	−6	1 14	−4
1915	0.860	−14	1.04	−1	1 16	−2
1916	1.103	10	1.32	26	1 44	21
1917	1.354	35	1.66	58	1 75	47
1918	1.598	59	1.81	72	1 97	66
1919	1.71	70	1.80	71	2 01	69
1920	2.01	100	1.94	85	2 01	69
1921	1.87	86	1.85	76	2 14	80
1922	1.83*	82	1.70	62	1.97	66

*Average of *News-Record's* mill quotations since Jan. 1.
** Necessarily includes freight between mill and Chicago. Consequently these two columns are affected by the freight increases.

Lumber, at $28.50 per M. ft. b.m., for Southern pine in New York in 1913, began to rise rapidly in 1916, reaching a peak of $70@$75 in 1920. There was little decline until 1921, when $45 was quoted September to November. The market strengthened in December, 1921, and now stands at $49 to contractors. The peak was 153@162 per cent and the price now is 72 per cent above 1913 level.

Labor reached a maximum in September, 1920, when the average rate of common labor was 62½c. per hour or 264 per cent above the 1913 level. Since

TABLE III. PRICES OF STEEL, LUMBER AND LABOR WITH PER CENT CHANGES FROM 1913

	Structural Steel—Pittsburgh Mill		Southern Pine—New York		Common Labor	
	Average Price	Per Cent Change	Average Price	Per Cent Change	Average Rate	Per Cent Change
1913	$1.50	..	$28.50	..	0.171	
1914	1.15	−23	29.00	2	0.177	4
1915	1.30	−13	28.00	−2	0.182	6
1916	2.55	70	31.50	11	0.281	64
1917	3.70	147	37.75	32	0.281	64
1918	3.00	100	43.25	52	0.380	122
1919	2.55	70	50.00	75	0.466	172
1920	2.95	97	67.50	137	0.579	238
1921	1.95	60	51.50	81	0.542	217
1922	1.40	−7	49.00	72	0.45	162

then the rate has declined to 45c., which is 162 per cent above the 1913 level.

Further light could be thrown on the situation by comparing cement with still other construction materials. In general the prices of brick, sand, gravel and crushed stone are high, and their increases over the 1913 level are comparable with that of the cement price.

It is apparent, therefore, that while the price decline of cement from the peak is not as great as that of other building materials, the present price level is at the same height above 1913 as those materials except steel, which was affected by special conditions.

Bituminous Prices 83 per Cent Above 1913 Level

In connection with the leading article in this section, "How High Are Cement Prices?," it is interesting to note that the average spot price of bituminous coal is $2.22 at mines, against $1.22 for February, 1913. The peak was in August, 1920, when the average price was $9.51. The price one year ago was $2.77. *Coal Age's* indices of bituminous coal prices, are as follows: Yearly averages; 1913, 102; 1914, 94; 1915, 91; 1916, 152; 1917, 269; 1918, 213; 1919, 214; 1920, 466; 1921, 211; Feb, 13, 183; 1920 peak, 786.

Car Loadings Show Gain

Due to increased traffic, principally in coal and merchandise and miscellaneous freight which includes manufactured products, loadings of revenue freight totaled 753,886 cars during the week which ended on February 4, compared with 743,728 cars during the previous week or an increase of 10,158 cars. This was 54,168 cars in excess of the corresponding week in 1921 but 8,794 less than were loaded during the corresponding week in 1920.

Loading of merchandise and miscellaneous freight amounted to 429,705 cars, an increase of 9,295 over the preceding week and 26,944 more than were loaded during the same week last year. It was, however, 9,212 less than were loaded during the corresponding week in 1920.

Coal shipments totaled 185,151 cars, a gain of 4,185 over the week before. This was 27,597 more than were loaded during the corresponding week in 1921.

Forest products also showed a gain over the week before of 2,831 cars, the total being 50,204 cars. It was, however, approximately 2,500 under the same week last year and about 10,000 below the corresponding week in 1920. Coke shipments totaled 7,844 cars, an increase of 342 over the week before but 1,678 below one year ago.

Shipments of grain and grain products amounted to 48,969 cars, a decrease of 1,911 compared with the previous week but an increase of 11,948 over the same week last year and 14,376 greater than the same week in 1920. Live stock shipments also decreased 4,592 cars compared with the week before, bringing the total to 27,998.

According to reports of the Car Service Division of the American Railway Association, idle freight cars totaled 467,997 for Feb. 8 as against 489,842 on Jan. 31; or 21,845 fewer idle cars this month than last.

To Penalize Those Who Disregard Jurisdictional Dispute Awards

The Associated General Contractors of America, the American Institute of Architects, the Engineering Council, the National Building Trades Employers' Association, and the Building Trades Department of the American Federation of Labor, through the National Board for Jurisdictional Awards which has just concluded its regular quarterly meeting in Washington, have reached an agreement, expressed in resolution form, heavily penalizing union workmen who refuse to abide by the decisions of the Board.

The resolution provides that local building trade councils of union labor shall suspend and refuse to recognize those unions which refuse to abide by decisions of the board; that general contractors and sub-contractors who employ only union labor shall incorporate in agreements with labor provisions that will secure compliance with all the board's decisions; that employment shall be refused to members of local unions who disregard such decisions; and that architects and engineers shall insert in specifications and contracts a clause that the decisions of the board shall be followed. The resolution signed by the various organizations came as the result of the non-conformance to decisions of the board on the part of the United Brotherhood of Carpenters and Joiners of America.

Of the seventeen international unions that constitute the Building Trades Department of the American Federation of Labor, sixteen have endorsed the work of the board and supported its decisions, the carpenters alone, though one of the original organizers of the board, refusing to support it. As a result, the carpenters have been suspended from the Building Trades Department and have been outlawed by every building trades council and the leading organizations of general contractors, sub-contractors, engineers and architects.

Trend of Business

Bonds—Announcement that Victory 3¾s would be redeemed in May was expected to bring forth heavy offerings of other kinds of bonds. On the contrary offerings were surprisingly light last week. Municipals firm but inactive.

Foreign Exchange continues to advance. Sterling, $4.37⅜; Canadian dollar, 96c.; German mark 0.48¼c.

Steel—New low price on structurals, $1.40, against $1.50 in 1913.

Employment—For 106 iron and steel establishments reporting to the Bureau of Labor Statistics the combined January, 1922, payroll numbers 21.5 fewer men and amounted to only 44.9 as much money, as for January, 1921. Nine industries show greater payrolls, five report a decrease.

Retail food prices were 5 per cent cheaper in January than in the preceding month. Prices were 44 per cent above the 1913 schedule, which is 18 per cent less than a year ago.

B. F. Goodrich Co. showed a net operating loss of $76,670 for 1921, compared with net profits of $7,756,676 in 1920.

Large Contracts Let

Among this week's announcements of contracts awarded in Construction News, pp. 71@81, are the following large projects: Rebuilding one of four piers along the Hudson River at Weehawken, N. J., to Foley Bros., 209 Gilfillan St., St. Paul, Minn., $1,000,000; paving streets in Norfolk, Va., to F. J. McGuire, Paul-Gale-Greenwood Bldg., $232,210; paving 2nd St., Duluth, Minn., to D. H. Clough & Co., 707 East Superior St., $237,837; a 10-story office building at Washington, D. C., to R. P. Whitty, Union Trust Bldg., $750,000; 40,000,000 gal. reservoir at Detroit, Mich., to W. C. Wood Co., 1805 Ford St. $687,580.

Private Garbage Collection for Salt Lake City

Salt Lake City recently entered into a contract with the Plymouth Stock Company by which the city is to pay the company $13,500 per year for the collection of residential garbage, heretofore collected by the city. The garbage is to be delivered at the old union stock yards.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for in Construction News, pp. 71@81 are the following:

A high school at Des Moines, Ia., $1,100,000.

A bank and office building at Indianapolis, Ind., $1,000,000.

A road improvement project in Ohio, $380,000.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted. Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section. The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of February 2; the next, on March 2.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$2.63	—$3.25	$4.00	$2.63	$2.91	$3.50	$3.10	—$3.25	$4.00
Structural rivets, 100 lb	3.50	—3.80	5.50	3.43	3.90	4.25	4.50	4.00	6.50
Reinforcing bars, ¾ in. and larger, 100 lb	2.53	—3.15	3.50	2.53	2.81	3.42½	2.75	—3.25	2.75
Steel pipe, black, 2½ to 6 in. lap, discount	61%	—68%	45%	57%	61.9–5%	44%	—58.8%	53%	35.10
Cast-iron pipe, 6in. and over, ton	47.30@48.30	—37.63	48.30	40.60@42.60	46.00	52.00	—48.00	45.00	60.00
Concreting Material:									
Cement without bags, bbl	2.30	—2.39	2.40	1.97	2.24	2.90	2.73	2.94	3.10
Gravel, ¾ in., cu.yd	1.75	1.85	2.00	2.00	1.50	2.50	2.25	1.50	1.50
Sand, cu.yd	1.00	1.25	2.00	2.00	1.00	1.10	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd	1.75@1.85	—1.90	2.93	1.60	2.25	3.50	2.25	3.00	2.10
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	49.00	7.00	34.00	44.00	38.00	50.00	—31.00	20.00	.....
Lime, finishing, hydrated, ton	15.80@16.80	—18.00	25.00	18.00	29.00	24.00	22.00	27.00	26.00
Lime common, lump, per bbl	2.75@3.48	—1.25	—2.50	1.40	1.40	2.70	1.75	2.75	11.00
Common brick, delivered, 1,000	21.40	8.50	11.00	11.00	15.00	14.00	15.50	14.00	16.00
Hollow building tile, 4x12x12, block	Not used	.0675	.13	.0821	.0752	.08	....	.10	.08
Hollow partition tile 4x12x12, block	.11120	.0675	.13	.0657	....	.10	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal	+.87	+.96	.93	+.89	+1.01	+1.14	+1.04	.86	.82
Common Labor:									
Common labor, union, hour	.60	.35	.....	.72½	.....	.50@.55	.62½	.50@.60	.....
Common labor, non-union, hour	.....	.20	.35@.45	.35@.40	.40@.50	.35@.40	.43¾@.50	.50	.20@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations are delivered except tiles, which are "on trucks." Common lump lime per 250-lb. net; both lump and hydrated quoted f.o.b. cars New York. Sand gravel and crushed stone are quoted alongside dock. Cement and steel pipe delivered to contractors on job. Gravel ready mixed $2 per cu.yd.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized.

Denver quotes cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to contractors in yards at San Francisco. Lumber price is for No. 1 fir, common.

Seattle quotes on Douglas fir instead of pine. Common lump lime per 180-lb. net.

Montreal quotes sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 95.8 cents). Bag change is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net.

Changes Since Last Week

Pittsburgh mill price on structural steel shapes, plates and bars continues at $1.40@$1.50 per 100 lb.; the smaller figure applying principally to lots of 100 tons or over. Mill shipments, New York, of shapes, plates and bars are quoted at $1.78@$1.88. Mill shipments, Denver, of structural shapes are quoted at $2.75 per 100 lb. Steel shapes are quoted in Atlanta at $3.25 as against $3.50 and in Seattle at $3.25 as compared with $3.36 per 100 lb. one week ago.

Substantial reductions in cast-iron pipe, wrought steel pipe and reinforcing bars quoted in Atlanta and Seattle warehouses. Atlanta also quotes a reduction of 16c. per bbl. on cement; 10c. per cu.yd. on crushed stone; $1 per ton on hydrated finishing lime and 25c. per bbl. on common lump lime. Dallas quotes common lump lime at $2.50 as against $2.75 per bbl. (180-lb. net).

Douglas fir down $1 per M. ft. in San Francisco. Increased cost of flaxseed continues to be reflected in exceptional advances in linseed oil. Chicago quotes a rise of 1c.; New York 4c.; Minneapolis 8c.; Atlanta 10c.; San Francisco 15c. and Denver 16c. per gal. in 5 bbl. lots.

A total of 364 mills reporting to the National Lumber Manufactures' Association for the week ending February 11 show 680,379,215 ft. cut · 646,346,937 ft. shipped and orders for 682,979,023 ft. Production is about 25 per cent, orders 25.5 per cent and shipments 29 per cent below normal. Orders equal production; shipments are below.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, President

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. Mehren
Editor

Volume 88 — NEW YORK, MARCH 2, 1922 — Number 9

Los Angeles Sewage Dilemma

THE CITY authorities of Los Angeles are in a dilemma. After their engineering department gave warning that sewage-flooded streets were imminent because of the effect of increasing population on an outlet sewer at times running practically full, the voters last year for the third time defeated a bond issue for a new outlet sewer and sewage treatment, and this in the face of advice from the State Board of Health before the first vote that treatment was needed even then. The predicted happened a few weeks ago, as noted on p. 336 of our issue of Feb. 23. Sewage burst from manholes on the outfall sewer and flowed through the streets of Los Angeles. To meet the emergency, the sewer was tapped and sewage diverted into Ballona Creek. The State Board of Health has refused to sanction this expedient, even if the city screens and chlorinates the sewage. Property owners down the creek are seeking an injunction against using the creek as stated. What can city authorities confronted with such a dilemma do? At latest accounts they were getting legal opinion on the recommendation of the city engineer to disconnect enough of the more recent sewer connections to relieve the overflow. This or some other drastic action seems to be necessary to bring the voters of Los Angeles to a realizing sense of the threatening condition with which they are confronted. Meanwhile, people outside Los Angeles continue to wonder how such a situation could arise and continue.

Preparing Lawyers and Engineers

AT A MEETING in Washington last week representatives of more than 150 associations in the legal profession adopted the recommendation of the American Bar Association, that future members of the Bar must have at least two years of college education in addition to their regular law school work. The proposal was not without opposition, but was adopted because of the pleas of eminent lawyers that such a preliminary educational requirement was necessary in order to raise the standards of the profession. The action is not without interest to engineers, for the higher the standards of other professions are raised, the more exacting will have to become the qualifications of engineers if their professional standing is to be on a par with that of members of other professions. If the discussions resulting upon Prof. Burr's paper at New Haven last June are a true index of the feeling among engineering teachers, stiffer preliminary requirements to the study of engineering will meet with approval in the engineering colleges. We are probably not ready yet to follow the lawyers in demanding two years of college preparation, but certainly there should be steady encouragement to those who have the capacity and the time to prepare themselves for a broader engineering career by a combined six-year course in liberal and engineering studies.

At Last a Port of New York

THE integration of the Port of New York is an accomplished legal fact. Both states have put their final approval on the Port of New York Authority and that novel and powerful body is now able to function. Primarily this new body is a political experiment, for while its conduct must be on engineering and commercial bases, it is something entirely new in American government. For the first time we have a political unit geographically delimited by industrial conditions and not by historically established lines. The very novelty of the expedient, therefore, should tend toward cautious progress, because so many pitfalls in the way of precedent must be bypassed or crossed. The enabling acts of the Port Authority are by no means perfect. They make altogether too ironclad the precise engineering schemes to be followed in developing the port. The commissioners, being appointed by the governors, are not readily enough reached by the people, industries, or communities whom they will serve. Some middle ground of compromise must be reached by the Authority and the City of New York. Without this the port will go backward; that is, as fast as the resistless flow of commerce will permit. These things, however, are subordinate to the fact that at last there is promise of some orderly consideration of this great national asset and that the engineering disgrace of the separated port belongs to the past.

Advertising Speed Records

EQUIPMENT manufacturers who exploit performance records, and particularly isolated extraordinary performances, in advertising their product, are inviting disfavor instead of gaining credit. At the recent convention of the Associated General Contractors there was vigorous condemnation of the practice on several occasions, and the association formally adopted resolutions asking that such advertising be discouraged as misleading and vicious. So little is gained, ordinarily, by quoting high output figures, however true they may be, that the manufacturer cannot afford to challenge so strong a sentiment on the part of many of his customers. There have been some particularly far-fetched uses of speed-record figures to carry the claim for especial consideration of some make of equipment. Good equipment does not need the adventitious support of record runs to gain the attention of high-grade contractors. In fact, the tendency always is to discount them, for the contractor is all too conscious of the many factors that in practice affect the speed of work. Speed "bursts" are generally looked upon as freaks. Also a trained organization with inferior equipment often surpasses in speed the untrained organization with superior equipment. In brief, all his practical experience incline the trained contractor to ignore statements of excessive performance records while the untrained contractor is misled into accepting them as common experience.

Doweled Pavement Joints Gain Favor

DOWELS have developed noteworthy prominence in the last year as a feature of joint construction for concrete pavements. In this issue an older example of the adoption of doweled joints is given, with evidence of their rather striking effectiveness in holding up an undermined road slab. There were probably previous uses of dowels in pavement joints, but any claim for precedence is secondary to the fact that their use was lost year adopted in a number of individual designs and, in two cases, in standard designs of state highway departments. Invariably the purpose of the dowels has been to keep the opposing slab-ends from moving up and down independently, due to vehicle loads, slab warping or subgrade movements. Except in case of the longitudinal joint dowels used in Illinois, which are bonded into the concrete as solidly as may be, bond is eliminated by painting, by wrapping with paper, or by gas pipe sockets on one side of the joint. The New Jersey state requirements are fairly typical; they call for ¾-in. x 2-ft. bars wrapped in paper and set across the joint 1 ft. from each slab edge and then at 2-ft. intervals. With the increasing use of doweled joints highway research bodies have another problem to consider. Pronouncement is needed, first, on the question whether doweled joints are a real structural requirement, and second, on the question of preferable design and construction. At present engineers are guessing at both questions.

A Field Day for Honesty

HONEST contractors, honest material-men, and honest workmen all will profit by the changes in working rules established for the 119,000 members of the Bricklayers, Masons, and Plasterers International Union of America, as a result of certain conferences between the officials of that union, the United States District Attorney at New York and the Attorney General. These rules have been embodied in a consent decree which has been signed at Washington by government officials and union representatives and which will be entered forthwith in the United States District Court at New York. If all concerned will line up to the spirit of these rules honest contractors will be assured a fairer market for both labor and material, honest material-men will be free from the menace of trade blackmail and honest workmen will be released from the hobbles that have penalized efficiency and stifled ambition. Everybody, in fact, will profit except the crooks.

To have been present during the conferences that led to this happy outcome would have been interesting. We should like to have heard what was said. We surmise that we might have discovered on the one hand an impelling quality, reminiscent of Davy Crockett, and on the other a certain tardy discretion suggestive of the treed "coon" that petitioned Davy not to shoot, as under all the circumstances, he had decided it would be better to come down.

Howbeit, the results are what matter. It is to be hoped that having demonstrated his prowess in this little encounter, our own Davy will seek out an opportunity to try his persuasive powers on other and perhaps heavier game, and that he may find a way to abolish the restrictive powers of other labor unions. If this can be done, persistently and fearlessly, the field of building and general construction may yet be made safe for honesty.

Methods or Results

AT ALL of the public hearings on the tentative specifications prepared by the Joint Committee on Concrete and Reinforced Concrete, there has been violent opposition on the part of contractors to the alternative proportioning clause which puts the responsibility for the strength of concrete upon the contractor. Such opposition is well founded not only because such a clause, in the present state of the art of making and testing concrete, would be practically impossible to maintain in the courts but because it takes away from the engineer the exercise of the judgment and discretion necessary to achieve his desired results. Curiously enough, however, one of the principal criticisms of other features of the specifications by some of these same contractors is that there is too much specifying by methods and not enough by results.

This incongruous position goes to the heart of the purposes of a specification. If it were possible to procure for an owner the kind of structure he wanted merely by stating what that structure is to be the engineer would be a superfluity, or at least his function would become merely the supervision of acceptance tests. It is because such tests can not be devised of sufficient scope and thoroughness to simulate all the varieties of service the structure must endure that the engineer must specify the way the work is to be done. The only alternative is to let the contractor do the specifying, which, however successful it may be in special cases, is unethical and in the long run dangerous.

This is of the very elements of the tripartite engineer-owner-contractor relation, but evidently it will bear repeating.

Boston District Water Question

UTILIZATION of "flood flows" instead of the common American practice of taking the stream flow up to the usual limit of economical storage, a reservoir of record-breaking size for a municipal water-supply project, and a large both-way-flow aqueduct are the most striking features in the report of the project for an additional water supply for the Boston Metropolitan District and the City of Worcester. The report is also significant for giving more consideration to filtration than is commonly expected in a Massachusetts State document. But filtration is merely recommended for the poorer existing sources "when needed" and recognized as ultimately required for all the surface supplies of the district.

In England, as also throughout the United States for water power, and in the West for irrigation, the utilization of "flood flows" only in order to disturb as little as may be lower riparian rights or, in the West, prior appropriations, is common enough. For American water supplies the practice is by no means unknown, but compensation in money rather than in water has been the general rule here when taking streams for public water supplies.

The decision of the Joint Board to advise immediate construction of the Ware unit only, the minority report by one member of the board being against even that until studies of storage on the Ware have been made, the strong feeling in some quarters against the invasion of Central Massachusetts for water, the plea for filtering nearer sources, and the optimistic hopes of at least a few that there can be further reduction in per capita

water consumption of so large a district when the rate is already down to less than 105 gal. a day, combine to make the fate of the project uncertain.

The final decision rests with the Legislature and depends upon its reaction to public and to official and scientific opinion. The whole matter may turn largely upon the reception of the proposal to take only the "flood flows." If this allays a considerable portion of the opposition from Central Massachusetts, and if the people of the state as a whole remain in their old faith in the preference for naturally safe rather than treated water supplies, then it seems likely that the Legislature will adopt the report—as it almost invariably adopted the recommendations of the State Board of Health and other boards or commissions which have advised it in the past on many important matters of public health and sanitation.

Facts About Muscle Shoals

LEAVING aside the sentimental regard in which the South now holds Henry Ford and the somewhat widely spread antipathy to the public utility company as such, it is proper to consider the plain facts of the two principal offers to the Government for the water power rights and the existing properties at Muscle Shoals on the Tennessee River. The first of these by Henry Ford proposes, as has already been stated in these columns, that the Government complete the two dams (at an estimated cost to the Government of $50,000,000) and that when complete the Ford company will take possession of the two dams, the two nitrate plants, the Waco limestone quarry, the steam power plants at Sheffield and at Gorgas and the transmission line between the two. For this the company will pay $5,000,000 cash and 4 per cent rent on new construction costs, say $2,000,000 a year, plus $24,000 a year amortization. The company would have a 100-year renewable lease and promises to operate one of the nitrate plants as a fertilizer factory, though the company's obligations in this respect are somewhat nebulous. The Government is to maintain the dams and is to be paid $55,000 a year therefor.

The Alabama Power Co. proposes to leave the nitrate plants and the Waco quarry to the Government, but agrees to take over the Wilson dam, as is, and complete it at the company's expense under the provisions of the Federal Water Power Act, with the usual 50-year recapture and rate regulation clauses. It offers to pay $5,000,000 for the steam plants and transmission lines and to turn over to the Government for the operation of the nitrate plants (or, if those prove impracticable, for commercial use) the second 100,000 hp. available at Wilson dam, which is designed for 600,000 hp. The company will maintain the dams at its own expense.

From a purely monetary point of view then in taking the Ford offer the Government would pay out another $50,000,000 and would get in return $5,000,000 cash and somewhat over $2,000,000 a year in perpetuity for giving up all but war-time rights at this site. It would also have the possibility of cheap fertilizer, but only the possibility. In accepting the A. P. C. offer the Government would give a regular federal water-power lease, reclaimable at 50 years, would not have to put up any more money, would get $5,000,000 cash and would receive 100,000 hp., worth at least $2,000,000 a year, which is a very fair rent and amortization payment for the $17,000,000 already spent on the Wilson dam works. It would still have the nitrate plant to operate or to seek an operator for.

There is no question that the latter is the better offer as a business proposition. If Congress is to be persuaded by the glamour of Henry Ford's name; if it thinks that the company he forms will perpetuate for all time the altruistic community development he proposes or if it thinks that only by him can the fertilizer possibilities of Muscle Shoals be developed, those features would weigh heavily in favor of the Detroit man's proposition. If on the other hand if it wants to make a favorable business deal which returns a proper proportion of the excessive war costs of the plants and guarantees a just and legal control of federal water power it will take the Alabama Power Co.'s offer.

Electric Torch for Under-Water Metal Cutting

MARINE salvage practice has been drawn upon successfully for handling an unusual job of emergency water-works repair. Last month a section of the 36-in. subaqueous cast-iron pipe line delivering Catskill water from Brooklyn under the Narrows to Staten Island, New York City, was smashed by the spud of a dredge. The break occurred at a depth of 50 ft. and the problem was to remove the damaged section, replace it with a new length of pipe, and get the line back into service at the earliest possible date. The novel and outstanding feature of the operations, described in detail by Mr. Brush elsewhere in this issue, was the use of an under-water electric torch for cutting out the broken section of pipe, which had a minimum thickness of 1⅛ in. To have attempted this work by drilling or other cutting methods would have been a slow and tedious process. With the electric torch, however, the damaged section of pipe had been removed nine days after the burning began.

In ordinary water-works practice such methods as were employed on the Narrows siphon will rarely be used, but the under-water cutting of metal has many other engineering applications, and the effectiveness of the tool developed for such work has been demonstrated not only on the Narrows siphon job but on a number of ship-salvage operations. It was for the latter type of work, in fact, that the electric torch was primarily developed. It was employed in salvaging the steamship "St. Paul," which turned over on her side at a North River pier in New York, April 25, 1918; here the under-water torch was used to cut large drainage holes between compartments. Again, in raising the army transport "America," which listed and sank at her pier Oct. 16, 1918, drainage holes were cut under water through a number of bulkheads. When the "Aquitania" cut through the "Lord Dufferin" Feb. 28, 1919, a large section of bent plating on the latter was cut off.

The original construction of the Narrows siphon, involving the use of especially designed flexible-joint pipe sections, laid by means of a huge steel cradle extending from a scow to the harbor bottom, presented a variety of new construction problems. The repair work now nearing completion has been done by methods as distinctly out of the ordinary as those of the earlier contract. While both rolled and cast steel had previously been cut under water by the electric torch, the Narrows siphon work represents the first successful submarine burning of the much more refractory material, cast iron.

Broken Section of 36-In. Pipe Line Burned Out by Electric Torch Under 50 Ft. of Water

Repairs to Narrows Submarine Siphon of New York's Catskill Water Supply System Develop Methods Without Precedent

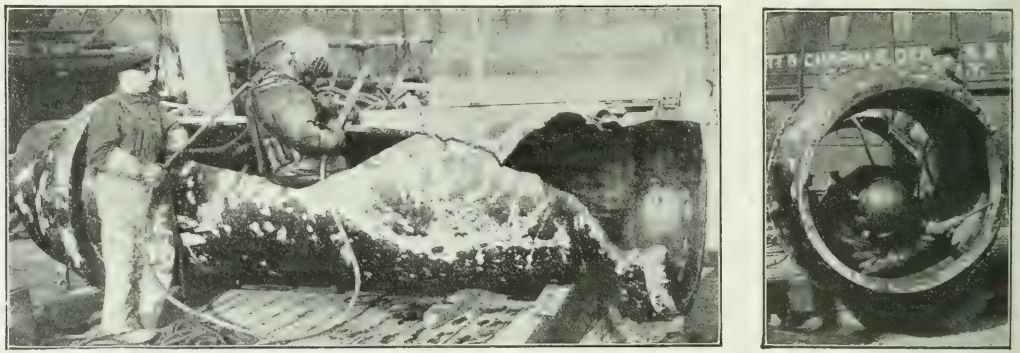
By William W. Brush
Deputy Chief Engineer, Department of Water Supply, Gas and Electricity, New York City

By the use of an electric torch specially designed for submarine cutting operations and operated by divers at a depth of 50 ft. below the surface of New York Harbor, a section of the 36-in. flexible-joint, cast-iron pipe line conveying New York City's Catskill water supply from Brooklyn underneath the Narrows to Staten Island, broken by the spud of a large dredge Feb. 2, has been removed and replaced with a new pipe length joined to the existing line by means of a cast-steel sleeve. The methods employed for restoring the damaged subaqueous pipe line to service constitute a radical departure from the ordinary practice of emergency water-supply repair work.

The submerged pipe line, known as the Narrows siphon, is made up of 12-ft. flexible-jointed sections, is about 10,000 ft. in length from 79th St., Brooklyn, to Arietta St., Richmond, and was laid in 1914-1916 by the Board of Water Supply of the City of New York as part of the Catskill delivery system. The contractor was the Merritt & Chapman Derrick and Wrecking Co. and the contract price for the original construction was about $1,000,000; the line was described in *Engineering Record* of Dec. 19, 1914, p. 656.

The large dipper dredge "Toledo," working under the direction of the city dock department on Feb. 2, was deepening the waterway in the slip at the foot of Arietta St. just north of the most northerly of the new Stapleton piers and it seems likely that one of her heavy spuds either came in contact with or was very near the pipe line, the break occurring at noon in the immediate vicinity of the dredge. The approximate location of the break was shown by the water boiling up at the surface from a flow of about 28 million gallons daily, which is about twice the normal flow, and this location was later confirmed when air was pumped into the pipe. The break was about 170 ft. from the Richmond shore, where the earth cover was about 20 ft., and the total depth of water to the pipe just over 50 ft. The Merritt & Chapman company was immediately asked to undertake the work of repair, and had its derricks on the job within 3 hours after the break occurred. This company has since continued work on the repairs, working double shifts.

Removing the Broken Pipe.—In three days the dredging, directed by divers, had uncovered the pipe sufficiently to determine that there was a large hole in one length, and that this length would have to be completely covered by a sleeve, or else removed and replaced. The Board of Water Supply in 1917 had designed a special split cast-steel sleeve, made up in twelve pieces, to cover two bells and the intervening length of pipe, but this sleeve was not carried in stock, and the estimate of time to fabricate it was three weeks. One of these sleeves was immediately ordered to be used if required, and the contractor was directed to remove the broken pipe and replace it with a new length of pipe, using a cast-steel sleeve to connect the two ends. A split and also a solid steel sleeve 5 ft. long were ordered, it being intended to use whichever one could most readily be placed.



DIVER IN BROKEN PIPE ILLUSTRATING USE OF ELECTRIC TORCH IN MAKING OUTSIDE AND INSIDE CUTS

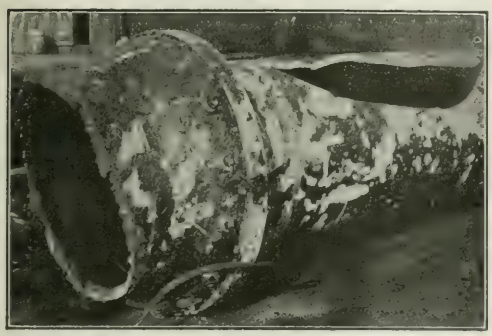
Electric Torch Methods.—The Merritt & Chapman company had started experimenting with burning cast-iron under water as soon as the order to make the repair had been given, and reported that the cast-iron could be cut with its patented under-water burning torch in considerably less time than it could be drilled or otherwise cut.

On Feb. 9 the burning of the iron was started, using one electric torch, and in a few hours the wrought-iron band 1½ x 4 in. was removed. Two torches were placed on the work Feb. 10 and kept in use for about 20 hours each day. The torches were operated by three divers assigned to each torch for each shift, it being necessary to relieve a diver after about 2 hours' work, due to the

freezing temperature of the water. Each diver was submerged for about 6 hours on each shift.

The burning of the pipe was continued until noon Feb. 19, or virtually for 9 days, when the section of the broken pipe and the adjacent bell were wedged free, and that afternoon the broken pipe was raised to the surface in the condition shown by the photographs.

To remove the pipe it was decided to cut off the upper



SHOWING CUT MADE BACK OF HUB, AT BEVEL OF 10 IN.

half of the bell of the broken pipe and to cut through the undamaged pipe next to the broken pipe just back of the bell, making the cut with about a 10-in. bevel to facilitate removing the cut section. In addition to this cutting work it was necessary to cut out a section roughly 12 x 25 in. to give room for the divers to get into the pipe to make the bottom cut. The divers cannot effectively operate the cutting torch above the shoulder level, and this limitation, together with the possibility of damaging the bell, formed the basis for the decision to cut off the adjacent bell rather than attempt to cut out the spigot end of the broken pipe. The pipe is 1⅝ in. thick, with the bell varying from 1⅝ to 3½ in. The total length of cutting was about 230 in. of 1⅝ in. metal, 30 in. of heavier metal up to 3½ in. thick, and 8 in. of wrought iron 1½ in. thick.

Burning Cast Iron a New Development

The cutting of the cast-iron under water by burning the metal is a new development. Both rolled and cast steel had previously been cut under water, but cast iron is so much more refractory that it seemed doubtful whether it could be successfully burned under water.

The first burning out of steel under water was done by the Merritt & Chapman organization in raising the steamer "St. Paul" in 1918, when steel plates and steel hawsers were successfully cut under water by burning. Since then both rolled and cast steel have been burned by this company on wrecking jobs, but no cast iron was encountered until the Narrows pipe line broke.

The relative speed of cutting iron by drilling and reaming and by burning was illustrated in the fall of 1918 in salvaging the "America." Two U. S. Navy divers, operating pneumatic drills and reamers, and relieving one another on the work, cut in 5 days a hole about 15 in. in diameter in a ⅞-in. steel plate under about 30 ft. of water. At the same time the Merritt & Chapman company, in practically a single day, cut a similar sized hole in a ⅞-in. steel plate under about 60 ft. of water, using one diver; the cut plate was brought to the surface the morning after operations began.

The burning is accomplished by using a patented electric torch, known as the Chapman-Kirk torch, invented by Ralph E. Chapman and J. W. Kirk, and developed and perfected by Mr. Chapman. This torch consists of a carbon electrode which is bored for the passage of cutting gas, the carbon being connected to one pole of a generator, the other pole being grounded through the water to the metal to be cut. The current required for cast iron is about 350 amp. at 60 to 100 v., a lesser volume of current being required for steel. As no local current was available, generators were set up on a derrick barge.

The carbon of the torch is wrapped with insulating tape to reduce current leakage. The arc is formed by establishing contact and then withdrawing the carbon about ¼ in. The cutting gas plays against the metal at the point of the arc and the metal is volatilized. The water is kept away by the gases formed in cutting and the diver is not physically inconvenienced by either the heat or the light from the torch, but the intensity of the light prevents him observing the actual cutting of the metal. The wires carrying the current and the cutting gas are both conveyed through a rubber hose, and the carbon point is attached to the end of the hose by a special coupling. The diver signals when he wants the current and the cutting gas turned on and off. A carbon will last about 20 min., and while a diver may cut an inch in 10 min. an average of 2 in. per hour is considered very good progress with cast iron 1⅝ in. thick.

The diver utilizes a relatively large percentage of the time in cutting away the small sections of metal which are left between the holes on the far edge of the cut metal, the holes being cut completely through the metal on the first burning. As it is very hard for the diver to keep the torch in the right place, a wooden templet



CAST-STEEL SLEEVE FOR MAKING JOINT WHERE OLD AND NEW PIPE LENGTHS MEET

Note ring of 1-in. bolts to center sleeve around pipe leaving ¾-in. lead calking space

is fastened to the pipe to act as a guide for the diver, and with such a guide a very close approximation to the line to be cut can be made by the divers who have to depend entirely upon the sense of touch, as they can see practically nothing, due to the mud in the water. The bevel cut back of the bell shown in one of the photographs well illustrates how closely the desired line is adhered to when a templet is used.

Replacement of Broken Pipe.—A new length of pipe was turned down on the spigot end for a distance of about 4 ft., and the enlarged grooved section which normally fits into the spherical bell was removed. A solid steel sleeve of the thickness of the cast-iron pipe

and 5 ft. long has been placed on the cut pipe now in place, and after the new pipe was properly fitted over the exposed spigot the sleeve was moved to cover the two smooth ends. Twelve 1-in. bolts spaced around each end of the sleeve about 5 in. therefrom and well covered with white lead to reduce leakage have been used to equalize the ¾-in. lead space between the sleeve and the pipe. An iron bar 2 in. wide by ½ in. thick, shaped to fit in back of the calking space, is placed against the bolts, which are 1 ft. apart, and thus forms a solid backing against which is calked lead wool to a depth of 3 in. A cast-steel gland or collar is drawn up against the lead joint by eight 1-in. bolts, and holds the sleeve joints from any possibility of blowing out.

The sleeve joint on the machined spigot end of the new pipe is equivalent to an expansion joint and it is believed will move if any settlement takes place. Neither the sleeve nor the glands will be coated, dependence against rapid corrosion being placed largely on the covering to be replaced over the pipe. The spherical flexible joint was made up with lead wool. After the repairs are completed the tightness of the joints will be tested with air pressure, the line will be blown out, sterilized by use of liquid chlorine, and then put in commission. The new pipe and the two adjacent lengths now in place will be thoroughly blocked up before the trench is backfilled. It is estimated that the cost of repairs to the pipe line will be approximately $60,000. It is expected that the line will be put back into service this week.

Reduced Consumption Urged

Water Supply Conditions.—The borough of Richmond (Staten Island), now has a population of about 120,000, and a normal consumption of 18 million gallons daily. When the 36-in. pipe line was laid the consumption was 12 million gallons daily and there was no indication of a sudden growth in population or consumption. This growth came as a result of the war, and as the pipe line can deliver about 13 million gallons daily with the available hydraulic gradient, the remainder is supplied by local pumping stations drawing from drivén wells. The total capacity of the local stations is about 13 million gallons daily. The Board of Water Supply constructed as part of the Catskill system the Silver Lake reservoir, holding 438 million gallons, with a depth of 36 ft.

When the break occurred 40,000 circulars were printed explaining the situation and asking the people to co-operate, these circulars being placed in the houses and also given to each school child. Pressures were reduced about 15 lb., but as pressures are generally 50 lb. or more this did not curtail the supply for many persons. For a few days there was a reduction in consumption of about 3 million gallons daily, but this reduction gradually disappeared. It is believed that after the first few days few of the consumers paid any attention to the department's request to reduce waste and use of water. The reservoir has been lowered about 9 ft., and it is expected that the repairs will be completed by the time the reservoir level has descended about 11 ft. The local stations were all put back in service, one of them having been shut down for the past four years.

The Board of Water Supply under date of Jan. 23, 1922, requested the Board of Estimate and Apportionment to appropriate $5,537,300 for additional Catskill delivery mains in Brooklyn and Richmond, including a 42-in. flexible-joint pipe across the Narrows from Brooklyn to Richmond. This pipe line would have a capacity of about 20 million gallons daily, and when laid would provide for the increase in the consumption up to about 1930. No action has as yet been taken on this request.

Large Quarry Rock Crushing and Screening Plant

Million-Dollar Plant with Roll and Gyratory Crushers—Cable Incline and Conveying Belts—Gravity Switching

By Hilmar F. Smith
Supervising Engineer, Construction Division, Quartermaster Corps, U. S. A., Belleville, Ill.

To supply oolitic limestone, averaging 98 per cent pure, for the U. S. Government Nitrate Plant No. 2, at Muscle Shoals, Ala., a quarry was opened at Waco, 30 miles distant, and equipped with a crushing and screening plant having a daily capacity of 2,000 tons. In the design of this plant, surplus material and supplies stored at Muscle Shoals were used as much as possible. The property is about ½ x 1½ miles in area, with a generally flat surface and a depth of loam and clay overburden ranging up to 8 ft. A 1½-mile spur track connects with the Northern Alabama R.R.

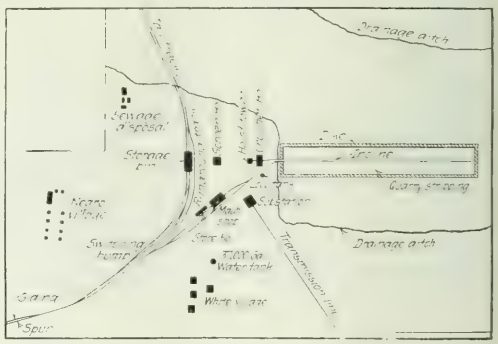


FIG. 1. LAYOUT OF QUARRY AND CRUSHING PLANT

Electric current for power and light is taken from a 110,000-volt transmission line ¾-mile distant, which line is owned by the government and supplied by the Alabama Power Co.

Included in the Waco quarry project were the following main features: (1) A negro village of ten small houses and a barracks for 29 men; (2) a white village of four bungalows; (3) a water-supply system and sewerage system with disposal plant; (4) a machine shop, storehouse, powderhouse, crusher building, screen house, hoisting tower and storage bin; (5) stripping an area 200 x 1,400 ft. and opening a rock cut 30 x 1,000 ft. and 8 ft. deep; (6) building five miles of railroad and ten miles of fence; (7) erecting ⅞ miles of 110,000-volt transmission line, with a 440-volt power system and 110-volt lighting system; (8) excavating drainage ditches to intercept surface water.

A layout plan is given in Fig. 1. From the spur the railway diverges, one line serving the machine shop and storehouse and extending about 1,000 ft. into the quarry. The other line swings round to the east, with

an ascending grade of 1½ per cent for 500 ft. to a switching hump or summit, followed by a similar descending grade 1,000 ft. long to the storage bin, beyond which is 1,000 ft. of tail tracks. A runaround track on the level connects the tail tracks with the main line. Three tracks on the hump provide for delivering empty cars by gravity to the stone bins or the dust bins, beyond which the loaded cars proceed by gravity movement to the tail tracks, on which trains of 20 cars are to be assembled. The trains will be hauled over the runaround track and along the spur to a storage yard at the connection with the Northern Alabama R.R.

From the plan and sectional elevation, Fig. 2, it will be seen that the 5,000-ton storage bin, screen house and crusher building are in line, connected by a conveyor structure. Beyond the crusher building a double-track incline of 20 per cent grade runs into the quarry. It is intended to finish the quarry floor to El. 645 or 60 ft. below the surface (El. 705), working down to this level by a central bench and two side benches, all 16 ft. deep, 30 ft. wide and 1,000 ft. long. At present only the first cut of the central bench is being opened, 8 x 30 ft. This will give eventually two faces 60 ft. high and 1,000 ft. long, from which the quarry will be widened toward the east and west boundaries.

To exclude surface water as far as possible the stripped area, 200 x 1,400 ft., is surrounded at a distance of approximately 500 ft. by about 10,000 ft. of drainage ditches, 2 ft. deep and 12 ft. top width, with the spoil bank on the quarry side. There is also a dike 8 ft. high and 20 ft. wide, built with the stripping.

Blasted rock is handled by a steamshovel of the railroad type with a 1-yd. bucket, loading 12-yd. dump cars which are hauled up the incline by a double-drum cable hoist with 150-hp. motor. An empty car descends as the loaded car ascends. At the crusher building the grade is reduced to 3 per cent, and as the car comes to rest over the track hopper it is dumped by hand by means of a pneumatic hoist.

The crusher house, 25 x 81 ft., has a concrete foundation and steel superstructure with corrugated iron sheathing. At one end are the two crusher motors and at the other end is the primary crusher, of the roll type, the middle being occupied by a secondary gyratory crusher. Stone from the track hopper is delivered to the rolls at El. 719. The product from these is discharged over an oscillating grizzly or screen 12 x 5 ft. at El. 708, the oversize spills into the gyratory crushers at El. 705. Fines from the rolls and the entire product of the gyratory are delivered to a 36-in. belt conveyor, the lower end of which is in a concrete tunnel.

As a protection against the pinching effect of the rolls, which at times causes them to eject heavy stones with great force, a 2½-ton counterweighted door of 3-in. plank covers the hopper. This opens when the car dumps a load of rock upon it but closes automatically when the rock has fallen through. The hopper is of steel, 8 x 22 ft. at top and 15 ft. deep with a bottom opening 8 x 14 ft. from which are suspended cast steel plates to guide the rock to the rolls. There are two rolls 4½ ft. in diameter and 4 ft. long, weighing 19½ tons each and revolving at 225 r.p.m., with an 11-in. space between their faces. This crusher, with a capacity of 1,000 tons per hour, is driven by a 250-hp. motor.

An oscillating grizzly set at an incline of 38 deg. and having bars spaced to give openings 4½ x 7 in., receives the crusher product, the undersize or fines passing through to the 36-in. belt conveyor which carries the discharge from the gyratory. The oversize goes to the gyratory crusher, driven by a 250 hp. motor and giving a product of 3¾-in. to 6½-in. size at a rate of 525 tons per hour. This product is fed to the 36-in. belt conveyor traveling on a grade of 30 per cent into the screen house.

Timber construction with corrugated iron sheathing is used for the screen house, 60 x 44 ft., the conveyors entering at the top and delivering the stone to two rotary screens 5 ft. in diameter and 24 ft. long, pitched 1½ in. per foot. A stone jacket with 3-in. openings extends

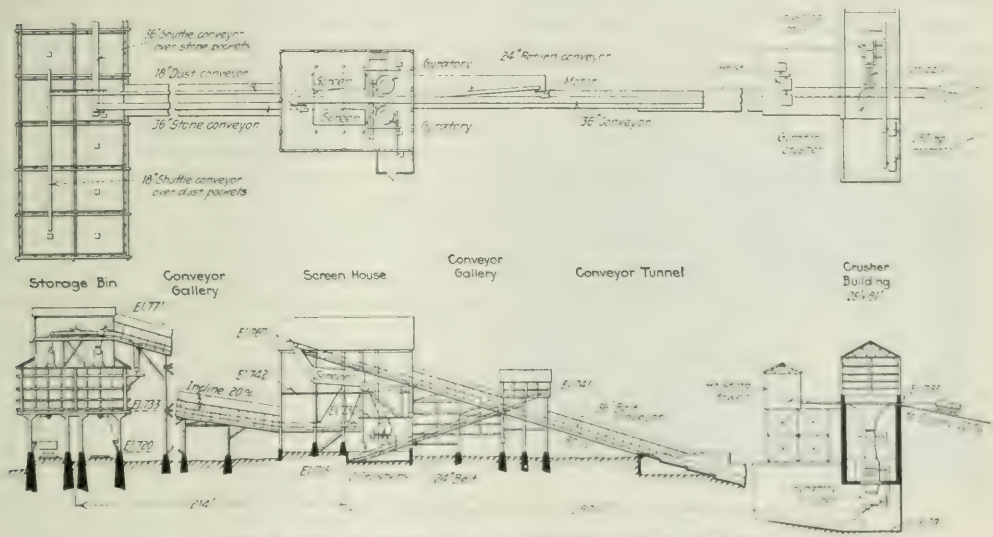


FIG. 2. CRUSHING AND SCREENING PLANT AND STORAGE BIN

the full length of the screen, and around this for half its length is a dust jacket with ½-in. openings. Each screen is driven at 12 r.p.m. by a 50-hp. motor. Oversize from the screens goes to two gyratory crushers having an output of 50 to 90 tons per hour of 2- to 3½-in. product, each driven by a 50-hp. motor. Their product is delivered to a 24-in. belt, inclined 30 per cent and discharging onto the main 36-in. belt from the crusher building for rescreening. All belt speeds are 250 ft. per minute.

Dust and 2½-in. stone from the rotary screens are delivered on 18-in. and 36-in. belts respectively (inclined 20 per cent) to the headhouse of the storage bin. This bin, 142 x 46 ft., is of heavy timber construction on concrete piers, with a floor of 12 x 12-in. timbers 48 ft. long. The two conveyors deliver their loads to lateral shuttle conveyors of the same size for distribution in the bins. Each of these shuttle conveyors can be operated in either direction and shifted longitudinally on tracks so as to cover seven bins. The total capacity is 2,000 tons of stone and 2,000 tons of dust. No hopper bottoms are used in the bins, but the discharge gates are set 7 ft. apart in order to reduce the dead storage to as low a point as possible for a cubical bin.

The crushing rolls, the two smaller crushers and the rotary screens were already on hand, and only the large gyratory crusher was purchased. Long conveyor belts were preferred to bucket conveyors or elevators as less liable to breakage. Cubical storage bins were adopted as it was considered that stone should form its own wearing surface, and this design gave a cheaper construction.

This million-dollar quarry and crushing layout plant was designed by the U. S. Ordnance Department and installed by Arthur G. McKee & Co., Cleveland, Ohio, under the supervision of the Construction Division, Quartermaster Corps, U. S. Army. It has not been put in operation, but is awaiting the government's disposition of the Muscle Shoals project.

Burning or Utilizing Old Railway Ties

Disposal of old ties by burning is not waste but an economic necessity in most cases, according to a statement by Samuel Porcher, general purchasing agent of the Pennsylvania Railway System. Although many old ties are sold as firewood at nominal prices to persons living near the right of way, this is only practicable where the ties can be delivered at a road crossing or other safe point for removal, and when this cost of delivery does not exceed the price paid by the purchaser. It would be dangerous practice to permit people to go on the track or through yards to gather up old ties, as such practice would only encourage trespassing, which is already a cause of frequent accidents. Dealers in firewood have little interest in the ties as they are dirty, partly decayed and dried out so that the wood burns too rapidly, and they contain more or less stone and old spikes which would be likely to damage the saws used for cutting up the wood. Attempts to dispose of the ties for the manufacture of pulp wood, charcoal and fertilizer ashes, or for the extraction of chemicals have been unsuccessful. As a rule, burning the ties on the right of way is the only practicable and economical method of disposal.

Defines Professional Attitude Toward Contracting

Institute of Consulting Engineers Distinguishes Between Professional Engineering and Contracting Functions

"WHAT is contracting? And what shall be the attitude of the Engineering Profession toward it as an occupation?" These questions have been answered recently by the American Institute of Consulting Engineers in order to interpret that provision of its constitution which declares ineligible for membership "engineers employed upon or connected with contracting or promotion, except in a strictly advisory or supervisory capacity where compensation is for professional service and not contingent upon profits."

The word "contracting" is restricted by the institute to mean "the common practice of carrying out public or private construction work under agreements between the owner or his agent on the one hand, and a person or company, called the *contractor*, on the other hand, under the terms of which the latter undertakes to perform a specified service, supplying the devices, materials, labor, superintendence and funds needed, and assuming the responsibilities and hazards involved, for constructing the work complete; and accepting payment therefore at rates or prices stipulated in the agreement. The object of the owner is to secure the carrying out of the work at a pre-determinable cost; that of the contractor to secure such compensation for the service rendered as shall cover the actual cost plus an adequate business profit."

The difference between the practice of engineering and the business of contracting is stated by the institute as follows: "The *engineer* supplies disinterested advice and service for which he is paid a stipulated fee; the *contractor* undertakes the work of construction at his own expense for stated prices, assuming all the uncertainties of actual cost and the contingency of final profit or loss. The business is therefore, in one sense, speculative in character."

Although the institute sees no moral or ethical reason why an engineer should not engage in a legitimate contracting business "independent of or in addition to, but *dissociated from* his professional work," it considers that it should be "distinctly held to be a violation of professional ethics for the engineer to undertake contracts for the construction of works, the plans and specifications for which have been prepared by him in his capacity of professional engineer. That the engineer in his capacity of a trusted counsellor to the client should be absolutely free from considerations of personal profit that may tempt him to sacrifice the interests of the client, is a cardinal principle of professional ethics recognized by all."

Whenever, in special cases, a client desires to place a designing engineer in executive control of construction work the engineer may act in that capacity, provided that "the client supplies the money to meet all current expenditures and assumes the contingencies involved; and the engineer's compensation is arranged on a fee basis, independent of questions of personal profit or loss."

If, however, the client desires the engineer to design and construct a work or plan for a specific purpose

"the engineer practically assuming in the construction work the rôle of contractor with its accompanying responsibilities and hazards and being compensated therefore, inclusive of the purely engineering service, in some one of the ways common in contracting," such an engagement "should be regarded as *contracting* rather than as *professional engineering*, for the contracting work will usually be of much greater financial magnitude than the engineering, and the practice may not be free from motives of business profit."

The institute modifies this provision, however, "in the case of the mechanical engineer connected with or interested in a manufacturing concern, who designs the standard or special devices or machines, made and offered or sold, upon their merits, to the trade or the individual client, in open competition with other concerns." Here the purchaser may exercise his own judgment assisted if he so desires by a disinterested expert, and the designing engineer is not retained by the client in the capacity of professional adviser. Such occupation and conduct is considered proper and ethical.

Revamping the Artesian Water Supply of Bryan, Ohio

THE water supply of Bryan, Ohio, is from a group of eight artesian wells connected to a 10-in. suction line 2,100 ft. long. From the construction of the works in 1892 until 1921 this suction line was direct connected to centrifugal pumps which supplied the town by direct pressure. The well pressure had always been sufficient to prime the pumps and the quantity large enough for domestic needs, but were not sufficient for fire purposes. To remedy this condition a 1,000,000-gal. circular reinforced-concrete reservoir has been constructed adjacent to the pumping station.

The reservoir is connected to the suction line by three 12-in. pipes so valved that the following can be done: Pipe 1 may be used to fill or partly fill the reservoir by direct pressure from the wells. Pipe 2 may be used to fill the reservoir full, as there is a centrifugal booster pump in this line. Pipe 3 connects the reservoir with the pumps in the station.

After 18 months service it has been found that the natural flow and pressure from the wells is sufficient to keep the reservoir from three-fourths to seven-eighths full except for the months of June, July and August, during which period it is necessary to use the booster pump.

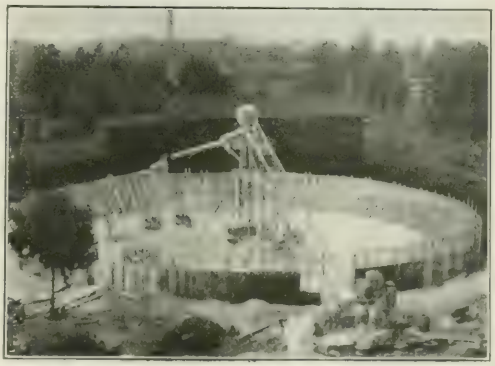
Three benefits were obtained by the construction of the reservoir, namely: (1) A 1,000,000-gal. fire reserve was obtained; (2) a well-water temperature of 52 deg. F. has been maintained in the distributing system; and (3) the flow of a large number of privately owned wells in the city has been restored and steadied during the summer months.

The reservoir is 100 ft. in diameter and has an effective depth of 17 ft., 10 ft. of which is below the ground level. Earth is banked around the sides so that only the concrete roof is exposed to sun and weather. The reservoir was constructed by excavating a circular trench for the walls in a clay which stands well when dry but caves badly when wet. The entire circular wall was then built in this trench, two openings being left in the wall through which the remainder of the earth excavated was taken by teams and slips and banked up on the outside of the wall. A concrete distribution tower was erected at the center of the reservoir with a chute mounted on a truck leading to the wall. Concrete was mixed outside of the wall and dispatched to the tower in a bucket running on an inclined track. After 12 months' service the reservoir has shown absolute water tightness.

The total cost of the reservoir, including a small enclosure for the booster pump and pipes, was $23,700.

This group of wells is located in a water-bearing belt 40 to 50 miles long and several miles wide, in which flowing wells are easily obtained at a depth of from 60 to 100 ft. The water-bearing stratum of gravel and sand is overlaid with a 60-ft. clay blanket, making the possibility of surface contamination remote, particularly when the water is under head. Repeated tests by the State Board of Health indicate an excellent uncontaminated quality, although the water does contain enough iron to stain porcelain fixtures.

Tests of two 10-in. wells 100 ft. deep put down in 1920 showed a yield of 400 gal. per minute with a drop of 7 ft. and 165 gal. with a drop of 6½ ft., the wells being pumped singly. The pumping of well 1 lowered



POURING THE WALLS OF A MILLION GALLON RESERVOIR
Concrete mixed outside wall, hauled up inclined track to central tower and distributed to walls through chute carried around deck on wagon trucks.

the water level 30 in. in well 2, which is 135 ft. away.

The lower 40 ft. of the 10-in. well casings were pierced with ⅜-in. holes spaced on 2-in. centers. Heavy pumping removes the fine sand and builds up a screen or filter of gravel on the outside of the casing.

As the demand increases this group of wells will become inadequate and ultimately new territory will have to be drilled and the suction line rebuilt and extended. Should the natural head become insufficient to fill the reservoir, a booster substation will be built in the new territory. No other supply is available for Bryan as there are no streams and the topography is too flat for an impounding reservoir.

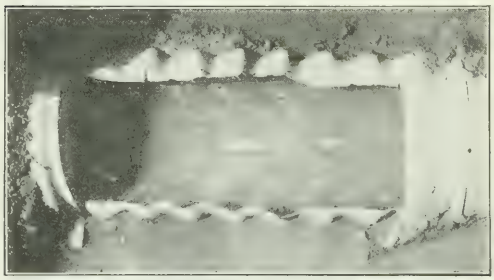
Conservation is being practiced through metering 98 per cent of the 865 taps, which brings the total summer consumption to 100 gal. per capita for the 4,250 population, with a day maximum of 150 gal. and a night minimum of 50 gal. About half of this consumption is domestic, the remainder being industrial.

The work of revamping the system and constructing the reservoir was carried out under the direction of **to A. H. Smith Co.**, consulting engineers, Toledo. The Toledo Residence Construction Co., Toledo, was contractor. S. Folk is superintendent of water works.

The Coefficient of Roughness in Corrugated-Iron Pipe

By D. L. Yarnell
Senior Drainage Engineer, Bureau of Public Roads, U. S. Department of Agriculture

TO DETERMINE the coefficient of roughness applicable to corrugated-iron pipe, experiments on two sizes, 8- and 10-in., recently were made by the Bureau of Public Roads, U. S. Department of Agriculture. The actual (smallest) internal diameters of the pipes were determined by making two measurements at right angles to each other, at both ends of each section of pipe. In the commercial 8-in. pipe, the actual average diameter measured $\frac{7}{8}$ in. greater than the commercial size. The 10-in. pipe measured $\frac{3}{4}$ in. over the commercial size.



FILAMENTS OF FLOW IN 10-IN. CORRUGATED-IRON PIPE ON 1.25 PER CENT GRADE

In all, 147 tests were made. Nine grades were used, ranging from 0.05 to 1.50 per cent. For each size and grade it was planned to make tests at depths of flow of $\frac{1}{4}$, $\frac{3}{8}$ and $\frac{1}{2}$ the internal diameter of the pipe, and for other depths ranging from half full to full by successive increases of 5 per cent of the diameter.

ELEMENTS OF EXPERIMENTS FOR DETERMINING THE COEFFICIENT OF ROUGHNESS IN CORRUGATED IRON PIPE

Depth of Flow (d) Ft.	$\frac{d}{D}$	Area of Flow (a) Sq. Ft.	$\frac{a}{A}$	Hydraulic Radius (R) Ft.	Discharge (Q) Cu. Ft. per Sec.	Velocity (V) Ft. per Sec.	Slope (s)	Kutter Coefficient (n)	Chezy Coefficient (C)
8-In. Pipe: Commercial Diameter, 0.667 ft.; measured diameter, 0.740 ft.									
0.709	96	0.4239	99	.2000	.2424	0.572	0.0005	.0170	55.8
.734	99	.4295	99	.1950	.3222	.750	.0010	.0175	53.7
.740	1.00	.4301	1.00	.1850	.4542	1.056	.0020	.0171	54.9
.740	1.00	.4301	1.00	.1850	.5540	1.288	.0030	.0171	54.7
.740	1.00	.4301	1.00	.1850	.7195	1.673	.0050	.0171	55.0
.734	99	.4295	.99	.1949	.8444	1.966	.0075	.0181	51.4
.712	96	.4248	.99	.2387	1.0261	2.415	.0100	.0179	52.9
.721	97	.4271	.99	.2046	1.057	2.475	.0125	.0192	49.0
.700	.95	.4211	.98	.2129	1.158	2.750	.0150	.0193	48.7
10-In. Pipe: Commercial Diameter, 0.833 ft.; measured diameter, 0.897 ft.									
.871	97	.6266	.99	.2495	.3660	.584	.0005	.0187	52.3
.856	95	.6216	.98	.2556	.4761	.766	.0010	.0206	47.9
.861	.96	.6234	.99	.2539	.6776	1.087	.0020	.0204	48.2
.864	.96	.6245	.99	.2526	.7932	1.270	.0030	.0214	46.2
.863	.96	.6241	.99	.2530	1.045	1.674	.0050	.0206	47.1
.701	.78	.5299	.84	.2725	1.184	2.235	.0075	.0203	49.4
.683	.76	.5163	.82	.2714	1.3475	2.610	.0100	.0201	50.1

However, the capacity of the pumping plant proved insufficient to fill the larger pipe at the maximum grades. The results of the tests for the pipe flowing full at the various grades are shown in the table.

In order actually to observe in detail the flow of water in corrugated iron pipe, a section was cut from the top of the pipe and photographs taken of the flow in the pipe at about one-half full. The breaking up of the filaments of flow can be seen plainly in the accompanying view. This disturbance of the flow in the pipe, due to the corrugations, undoubtedly is the reason for the comparatively high coefficients of roughness in such pipe.

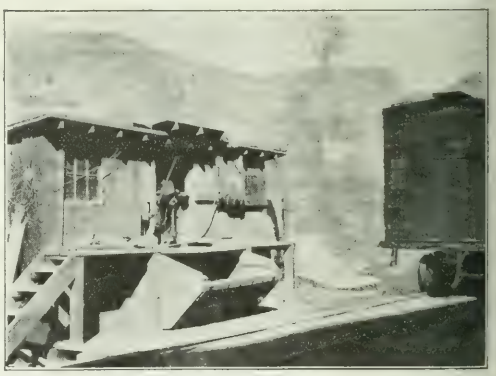
The values for the Kutter coefficient of roughness ranged from 0.017 to 0.021 for corrugated iron pipe flowing full (see table). No explanation is offered for the rather consistent variation in n as between the 8-in. and the 10-in. pipe.

Cement Handled in Bulk on the Hetch Hetchy Dam

Cars Unloaded With Flat Scraper for 15 Cents Per Ton—Manual Control of Weighing Machine Quicker Than Automatic Device

By N. A. Eckart
Chief Assistant Engineer, Hetch Hetchy Water Project

CEMENT is being handled in bulk on the new Hetch Hetchy Dam, east of San Francisco, and being proportioned for the mixer by weight. The Utah Construction Co., which has the contract for building the dam as a part of the new water-supply system for San Francisco, decided upon this system as the most economical and convenient method for this job which involves placing 370,000 cu.yd. of concrete on a schedule of 1,000 cu.yd. per day. At present 5 to 6 cars of cement, averaging from 176 to 265 bbl. per car are unloaded every day at the dam. Ordinary box cars are used without any preparation other than partial lining with building paper where the car floors or sides are not tight. These cars are loaded at the mill from sealed bins, the cement in which has been tested in the city's laboratories so that except for occasional check tests from the job storage bin, no further sampling is necessary.

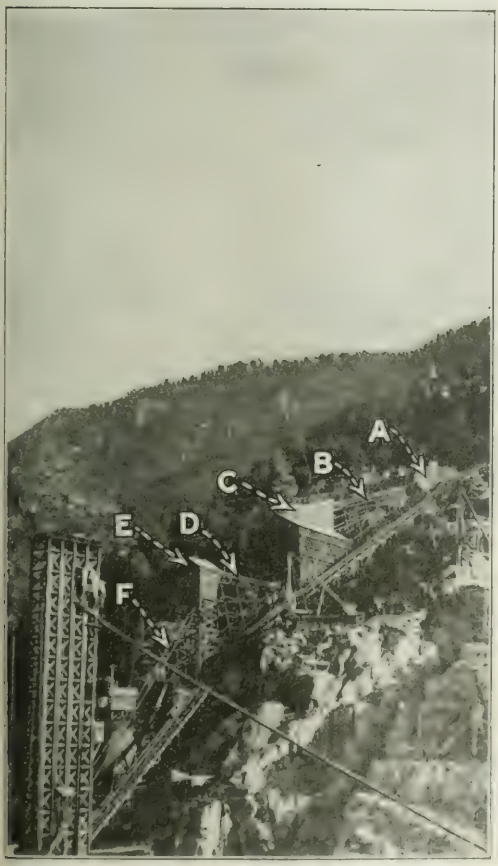


CEMENT RECEIVING HOPPER ON HETCH HETCHY R.R. SIDING

The cars of cement are delivered via the Hetch Hetchy R.R. to a siding just above the main storage bin at the dam site and are spotted opposite the unloading hopper shown in the accompanying picture. This hopper is hinged so it can be drawn into the clear under

the building platform until after the car has been spotted when it is swung out directly under the side door of the car.

Just above the hopper is a small motor-operated winch with a friction drum which is used to drag a light flat board scraper working inside the car and scraping the cement to the door. The unloading is done under contract on a basis of 15 cents per ton, this price covering the spotting of the cars, unloading and payment of demurrage when any accrues due to delay in unloading. Three men are able to take care of the



GENERAL VIEW OF CEMENT HANDLING SYSTEM, HETCH HETCHY DAM

A—Unloading hopper. B—Screw conveyor. C—Main storage bin. D—Screw conveyor. E—Weighing hopper. F—Mixers.

cement as it comes in, unloading by actual timing 7 cars in nine hours, or approximately 200 bbl. per hour. While working in the car ordinary dust masks or muzzles are worn.

From the receiving hopper the cement is delivered to the main storage bin by means of a 12-in. screw conveyer, approximately 200 ft. long driven by a 15 hp. motor. The main storage bin is 60 ft. long, 32 ft. wide and 34 ft. deep, with a capacity of 13,000 bbl.

From the main storage bin the cement is moved on to the weighing shed a distance of about 120 ft. by means of a second screw conveyor. This conveyor runs underneath the storage bin in a 4 x 6-ft. tunnel along the sides of which are a number of slide gates controlling the rate of speed from the bin to the screw conveyor and permitting cement to be drawn from any section of the bin.

This screw conveyor delivers into a small hopper or bin just above the weighing machine and which has a capacity of about 60 bbl. The weighing machines were made by the Hoepner Automatic Scale Co. of Chicago and have a capacity per batch of 1,200 lb. each. The automatic feature is not now being used as it was found that with the machines as installed the rate of weighing can be increased by manual control from about 20 to 30 batches per hour per machine. When using the 1:2½:5 mix each batch requires 902½ lb. of cement; with the 1:3:6 mix 752 lb. of cement are required. From the weighing machines cement is discharged directly to the mixers through two 8-in. steel pipes supported by cables on a 1 to 1 slope.

Communication between mixers and weighing shed is maintained by telephone, as well as by signal horn and flash lamps, the purpose of these alternatives being to make certain that the cement charge can be varied at will for a change of mix without loss of time. The concrete mixers used have a capacity of 2 cu.yd., are motor driven and have hydraulickally-controlled charging gates. To date approximately 80,000 cu.yd. have been poured and the method of handling the cement has proved entirely satisfactory.

The construction of the Hetch Hetchy Dam is being carried on by the Utah Construction Co. under the general direction of M. M. O'Shaughnessy, city engineer. C. R. Rankin is construction engineer, locally in charge for the city.

An Insurance Company's Recent Housing Loans

The reported willingness of the Metropolitan Life Insurance Co. of New York City to finance housing in New York State to the extent of $100,000,000, provided the State Legislature would amend the insurance law so as to permit life insurance companies to invest 10 per cent of their assets in housing, led *Engineering News-Record* to request a statement as to the housing loans made by the company in the last two years. Walter Stabler, comptroller of the company, in reply states that from Jan. 1, 1920, to Dec. 16, 1921, the company loaned or pledged itself to loan a total of $68,080,107 to house 17,744 families. The division of these totals between New York City and all other cities, and between dwellings and apartments is given in the accompanying table:

SUMMARY OF HOUSING LOANS MADE OR PLEDGED BY METROPOLITAN LIFE INSURANCE CO. JAN. 1, 1920, TO DEC. 16, 1921

NEW YORK CITY		
[illegible]	[illegible]	[illegible]
[illegible]	9,775 families	[illegible]
	10,00[illegible]	$54,[illegible]
ALL OTHER CITIES		
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
	[illegible]	$[illegible]
GRAND TOTAL		
[illegible]	[illegible]	[illegible]
[illegible]	17,744	49,205,750
	[illegible]	[illegible]

Controlling a Mountain Torrent in Switzerland

History of Check Dams and Channel Regulation on Lammbach Creek and Results After 24 Years of Control

By Karl Haller

Doctor of Engineering, Langenau in Wurtemberg, Germany

Mountain torrent control and the regulation of small flashy streams is a very important class of engineering work that has not been extensively practiced in this country except, to some degree, in southern California. In Switzerland, however, conditions are such that it has long been a problem requiring constant solution. The following description of the control of a typical Swiss mountain stream should prove of value to American engineers contemplating similar work.—Editor.

As a result of atmospheric conditions in mountains, particularly high mountains, there occur formations of torrents, which in the course of time cut more and more into the mountain, disturbing thereby the state of equilibrium of the slopes on both sides and finally bringing about collapse of the mountain structure. The extent and danger of such a collapse as far as it affects the two slopes depends on the size and gradient of the torrent. It has happened, however, more than once that such mountain streams have carried away bridges, roads and indeed whole sections of the countryside. Such catastrophes usually occur after prolonged and extensive rainfalls or after excessively rapid melting of snow, and take the shape of a torrential movement of a mixture of water, earthy matter and stones.

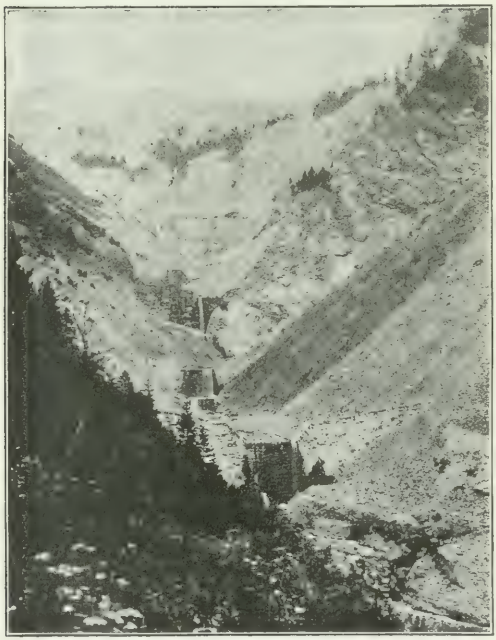


FIG. 1. A SERIES OF CHECK DAMS ON LAMMBACH CREEK

The stream is partly dammed by massive detritus in the upper part of its flow, which holds back the water until gradually it finds a new outlet through the deposits and when this happens, the whole mass of water backed by the tremendous pressure accumulated back of the dam suddenly rushes into the valley below, carrying with it everything that stands in its way.

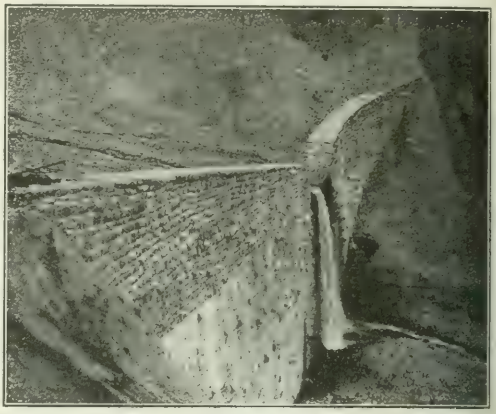


FIG. 2. A CLOSE-UP OF DAM 4

If one investigates the origin of such a mountain torrent, he finds that the stream coming from the high mountain levels has a tendency to cut deeper and deeper into the mountain bed and the power of erosion of the water is naturally most noticeable along the line of its greatest gradient, that is, in the upper part of the stream. It gradually loses this eroding action as the flow approaches the bottom of the valley, where the masses of water discharge into some other river or lake.

It has often happened that where this discharge takes place, the river, because of the great masses of detritus discharged into it by the creek, is deflected out of its original course and forced over towards the opposite shore. Not infrequently, in the region of the mouth of the mountain torrent, large sections of valuable ground have been destroyed by deposits of detritus or converted into a morass as a result of frequent inundations and, in any event, made permanently unsuitable for agricultural purposes. The dangerous and harmful results produced in neighborhoods suitable for the origination of mountain torrents of the character described above, are intensified with the increase in the erosion produced by the stream in the mountain.

In order to prevent the material harm that can be done by this kind of stream, it is necessary *in proper time* to take precautions that would counteract the causes creating the mountain torrents, which means, it is necessary to suitably harness the streams. Bearing in mind the way in which the mountain torrents originate, it is obvious that works to get them under control should be started, not in the lower part of the stream, that is, in the region where the creek discharges into some river or lake, but in the upper part of the stream which is the source of the evil. It is there, where the gradient of the fall is at its maximum, that the creek has a tendency to cut deep into the mountain, and the transport of detritus is at its maximum. In order to prevent the former as much as possible and to reduce the latter to a minimum, dams are constructed in the bed of the creek across its flow. Such dams are nothing but

stationary weirs. In contradistinction to the use of weirs in rivers to raise the level of the water, here they are built to keep back the masses of detritus and to give back once more to the slopes of the valley on both shores of the creek a firm hold on themselves. From this it follows that the construction of the dams not only artificially reduces the gradient of the creek but also tends



FIG. 3. MASONRY LINING OF A CONTROLLED CHANNEL

to restore the disturbed state of equilibrium in the entire region through which the creek flows.

But this is only the means to an end and not the end itself. It is only after a little while, subsequent to a successful harnessing of the creek, and after a certain permanent state around the creek has been established, that one can proceed with the last and most important stage of the work which alone can make the harnessing secure; that is the reforestation of the bare slopes. If this is carried out successfully, then the harnessing of the torrent may be considered as completed and for the future the creek may be left alone without particular apprehension.

To illustrate such work it will be useful to describe an interesting case of this kind of work recently carried out in Switzerland, namely, the harnessing of Lammbach Creek near Brienz. This creek has a long history of misdeeds back of it. Already in 1499, it overwhelmed the large village of Kienholtz and the Castle Kien by a wave, ten meters high, carrying with it masses of stone and earth. For many years thereafter, only a few miserable huts stood in the place of a once wealthy community. An impetus towards an effort to a thorough harnessing of this dangerous torrent was given, however, by the catastrophe of the year 1896. In the end of May in that year, large sections of the overhanging shores in the upper part of the creek collapsed, and the next September, after a period of prolonged rains, a threatening state of affairs was found to exist. With a noise like thunder, large sections of the shore fell in the upper part of the creek, dammed the flow of its water and forced the current to one side until it succeeded in carrying into the valley large amounts of detritus in one tremendous wave.

Previously, in 1872 to 1874, a large protecting dam had been built at the outlet from the valley but it was twice, shortly after its construction, carried away by the rising stream. In the meantime, the creek cut into its former bed to a considerable depth and as a result of this there was created in the immediate proximity of the valley, a fairly deep eroded ditch with steep crumbling walls on both sides.

The drainage area of the creek comprises 4.3 sq.km. From a geological point of view, the section of the mountains lying within this area consists of layers of lower chalk formation. The surface of these layers is often crossed by faults which facilitate tremendously the loosening of rock. Out of the detritus, as one can see from Fig. 1, upstanding rocks of harder formation stick out.

The following leading ideas were made the foundation of the plans worked out for harnessing the creek: In the first place, it was decided to build high dams in the collecting canal at the place where hard bald rocks came



FIG. 4. LOOKING DOWN OVER SOME STONE TERRACES

out of the ground, the purpose of this being to raise to the original level the bottom of the creek and to give a firm hold to the valley slopes on both sides.

Next, it was decided to put a definite end to the deposition of detritus masses at the so-called Blue Egg and to reinforce the steep section below that range by channel lining.

After the barrages across the creek had been completed, it was intended to put in intermediary dams in order to reduce still more the excessive head of the creek. Finally, it was decided to try to raise the bed of the creek still more in its lowest section by means of so-called Schindler piles in order to force, by these means, as great as possible a deposit of detritus. On the other hand, the amount of detritus brought in was to be reduced by proper harnessing of the lateral streams running into the main creek.

In the lowest part of the creek, a further large loca-

tion for the deposit of detritus was to be created and in order to protect the land in the neighborhood of the creek from further danger of being overrun by the waters, the place selected for the deposit of the detritus was to be kept within proper limits by a strong dam. In order to close off finally this location, a strongly built channel lining going as far as the Lake of Brienz was provided, this lining being built in the way shown in Fig. 3.

After a number of opinions had been obtained from prominent experts, the construction works were started and carried on in such a manner that already in the spring of 1897, the first large barrage constituting the foundation of the whole system of harnessing the creek was ready. The next job was that of protecting the location into which the deposit of detritus was to take place, with a massive dam, the purpose of which was to protect, during the period of construction, the inhabitants of Kienholz village, as well as the public road and the railroad. This being done, work was started on the next high barrage, this time at the so-called Blue Egg boulder.

In order to make the filling behind the dam as dry as possible a drainage system was provided and over it stone was packed. In this way a constant means of efflux of seepage water was secured until it became possible to pass the water from one dam to the other. This dam at Blue Egg is 90 m. wide and 19 m. high and is shown in Fig. 1.

After its completion, a start was made in 1898 on the barrage at Engi. Between these dams, tests were made with belts of piles which were, however, entirely destroyed as a result of a violent torrent in the course of which 172,000 cu.m. of detritus were hurled into the valley.

The essential difference between these two kinds of structures, namely, the massive barrage and the pile belt, lies in the fact that in the first case, the fall of the brook is broken while in the second case where the construction is not of massive character, it is intended to break the force of the water by sub-dividing the stream, which is to be attained by a series of belts of piles.

In 1904, Dam 4, shown in Fig. 2, was raised. In the following years a number of other dams shown in Fig. 1 (looking from the Blue Egg) were carried out and also the public road and railroad bed were raised (these were lying crosswise towards the lake at the foot of the spoil mound).

Fig. 3 shows the beginning of the channel lining leading directly from the location of detritus deposit towards the Lake of Brienz; this lining is somewhat over 200 m. long and has a slope at the bottom of 5.71 per cent. The entire construction in all its material parts was practically completed by the time the Great War began. The great extent of the work connected with this enterprise may be among other things judged from the fact that the cost of harnessing Lammbach Creek up to the end of 1913 was not less than 1,122,700 fr. of which 670,415 fr. was the cost of the twenty sections of channel lining erected in the course of the construction.

According to the figures kindly placed at the disposal of the author by the Federal Chief Inspection Service, a cubical content of the wall construction of all the dams amounted to 33,000 cu.m. to which should be added 2,000 m. of stonework for the dams in the drainage area and in the lower part of the creek.

The dimensions of the most important dams are:

	Upper Width	Height	Stonework
Dam 1	74 m.	13 m.	3,655 cu m.
" 2	41 m.	16 m.	2,525 " "
" 3	60 m.	28 m.	5,600 " "
" 4	90 m	19 m.	3,400 " "
" 4A	90 m.	19 m.	6,000 " "

So far, the results of the work of harnessing the creek have been satisfactory. Up to the end of 1914, already 500,000 cu.m. of detritus were deposited back of the dams. The right-hand walls have, in general, reached a suitable state. The entire region of the creek is again gradually acquiring a suitable character. Finally, at the location selected for the deposition of detritus by the creek, considerable amounts of material have been deposited.

It is now time to crown the excellent result of the constructional work in harnessing a mountain torrent by reforestation and grass planting of the bare slopes. Of course, reforestation and grass planting can begin only after the creek attains a state of more or less permanent equilibrium and the slopes on both sides have secured a reliable foothold.

Up to the time of the completion of the structural operations, less than 5 per cent of the entire encatchment area of the creek was covered with forest. The productive area under consideration amounted to 132 hectares. The lower section comprising 72 hectares is to be improved with 670,000 trees, 600,000 of which are to be alders.

In the upper zone of reforestation comprising 62 hectares, there is still an ever-present danger of avalanches. An attempt will be made to meet this danger by constructing numerous terraces of earth and stone as there is no wood for pile construction or material available for cut-stone masonry, generally. On the whole, it is intended to construct a total of 84,000 m. of earth terraces, 1 m. wide and in addition to this, 17,000 m. of stone terraces. The reforestation of this upper region, which has not yet been carried out, will comprise the planting of about 450,000 trees of which there will be 90,000 alders, 100,000 Siberian stone pines, 40,000 larches and 60,000 fir trees of two kinds.

Louisiana's New Vehicle Fees

Effective Jan. 1, 1922, a new schedule of license fees for passenger automobiles and motor trucks has been issued by the Secretary of State. Passenger automobiles are taxed on the basis of 68c. per horsepower, with a minimum fee of $15. The fees for motor trucks are as follows:

Capacity, Pounds		
750 to 4,000	per thousand	$10 00 plus 68c. per hp
4,001 to 5,000	per thousand	12 50 plus 68c. per hp
5,001 to 6,000	per thousand	15 00 plus 68c per hp
6,001 to 8,000	per thousand	20 00 plus 68c. per hp
8,001 to 10,000	per thousand	25 00 plus 68c. per hp.
Over 10,000	per thousand	150 00 plus 68c. per hp
Minimum		25 00

$10 per thousand pounds capacity for those used exclusively in cities of over 10,000 inhabitants.

Vehicles for passenger hire are required to pay 68c. per horsepower plus $2 per passenger for capacities of from 1 to 7 passengers; $3 per passenger for capacities of 8 to 25 passengers; and $5 per passenger for capacities of 25 passengers or more. A minimum fee of $25 is specified for vehicles operated for hire. Animal-drawn vehicles are taxed 25c. per 100 lb. of rated capacity.

Six Construction Mistakes in One Concrete Road

Ten-Inch Slab Too Thin for War Traffic—Dowels at Expansion Joints—Washout Shows Strength of Slab

By George L. Smith
Newport News, Va

EXPERIENCE in building a 20-ft. concrete military road three years ago disclosed a number of errors which carry lessons. Early in the first year of the world war, the general in command of the port of embarkation at Newport News, Va., warned the city council that the army motor and other traffic which the streets of the city would be called upon to sustain would probably ruin all of the hard-surfaced pavements then existing, unless a special route were laid out and paved from Camp Stuart on the south to Camp Hill on the

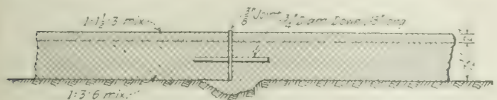


FIG. 1. DOWELED EXPANSION JOINT WITH THICKENING RIB

north of the city. This warning, together with the offer of certain citizens and the banks to finance the building of the special road, led to the appropriation of $100,000 for the construction of a "military highway" a little over three miles long.

A 10-in. concrete pavement 20 ft. wide was decided upon. It was also decided, in deference to the wishes of the city engineers, to make a flat sub-grade and to crown the concrete 2½ in. This gave a relatively thin edge—too thin, because lack of money prevented the building of water-bound macadam shoulders, even at street intersections. The thickness worked out, then, 10 in. at the center and 7½ in. at the edges. This was mistake No. 1.

Owing to the necessity for quick action, it was decided, with some misgivings, to let the contract on a cost-plus basis, the contractor to receive a total of 15 per cent over the cost of direct labor and material, the percentage to cover plant rentals, overhead and profit. The percentage was reasonable, but—this was mistake



FIG. 2. METHOD OF FORMING EXPANSION JOINT

No. 2—the city got neither an early completion of the work nor the benefit of highly efficient supervision, and the cost was excessive. Under the conditions, the contractor was not to blame. The city did the last third of the job at a considerably less unit cost and in quicker time, although wages were then over 5c. an hour more.

As the result of much pressure, the thickness of the pavement was cut down ½ in. leaving it 9½ in. at the center and 7 in. at the edges. This was mistake No. 3, because the thickness was needed, both for strength and for mass to resist shock.

The design contemplated the installation of expansion joints at 25-ft. intervals, with ¾ in. of solid, asphalt-impregnated felt between blocks and four ¾ in. steel

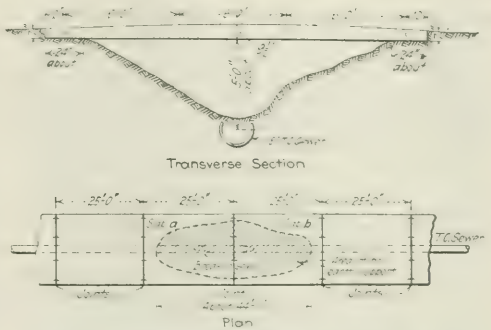


FIG. 3. DETAILS OF WASHOUT LEAVING SLAB UNSUPPORTED

dowels set half-way into the ends of adjacent blocks and passing through the joint material, as shown by Fig. 1. The idea was that a wheel, in passing from one block to another would have part of its load transmitted, through the shear in the dowels, to the block which it was approaching, before the tire actually passed the joint. Cantilever action, leading to excessive compression of the sub-grade at the joints under heavy loads and consequent cracking, would thus be avoided. Experience has borne out this theory fairly well; but we should have had eight dowels (we now use eight)—the small number of dowels was mistake No. 4.

The specifications called for the blocks to be installed alternately, both in order to avoid (or at least to remedy) honeycombing of the ends of the blocks at the joints and in order to provide for the joint material a solid bottom on which to rest, as shown by Fig. 1. This resulted in delay and some cost in moving the machine. Moreover, the blocks on the second pouring settled and shrank below the first ones, when struck level in finishing, thus making a slight hump or step at each joint. This was mistake No. 5, which was afterward remedied by measuring the shrinkage and altering the strike-board or joint screed. The shrinkage was not a constant amount, measured from a line parallel to the axis of the road, but was a maximum about 9 in. from the joint and a minimum at the joint—due probably to the thorough spading at the joint.

In order that the expansion joint might continue to protect the edges of the blocks, the material was cut off ¼ in. above the surface of the concrete by means of a sharp shovel with ¼ in. gage blocks secured to the under side. This worked very well. To prevent the joint material from being hammered down into the earth (the resistance of the dowels to this is very small), a scab or toe was provided by digging under the transverse forms before pouring, as shown by Fig. 2, and letting the concrete run beneath the form, care being taken to keep the top of this scab low enough to permit the removal of the form without loosening the dowels. In hot weather, the joint material is squeezed up and traffic irons it out so that it sticks only a little above the concrete. As cold weather comes on, traffic drives the joint material back into the recess. It has done this for four seasons, with the aid of a little hot bituminous material lately, and no joints are worn seriously, except some longitudinal ones alongside of car tracks which have not received proper attention.

These joints and this road have withstood the as-

saults of overloaded seven-ton trucks traveling at high speed, and provided with anti-skid chains consisting of one turn of ⅝ in. close-link chain. There is a terrific jar from such a truck for every revolution of the driving wheels, and the loose chain acts like a flail on the surface. Some of the first work put in cracked somewhat irregularly but not seriously; it was put into commission too soon after pouring. Another section was poured with slag in the bottom course, which floated up through the top course and made soft spots. The use of this slag without preliminary soaking was mistake No. 6.

Soon after one portion of the road was opened, there were hauled over it several 24-ton field pieces. These were mounted on two wheels, provided with diagonal cleats secured by snap-head rivets; so that, as the wheels turned, the entire weight came for a short period entirely on one rivet head in each wheel. Twelve tons on a rivet head gives a very high compressive stress, and this road surface bears today the imprints of the rivet heads, which compress the concrete in the same way as wood would be compressed and with practically no spalling.

A little later there was a stoppage in a main sewer running longitudinally beneath the center of the pavement. The stoppage became known through the overflowing of a manhole. Rodding showed a long plug of earth in the sewer in the middle of a block. To remedy the trouble it was necessary to make an exploration hole in the concrete, which revealed the condition shown by Fig. 3. Nobody could form any idea as to how long the sewer had been broken, because there had been no noticeable disturbance of the joint between blocks *a* and *b* and nobody could be found who had heard a hollow sound as the heavy trucks passed this point. Blocks *a* and *b* were at once broken up, the sewer repaired and, after a proper period had elapsed for settlement, the slabs were replaced. Undoubtedly the doweling of this joint was responsible for the maintenance in alignment of the blocks and, probably, for the avoidance of a serious accident.

Although built under very trying conditions (it will be recalled that the winter of 1917-18 was very severe) and although subject to the most extraordinary use and abuse, this piece of road which forms part of the national highway from Old Point Comfort to Washington via Richmond (and also part of the road from Old Point Comfort to Washington via Yorktown and Fredericksburg), is still in excellent condition and has many more years of life. The cost of maintenance has been very low.

First Brick Paved Street in U. S.

Charleston, W. Va., was the first city in the United States to use brick for street paving. Although brick had been used to pave streets in European countries, principally Holland, for nearly a century, they were not tried in the United States until 1871, when Charleston paved Summers St. with building brick, which served for 38 years. The state museum at Charleston has on exhibition the first brick laid in the street, from which not more than 1 in. was worn in the generation it served. In 1894 Quarrier St. was paved with brick and, although 27 years old, is still in good condition today. The brick were laid on a base of 3 in. of sand, 1 in. of tarred oak planks and a second 3-in. layer of sand.

Careful Handling Required in Placing Creosoted Piles

San Francisco Bay Study Shows That Treated Layer Must Not Be Broken Where Marine Borers Exist

AFTER the discovery a little over a year ago that the limnoria and teredo, marine borers hitherto absent from San Francisco Bay, were causing tremendous damage to wood structures in various parts of the bay, the San Francisco Bay Marine Piling Committee was organized to study the situation. Its second report, presented at the recent meeting of the American Wood Preservers Association, contains much recent information regarding the inroads made by the borers on harbor structures, and discusses especially the necessity for preserving intact the surface of all creosoted piles. This section of the report is as follows:

The data so far in hand indicates that it is fair to expect creosoted Douglas fir piling in San Francisco Bay to give a life of 15 to 20 years under present conditions. Certain piles are of authentic record from the Oakland Long Wharf which were sound when removed after a service of 29 years. Poor treatment, or damage to creosoted piling by careless handling, rafting, storage or construction, will materially reduce the life which might otherwise be rendered by such piling.

Copper sheathed piles have given very satisfactory service in locations where damage from abrasion and theft can be minimized. Such piles carefully prepared and handled fall into the class of best surface protections, when used under the conditions indicated.

Handling Piles Properly

The wharf construction sub-committee formulated specifications for handling on which it claims too much emphasis cannot be placed since so great a proportion are subjected to attack by marine borers on account of physical damage to the protective shell. The extent of the damage is likely to be in direct relation to the extent to which it is necessary to handle the piles.

The dog is by far the worst enemy of creosoted piling. The use of dogs should be unconditionally prohibited, except within specified distances of either end which will allow ample margin to protect the water section of the pile. When creosoted piles are prepared for towing considerable distance boring and reeving should be the only method of fastening allowed. The ax, the pike and the peavie also cause much damage. The holes left by sinking an ax in the piling, as is frequently done in handling, are much like those caused by the dog and are particularly dangerous. The use of pike poles and peavies should only be permitted when their points are blunted. The use of boat hooks during inspections by row boat or raft is also a source of considerable damage to treated piles in place and should be prohibited.

One of the most important duties of the pile-driving crew is to drive the piles without puncturing the protective shell. There is always danger of checking the piling under the hammer. In using a steam hammer it is well to use piles of a minimum butt diameter of 14 in. This permits the pile to be headed, trimming off all creosoted material so that the plate upon which the plunger strikes rests entirely on untreated wood and is not so likely to cause checking. On rocky bottoms, where there is little or no mud, great care must be taken not to split the pile. This can be done by avoiding hard driving and by the use of various types of steel shoes and plates.

Creosoted piling should not be cut off below high-water line, thus exposing untreated wood to attack by borers, if it can be avoided. Even side sloping where piling is cut near high water level, may permit limnoria attack, if water can settle where it does not run off. Furthermore, decay frequently occurs in the untreated interior of piles

when they are cut off at any level above high water. Whenever piles are cut off, therefore, the untreated wood should be protected by thoroughly painting the top of the cut-off portion with hot creosote. Above the water line, a further coating of thick asphalt may be applied to prevent the penetration of moisture; below water line the access of borers can be prevented by covering tightly with sheet copper.

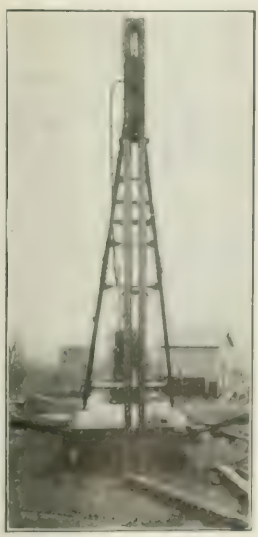
The only safe way is to have all bracing, ribbing and other construction attachments well above high water. Where this cannot be done, dapping the piles, which exposes untreated wood, should be prohibited, except where it is absolutely unavoidable. Necessary cutting or framing should be done, so far as possible, on the pieces to be attached to the pile, since they are cheaper to renew. The braces, ribbing and other attachment members should be creosoted if they will be exposed to borer attack, and all boring and framing which can possibly be done in advance should be done before the members are creososted. Otherwise all such holes or framing cuttings should be well swabbed with hot creosote before putting the parts into the construction. All holes for bolts or pins should be bored not larger in diameter than the bolt or pin, to insure a driving fit. This will prevent borers from entering the bolt holes, so far as it is possible to provide against it.

Fender lines are always constructed of wooden piling, usually untreated in this region but sometimes treated. Connections to treated piling below the water line, where such connections expose untreated material, are dangerous. Bolt and spike holes provide a ready means for borers to enter. Where it is necessary to bore holes in creosoted fender piling the holes should be bored for a driving fit.

When a treated pile is damaged it should be immediately repaired. Holes should be plugged with creosoted material, and where repairs cannot be made in this way the damaged place should be covered with sheet copper. The Board of State Harbor Commissioners has recently been filling such holes, as well as those of the initial attacks of limnoria working in them, with cement mortar. It is too early to judge the effectiveness of the method, but it looks promising.

Portable Sectional Highway Piledriver with Swinging Leads

DEVELOPED for military road bridge building the piledriver shown by the accompanying view can easily be adapted to highway bridge building generally. It is assembled in sections which can be handled by a 3½-ton truck with a 6½ x 12-ft. box body. It will drive 40-ft. 15-in. piles in a 15-ft. bent, with a swing on the leads sufficient to drive the outside piles on a batter, and overreach enough to space the bents 15 ft. apart. Working tests with the first machine built developed the information that the machine could be assembled by untrained men in 15 working hours; that best results were secured with a steam hammer; that six trucks of the size stated would carry the whole outfit. With minor changes the piledriver is capable of rapid assembly and quick transport. It has the capacity to construct bridges that will take the heavier military loads and it is as light as safety and success of operation will permit. Using the normal five-pile batter bents 15 ft. wide it can accomplish its task with dispatch. The machine was built for the War Department by the McKiernan-Terry Drill Co., Dover, N. J.



Ditch Riders, Their Qualifications and Duties

By G. A. Remington

General Manager, Nampa & Meridian Irrigation District, Idaho

Abstract of Paper Presented to Idaho Irrigation Congress Jan. 20

THE ditch rider, ditch walker, ditch tender, patrol man and zanzero are various titles or names used to describe the man who acts as the "go between" for the irrigation canal management and water user. He is the one who comes in daily contact with the man who carries the shovel. He must listen to all the things the irrigator has to offer in the shape of complaint, advice or criticism. He must sift out the portion to receive the attention of the water master or manager. On the job with arduous duties to perform by day, he is also subject to call by night to prevent or repair a break in the canal system.

A ditch rider should be courteous, accommodating and patient to those with whom he comes in daily contact. All canal companies or irrigation districts require these qualifications, the most important of which is to be patient and able to keep one's head under trying conditions. The user does not always stay cool and collected; he may air his opinions regarding the ditch rider and everyone in authority. It is much easier for the canal management to adjust difficulties if the ditch rider has not said too much.

The duties of each rider measured in irrigable area, the number of taps or miles of ditch varies so greatly on account of local conditions that it is impossible to set a hard and fast rule and say that a rider should make deliveries to so many acres, to so many taps or to travel a certain number of miles each day, in order to perform his full duty to the man who pays the water bill.

Under our project we patrol 153 miles of canal and laterals with ten riders, or an average of 15.3 miles on each ride, but the length each rides actually varies from 6 to 21½ miles. Still we think that the duties of each are so near alike that all get the same wage. Short rides are usually patrolled for protection, often two or more times during the day or night, while a longer ride is patrolled for the delivery of water only and the rider reaches a given point only once in 24 hours. Our district requires riders to patrol ditches 7 days of the week, while other work for the district is limited to 6 days.

Some companies or districts operating canal systems require the riders to keep a daily record of water deliveries. Such a record indicates the water delivered to each user each day and at the close of each month the record book is delivered to the secretary. We find that such a record is very valuable in cases of litigation and especially in cases of a claim for damages against us for non-delivery of water. This book contains the entire record of water called for and water delivered at each tap expressed in miners' inches.

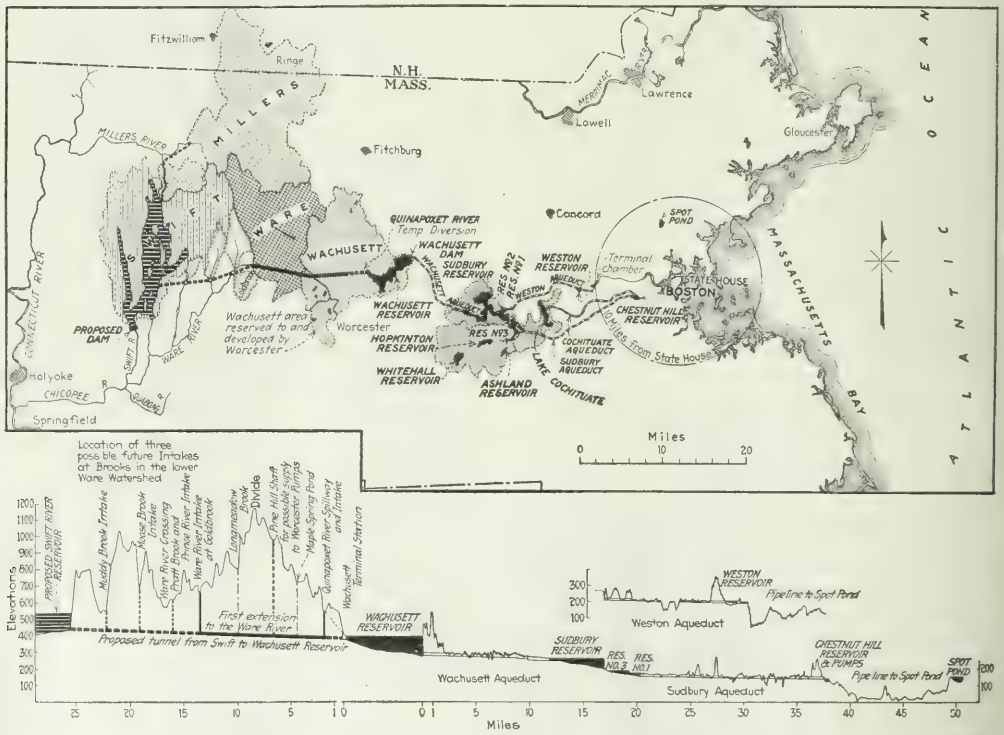
In the early days of irrigation in the Snake River valley, the supply of water was great and the acreage was small, which made it possible for a number of years to operate canals without locks, but as time went on the necessity for structures with locks became more and more apparent. Now with practically every irrigable acre receiving water, we find no canal operators undertaking the delivery of water without padlocks. This system is a protection to the district, as well as an insurance to the user that he will get his supply of water. After a user has had his gates locked for any length of time, he is satisfied with this method of delivering water, although we have been told that [illegible] water users in our valley threatened that they would come to be gates when the first locks were placed on their gates

A $60,000,000 Addition to Boston District Water Supply

Store Run-Off Above 1.2 Sec.-Ft. Per Square Mile from Ware, Swift and Millers Rivers in Single 410 Billion Gallon Reservoir—500 M.G.D. Tunnel to Wachusett Reservoir—Yield 202 M.G.D.

IMMEDIATE construction of a tunnel to divert the flood flow of the Ware River to the Wachusett reservoir and thus provide an additional water supply of 33 m.g.d. for the Boston Metropolitan District and the city of Worcester is recommended by the Joint Board created by the Massachusetts Legislature of 1919 to report on the water-supply needs and resources of Massachusetts. The tunnel, which would carry 500 m.g.d. when extended to the Swift River, and the construction on that stream of a 410 billion gallon reservoir to store the flood flows of the Ware, Swift and Millers Rivers would together give a safe yield of 202 m.g.d.

The cost of obtaining 202 m.g.d. from the flood flows of the three rivers is estimated at $60,000,000, of which $12,000,000 is for the initial supply by tunnel from the Wachusett reservoir westerly to Coldbrook on the Ware River, including the diverting dam at that point. The tunnel to the 410 billion gallon reservoir on the Swift River to be formed by a dam at Enfield, and the other works necessary to obtain the full 202 m.g.d. yield from the Ware, Swift and Millers Rivers, is estimated to cost $48,000,000. The tunnel would have a capacity of 500 m.g.d. through its entire length since it is planned to convey flood flows for storage, and since the portion



MAP AND PROFILE OF PROPOSED ADDITIONAL WATER SUPPLY FOR METROPOLITAN WATER DISTRICT AND WORCESTER, MASSACHUSETTS

Besides basing the project on flood flows exceeding 1.2 sec.-ft. or about 775,000 gal. per day per square mile, the report is notable, considering its Massachusetts origin, for its recommendation that certain of the older portions of the existing water supply of the Metropolitan District, usually held in reserve because poorer in quality than the Nashua River supply, should be filtered "when needed." A minority report by one member of the Joint Board, advising further study of the Ware possibilities, including storage, before any land is taken or work done, is noted more fully at the close of this article.

between the Ware and the Swift rivers is designed to carry water in either direction, so that when the Wachusett reservoir is full the flood flow of the Ware may be sent westward for storage in the immense reservoir on the Swift River. The total length of the tunnel would be 25.1 miles, of which some 12 miles lies between the Wachusett reservoir and the Ware River. For purposes of estimating, the diameter of the tunnel is placed at 12¾ ft. It would be in deep rock. All the cost estimates are based on pre-war prices, plus 30 per cent, which is reasonable inasmuch as most of the construction would not be undertaken for some years.

In addition to the needs of the Metropolitan Water District, the report also considers (1) the water problems of several other sections of the State; (2) the possibilities of filtering Merrimack River water; (3) artesian wells; and (4) the wisdom of permitting some of the "Great Ponds" of the state to be used for boating, bathing and fishing instead of holding them so exclusively for water-supply as some of them are. The formation of three new water-supply districts is advised. Filtration of the Merrimack is not recommended because the stream (1) is so badly polluted and (2) is so much needed for power, while (3) a joint supply for several of the Merrimack Valley cities promises to be far better. Artesian and other wells are briefly dismissed as of no promise, except for small local supplies. The need of a freer use of the Great Ponds for recreation is recognized and such use is approved, but subject to purification of water drawn from them for domestic use, and with a recognition that public sentiment is against bathing in waters devoted to public supply, even though the waters be purified subsequently.

Antecedents and Personnel

The Joint Board, it may be noted in passing, is composed of the State Department of Health and the Metropolitan District Commission, the latter, through successive consolidations, now exercising the functions of the earlier (1) water, (2) sewerage and (3) park commissions. The Metropolitan Water and Sewerage Board constructed the existing works of the Metropolitan Water District in accordance with the 1895 report of the Massachusetts State Board of Health. The Joint Board was organized with Dr. Henry P. Walcott (then chairman of the Massachusetts Water & Sewerage Board) as chairman, X. H. Goodnough, chief engineer State Department of Health, secretary and engineer and F. P. Stearns as consulting engineer. Dr. Walcott soon resigned from the Water and Sewerage Board, but continued as adviser to the Joint Board. Dr. Eugene R. Kelley, state commissioner of health, has since been chairman of the Joint Board. Mr. Stearns died Dec. 1, 1919, and was succeeded as consulting engineer by J. Waldo Smith, chief engineer of the Board of Water Supply, New York City. Mr. Goodnough has been chief engineer of the investigations, with Bertram Brewer as principal assistant engineer. Professors W. O. Crosby and Charles P. Berkey have given advice on matters of geology; Harry W. Clark on filtration; Charles T. Main on water power; and Ralph A. Stewart on special legal phases of the problem.

The Metropolitan Water District now embraces 18 municipalities within ten miles of the State House that take their supply from common sources, and the city of Newton, which as yet depends chiefly on its own independent supply. There are 16 additional cities and towns within the ten-mile circle that now use local supplies but are entitled to join the district, and there are a considerable number of the towns that may yet wish to come in. The needs of the city of Worcester are also taken into account, for reasons given later.

The Joint Board's own summary of its recommendations follow:

1. Definite arrangements should at once be made for securing an additional supply of water from the Ware River for the joint use of the Metropolitan Water District and the City of Worcester.

2. A tunnel about 13 ft. in diameter and about 12 miles long should be constructed from the Wachusett reservoir westward to Coldbrook on the Ware River at an estimated cost of about $12,000,000.

3. This tunnel should be used to divert the flood flows of the Ware River to the Wachusett reservoir, securing an additional supply of water of about 33 m.g.d., in such a way as to interfere as little as possible with the mills on the lower Ware River.

4. Provision should be made for pumping water from this tunnel into a stream which flows to Pine Hill reservoir, now being constructed by the City of Worcester, or from the Wachusett reservoir into the Worcester distributing system, as may hereafter be determined.

5. The Swift River project, involving the construction of a great reservoir near Enfield and connecting it with the Wachusett reservoir by means of an extension of the tunnel to the Ware River, should be approved as the logical extension of the water supply system.

6. The construction work on the approved project should be progressively developed as required in order to insure at all times an adequate supply of water to the Metropolitan District and to Worcester.

7. Plans should be drawn for filtering the waters of the South Sudbury and Cochituate systems, now held as reserve supplies, keeping in mind the ultimate filtration of all of the Metropolitan water supply.

8. The South Sudbury and Cochituate filters should be constructed when needed.

9. Efforts to prevent leakage and waste of water should be continued in order to conserve the present supply to the greatest possible extent.

10. For the same reason the local supplies of the communities within the ten-mile radius and adjacent thereto should be developed to their economical limit, using filtration if necessary, but keeping in mind the possibility of their ultimate abandonment.

11. The construction of the proposed works should be entrusted to the Metropolitan District Commission or to a special commission, as the Legislature may determine.

12. A Southeastern Water District should be created to enable the cities of Fall River, New Bedford and Taunton, and such other cities and towns as may desire to do so, to develop the Assawompsett and adjacent ponds as a common source of water supply.

13. Consideration should be given to the advisability of organizing a similar water district in Essex County for the purpose of developing the Ipswich River by the construction of one or more large storage reservoirs for the joint use of the cities and towns in that part of the state.

14. Consideration should be given to the advisability of organizing still another water supply district in Hampden County for the purpose of developing the Westfield River for water supply purposes.

Conservation of Water Power

Considerable portions of the reports of both the Joint Board and Mr. Goodnough are devoted to the conservation of existing water powers. It is noted that even where fuel is substituted for water power and full compensation made, streams may be left in a "sorry condition" from the sanitary and other viewpoints and much damage done. To interfere as little as may be with water power and the useful flow of the streams to be taken for an additional supply, Mr. Goodnough worked out the plan for utilizing flood flows, the main features of which are the immense storage reservoir and the large tunnel already mentioned. This plan, the Joint Board believes, has merits that will win the co-operation of riparian owners. It expresses the opinion that "the mill owners want water, not money"; and that the "communities in the central part of the state should not be called upon to sacrifice their summer rivers for the benefit of the Metropolitan District when it is possible to utilize the spring flood waters which would otherwise

go to waste." The discussion of these and related phases of the subject is thus summarized by the Joint Board:

The following general principles should be considered as representing the Massachusetts policy for protecting the purity of her surface water supplies: (1) Choice of unpolluted sources as far as practicable; (2) utilization of the natural agencies of purification to the greatest practicable extent; (3) prevention of pollution by land purchase and by the enforcement of sanitary rules and regulations; (4) filtration of water (a) when the population on the watershed is relatively large, (b) when it is desired to permit boating and fishing in the sources of supply, (c) when the water is unsatisfactory in its appearance, taste, or odor; (5) the choice of filtration and other purification methods to be governed by the nature of the supply, by cost considerations, and by the desire to produce a water hygienically safe, attractive in its appearance, tasteless and odorless, and without corrosive properties; (6) the combination of these various natural and artificial protective methods according to local conditions and economical considerations; (7) the storage of filtered water in covered basins as far as this is practicable.

Mr. Goodnough's report presents in detail the yearly water consumption in the cities and towns of the present and prospective Metropolitan District and in other cities as well, and the per capita water consumption in the District and also in a number of other cities chosen for comparison. Mr. Goodnough states that, in all the cities studied, after from two-thirds to three-fourths of all the services had been metered, there was no case where an increasing consumption was checked by setting more meters. The Joint Board assumes that after the waste in the Metropolitan District has been cut to the minimum the consumption will continue to increase about 1 gal. per capita per year, which has been the average rate of increase in Boston since 1850. It notes that in many other cities, completely metered, the increase is 2 gal., but adds that Boston uses less water for manufacturing than most of the cities considered. One of Mr. Goodnough's tables shows that with 75.6 per cent of the taps metered the per capita water consumption in the Metropolitan Water District, including Newton, was 105.4 gal. in 1920, which was the lowest for any northern city in the United States east of the Rocky Mountains with a population in excess of 400,000. Mr. Goodnough estimates that by 1970 the Metropolitan District and Newton will have a population of 2,590,000 compared with the 1920 census count of 1,252,903; that the per capita water consumption will be 146.3 gal. and the total daily consumption 379 million gallons.

The total safe yield of the present sources of water supply of the Metropolitan Water District is placed at 154 m.g.d.; Newton, 4; Worcester, 19.3; total, 177.3 m.g.d. Looking ahead no further than 1935, and assuming that up to that time only the present district, Newton, Worcester and certain other municipalities whose local supplies could still be used to the extent of a yield of 22.8 m.g.d., would need to be provided for, the conditions in 1920 and each succeeding five years would be (in m.g.d.):

	1920	1925	1930	1935
Safe yield	200 1	200 1	200 1	199 1
Total need	172 1	192 5	222 9	254 6
Excess	28 0	7 6		
Deficiency			22 8	55 5

The Ware River diversion, without storage, would give a safe yield of 33 m.g.d., and with the storage afforded by the Swift River reservoir, 47 m.g.d., from a drainage area of 100 sq. miles. The yield from 186 sq. miles of Swift River drainage area is placed at 87 m.g.d. Millers River could be diverted to the Swift River reservoir from an area of 220.5 sq. miles, giving 96 m.g.d. The total area of 506.5 sq. miles would yield altogether, it is estimated, 230 m.g.d. or, allowing for various losses, 202 m.g.d. net. All these yields are based on using only high flows, generally occurring in the winter and spring, in excess of 1.2 sec.-ft. per sq. mile, and without interference with the normal flows of the three streams. It is recommended by Mr. Goodnough that the Swift River reservoir be put under construction soon enough to begin filling in by 1934.

At this point it may be explained that one reason for including Worcester in the proposed additional supply for the Metropolitan District is that the city already has rights from the Legislature and has already diverted a part of the watershed tributary to the Wachusett reservoir. The city has petitioned the Legislature for the right to a further supply from the Wachusett watershed and if this water is diverted to Worcester the Metropolitan supply would be still further diminished. It would be better for all concerned, the Joint Board believes, for Worcester to join with the Metropolitan District in an extension of the Metropolitan works to the Ware River, and then take water either from the tunnel to the Ware River or from the Wachusett Reservoir.

The cost of the entire project, as estimated by Mr. Goodnough, is summarized in the accompanying table.

The Swift River reservoir would be formed by an earth dam at Enfield 165 ft. high above the present surface of the river and 271 ft. above rock at lowest point, and a dike across Beaver Brook 133 ft. high above the natural water surface and 268 ft. above rock. Both the dam and the dike would have their tops 18 ft. above the flow line, and slopes "somewhat flatter" than 3 to 1 for the upstream and 2.5 to 1 for the downstream faces. The dam and dike would have impervious cores to bedrock. The reservoir would have a water surface of 39 sq. miles; maximum water depth, 150 ft.; average depth, 51 ft. The length of railways flooded would be 15.9 miles and of highways, 106 miles. The number of buildings flooded by the reservoir would be 1,040 of which 463 are occupied houses and 30 vacant houses and 61 camps and summer cottages. As to the preparation of the reservoir site, Mr. Goodnough states that it "should be cleared of bushes and trees and all organic matter destroyed so far as practicable," but soil stripping "would be impracticable on

SUMMARY OF COST ESTIMATES, ADDITIONAL WATER SUPPLY FOR METROPOLITAN WATER DISTRICT AND WORCESTER, MASS.

	Construction Cost and Overhead, Pre-war Basis		Probable Cost in 1924-1935, Pre-war + 30%
Main Dam at West Ware Station:			
Main embankment	$7,124,000		
Diversion tunnel and control works	1,201,900		
Spillway and flood channel	251,700		
		$8,577,600	$11,150,880
Beaver Brook Dike:			
Main embankment	6,529,000		
West dike	85,000		
		6,614,000	8,598,200
Main Storage Reservoir in Swift Valley:			
Clearing, grubbing and fencing			
Relocation and reconstruction of highways, 47 miles			
Relocation of R. R., 2¼ miles		5,064,300	6,583,590
Relocation of cemeteries			
Relocation of transmission lines			
Sanitation and forestry			
Eagleville Reservoir Diversion:			
Raising Eagleville dam	44,700		
New channel via Hacker Pond	108,400	153,100	199,030
Millers River Diversion:			
Diversion dam and intake	159,400		
Aqueduct to Eagleville Res.	1,173,500		
Gardner & Winchendon sewer	729,400		
		2,062,300	2,680,990
Aqueduct to Wachusett Reservoir:			
Tunnel and shafts	17,457,100		
Intakes to aqueduct	376,000		
Wachusett terminal	339,400		
		18,172,500	23,624,250
Total Construction		$40,643,800	$52,836,940
Real estate, rights of way, depreciation, business damage, diversion damages and water rights, mills and factories below the points of diversion			7,109,600
			$59,946,540

account of the excessive cost and is unnecessary in the existing circumstances."

In a minority report, James A. Bailey, chairman of the Metropolitan District Commission (which operates the present Metropolitan water system) agrees with the other members of the Joint Board as to the advisability of going to the Ware River but not as to its immediate urgency or as to its being certain that no storage should be provided on the Ware. He recommends that the Legislature make a moderate appropriation for further studies of the Ware, but that it authorize no taking of lands or construction of works at this session. He thinks that the Metropolitan Water District, together with any likely enlargement meanwhile, will not "need additional water before 1935." He bases this on the possibility of checking the increase in consumption, and on the slow growth of the district.

New Type of Trunnion Bascule Bridge: Wabash Ry.

Link System in Abt Design Connects Machinery Girder Traveling on Incline with Movable Counterweight Pivoted to Bridge Side of Tower

A NEW type of trunnion bascule bridge has been built for the Wabash Ry. Co. crossing of the River Rouge near Detroit, and was put into service Jan. 26. The bascule span, shown by the views in Fig. 1, is 162 ft. long. It is flanked by a 73½-ft. span at one end to carry the counterweight tower and a 53-ft. approach span at the other end, the total length of the bridge being 291 ft. The new design is considered to be more economical than other types.

A contra-rotating counterweight mounted on the bridge side of the tower and a link system connecting this counterweight with the bascule leaf form the special features in the design. From the drawing, Fig. 2, it will be seen that the link system is composed of four members: (1) a rocking link pivoted to the trunnion and having its head connected to the hip joint at the top chord; (2) the tension member or link attached to the head of the rocker and through it connected to the top chord of the truss; (3) the compression link supporting the counterweight, and (4) the counterweight arm pivoted to the tower.

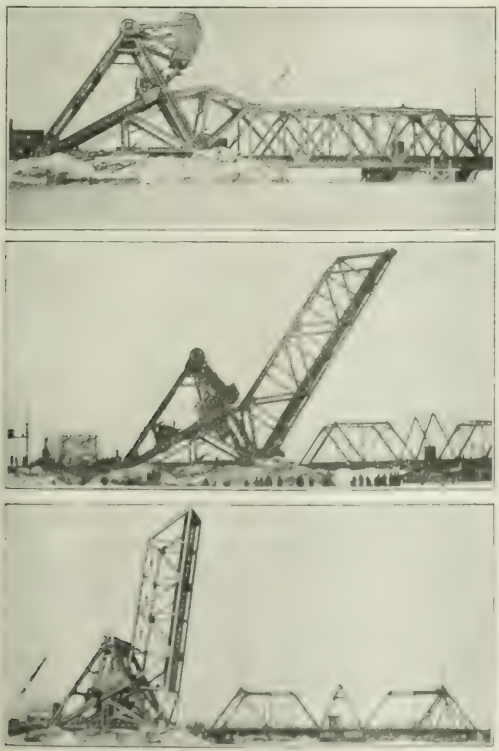


FIG. 1. WABASH RY. BASCULE BRIDGE OVER RIVER ROUGE, DETROIT

Top, bridge lowered; middle, bridge partly raised; bottom, bridge in full raised position.

The tension and compression links (2) and (3) are both pivoted to a heavy transverse girder which carries the machinery and which travels on inclined rails in the tower framing. Operating pinions on this girder engage with racks on the inclined path. As this girder is moved down the incline it raises the bridge. At the same time it allows the counterweight to swing downward and thus exert a thrust against the girder to counterbalance its pull on the leaf.

The counterweight is a steel basket filled with concrete. Since the bridge was erected in the open or vertical position the counterweight hung suspended from its bearings, which facilitated placing the concrete fill. The counterweight weighs about 1,000 tons. Adjustments of weight are effected by means of separate concrete blocks weighing 2,500 lb. each. The weight of the moving leaf approximates 400 tons. The main trunnions are 26 in. in diameter and 19 in. long.

Bascules of four different types and a vertical-lift span were considered in the preliminary designs for this bridge. The bascule designs were as follows: (1) A plan prepared by the engineering department of the Wabash Ry., having a counterweight attached rigidly to the leaf; (2) a Strauss bascule bridge; (3) a design originated by C. G. E. Larsson, of the American Bridge Co., New York, which required no counterweight and was to be operated by combined pneumatic and hydraulic machinery; (4) a bridge similar to the type patented by Elmore D. Cummings, St. Paul, Minn. It is understood that no bridges of the last two types have been built, and the Cummings patent (Dec. 31, 1901) has now expired.

This fourth design as submitted originally by the American Bridge Co. included features which were similar to those of the Cummings patent, although that patent was not known to the representatives of the company until later. Mr. Cunningham, chief engineer of the Wabash Ry., informed the company that a model of a similar design had been submitted to him when he built his first bascule bridge, but that he objected to it on account of the flexible connection (chain or cable) of the counterweight to the bridge. After a thorough study of this type of bridge the American Bridge Co. modified its design by using two links for connecting

the counterweight to the trusses, which design was submitted to Mr. Cunningham and approved by him. This new design, which has been patented, was prepared by Hugo Abt, of the company's designing department, under the direction of Albert Reichmann, division engineer.

Two 100-hp. electric motors are installed in the machinery house located on the traveling cross-girder. One of these is sufficient to operate the bridge; clutches are provided so that either motor can be used alone. For auxiliary power there is a 58-hp. gasoline engine. One motor can open or close the bridge in less than 1½ minutes, but with the gas engine the time is about 8 minutes. Each motor has a solenoid brake for full torque, that is, for holding the leaf in any position. One of these brakes has an attachment for converting it into a hand brake when the gasoline engine is to be used. On the motor shaft is an air brake designed for the full torque of the two motors.

Two emergency brakes, entirely independent of the operating machinery, grip I-beams laid along the inclined track girders of the tower. Each of these can develop a holding power of 88 tons. These grip brakes are operated by compressed air, the supply being independent of that to the air brake on the motor shaft. All brakes are arranged to set slowly and release quickly. A compressor with a capacity of 25 cu.ft. of free air per minute keeps the receiver pressure automatically at 100 lb.

The bridge is operated from the second floor of the operator's cabin on the approach, on which floor is also installed the interlocking machine for the railway signals. Electrical interlocking of the bridge mechanism with the track connections and signals is so arranged that the bridge cannot be operated until the signals have been set properly and that the several operations must be performed in regular sequence.

The bridge is designed for E 50 loading on each track. It is dimensioned according to the specifications of the American Railway Engineering Association, and its machinery according to that association's proposed specifications for movable railway bridges.

Fabrication was done at the Gary plant of the American Bridge Co. Erection was in charge of James L. DeVou, division erecting manager of the same company. Electrical, air and gasoline equipment was furnished and installed by the Norwood-Noonan Co., Chicago. Signal and interlocking plant was provided by the Union Switch & Signal Co. The substructure was built by the J. W. McMurry Contracting Co., of Kansas City, Mo. To avoid interference with traffic, the bridge was erected in the vertical or open position at one end of the old swing bridge, which continued in use until the new structure was practically completed. Then the old bridge was moved out laterally on rollers upon falsework. Traffic was interrupted for only 7½ hours during this change. All design and construction work was subject to the approval of A. O. Cunningham, chief engineer, Wabash Ry.

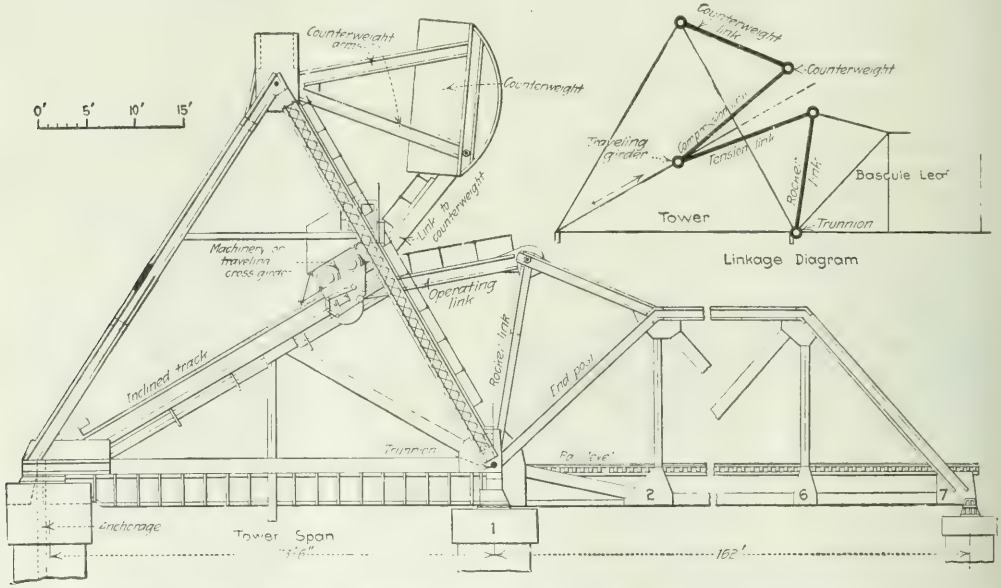


FIG. 2. OPERATING AND COUNTERWEIGHT SYSTEM OF ABT TYPE OF BASCULE BRIDGE

Thawing Shed for Coal Cars

To facilitate regular service of the car dumpers of the coal terminal at South Amboy, N. J., the Pennsylvania R.R. has built a large thawing shed, at a cost of about $100,000. The building is 448 ft. long, with two tracks, giving capacity for 20 cars. When the cars have been placed in the shed the doors are closed and air heated to 200 or 250 deg. F., is forced by blowers through concrete-floor ducts having openings 6 ft. apart between the track rails. Three hours is an average time for thawing, but the actual time varies from one to twelve hours, depending upon the weather and the condition of the coal. From the shed the cars are moved by gravity to the car-dumping machines.

Against Maintenance Guarantees for Roads and Pavements

They Prove Unfair to Contractors, Uneconomical to Owners, and Frequently Limit the Number of Bidders

By Edward W. Bush
Engineer, Fidelity and Surety Department, Aetna Casualty and Surety Company, Hartford, Conn.

MAINTENANCE guarantees in road and pavement contracts are generally so drastic in form and so unfair to the contractor that, instead of benefiting the owner, they actually force him to pay more than he should for the work. No one can tell what kind of traffic a road will be called upon to bear three or four years hence. A. Dryland, county engineer of Middlesex, England, states in an article in *Engineering News-Record*, Dec. 1, 1921, p. 892, that our troubles from heavy vehicles are just beginning, judging by the English experience. These are risks that the owners should assume, because their engineers specify how the road is to be built and supervise its construction. It seems manifestly unfair to ask contractors to guarantee to owners that their engineers know their business. The fair way would be to ask contractors to bid on supplying materials that will pass specifications and construct the work in the manner specified. When they have done this, the job should be considered completed and the contractor's liability terminated. To ask for anything more is unfair and uneconomic. The day is past when any state or city can get something in the paving line for nothing.

Good roads are expensive and because every locality wants good roads there is a constant tendency to stretch available funds out too thin and try to cover more area or mileage than is possible and still produce a road that will stand up well under traffic. This is a matter that engineers cannot always control and no doubt many of them try to do the best they can under the circumstances, but they can always tell the owners that the final results may be disappointments. Many localities seek to safeguard their large expenditures for roads by incorporating a stiff maintenance guarantee in their contracts and thus pass the buck along to the contractors.

No Uniformity in Guarantees

The author has reviewed a large number of road and pavements contracts from every part of the United States that have included maintenance guarantees of all sorts. No general uniformity of specifying the guarantee exists, and one is never sure as to what the guarantee covers until the contract, specifications and bond have been closely read and a guess made as to what the engineer really intends or how he will interpret the language set forth in the documents. Some contracts may, in one clause, clearly limit the guarantee to defects of workmanship and materials while under another clause of the same contract the guarantee is restated in so broad a manner that the contractor is liable for about anything that can happen to the pavement irrespective of whether or not his materials or workmanship contributed in any way to the defect or repairs.

The author was rash enough at one time to believe he could classify the different kinds of maintenance guarantees on roads and pavements, but soon gave it up as an impossible task and was only able to make three broad divisions as follows:

A. Guarantee against defects in workmanship and materials.

B. Guarantee against defects in workmanship and materials and defects arising from the use of the surface as a roadway.

C. Guarantee to make all repairs and maintain the pavement in perfect condition, irrespective of the causes that produce the defects, or, by specifically excluding certain causes, leave the guarantee active on defects arising from all other causes.

If the contractor has carefully performed the work, has been particular in obtaining the inspector's approval of all materials and workmanship and has kept a good record of these things, it will probably be difficult for the owners to recover under guarantee A, unless the contractor prefers to make the repairs rather than dispute the claim. In the absence of fraud on the part of the contractor, it is difficult to conceive of any just claim being made during the guarantee period if the work was carefully supervised by the engineer during the construction period. In fact, the engineer certifies in the final estimate that the work has been performed and completed in accordance with the terms of the contract. As long as politicians are placed in authority over the expenditure of public funds we will see newly appointed commissions trying to discredit the acts of their predecessors and extravagant claims may be made under paving guarantees.

Effects of Guarantees

Many reputable and experienced paving contractors do not object to taking contracts that include a simple maintenance guarantee (such as Class A), against defective workmanship and materials, because, having faith in their ability to fulfill the contract and specifications, they do not believe they will be called upon for any great amount of repairs. The maintenance guarantee is a liability, however, and the conservative contractor will set up a reserve against it and will charge accordingly in preparing his bid.

If engineers and commissioners feel that they must have a maintenance guarantee, it should be limited to defects arising from poor workmanship and materials, anything beyond this is unfair to the contractor.

The Class B guarantee is the same as Class A plus a guarantee that the road will not wear out under traffic. In other words, it is a guarantee to the owners that the engineers and inspectors employed by them know their business and the road designed by and constructed under them will remain in perfect condition during the guarantee period. If the engineers have used poor judgment or stretched the money too far, the contractor is obligated to repair any places that wear out under traffic, even to the extent of replacing the entire job.

The Class B guarantee is illogical unless the owners employ no engineers or inspectors to design and supervise, but leave the design as well as the entire construction wholly to the contractor and merely hold the latter responsible for building a road of a certain general type that will stand up under an unknown traffic during the term of the guarantee. There are innumerable road contractors who are entirely competent to undertake contracts on this basis, but in recent years the author has never happened to run across a road or pavement built with public funds that had such a form of contract.

All other kinds of maintenance guarantee, not included in Classes A and B, have been placed in a Class C, where there seems to be no uniformity in the terms but a general desire to have the contractor supply a maintenance service in addition to building a perfect road or pavement. Often it is difficult to reconcile the different clauses of the same contract and some contracts have been reviewed where it is believed the engineer wrote some of the clauses limiting the guarantee to certain things, and afterwards a lawyer added his clause drawn in such a way as to make the contractor liable to repair all defects, irrespective of the cause. Other contracts appear to have been assembled by taking a clause here and there from different sources and perhaps applying a guarantee taken from a sheet asphalt job to a one-course concrete pavement.

Unjust Requirements

Clauses have been seen that would make the contractor keep the pavement free of snow, ice or mud, provided the engineer ordered such maintenance under the clause. Some contracts exempt ordinary wear or use of the pavement, and others specifically state that just before the guarantee period expires a careful examination will be made and, if the pavement is not in perfect condition, the contractor will proceed to put it in perfect condition, no exemptions being included. A few contracts for concrete roads have been found recognizing that such roads may crack and providing for the cracks being filled with bituminous material, but very many other contracts have been written that ignore cracks and it is possible for maintenance claims to be made because of the cracks.

Trenches are constantly being opened in streets before and after pavements are laid and in many soils it is almost impossible to tamp the refilling so no depression will occur. Sometimes sewers break and great holes are washed out beneath the pavement. When a water main breaks the hydraulic pressure may force a large area of the pavement upwards. These and many other causes will produce an uneven surface, and it does not seem fair to ask the contractor to carry these risks. Still, contracts have been read that make the contractors carry the liability. Recently the author read a paving contract that specifically made the contractor responsible for five years for any depressions caused by any trenching done prior to the laying of the paving foundation. Also, it defined a depression as being any place that would hold water or was apparent by laying a straight edge along the surface.

Past experience has shown that the business of building roads and pavements is a precarious one. Uncertainties about the weather, the cost of transportation, ability to obtain labor, the cost of labor, and whether or not local materials can be used, enter into many contracts, with the result that the bonding companies have been called upon to pay large losses on road contracts. No one knows what contractors will be in business five years hence, and, because of this, sureties are disinclined to write maintenance bonds except for contractors who are well established and have a financial strength sufficiently great to permit them to overcome reasonable reverses in the business and still be a going concern during the maintenance period. Surety bonds are not written on an insurance basis; they are a form of credit. Whenever a maintenance guarantee is required it automatically limits the bidding to those who are able to obtain the maintenance bond, and many otherwise desirable contractors refrain from bidding.

A close study of this question of maintenance has convinced the author that all maintenance guarantees are decidedly unfair to the contractors and uneconomic to the owners. They should no longer be called for in road and paving contracts.

Reducing Bend as Venturi Meter in Hydro-Electric Plant

Penstock and Scroll Inlet Tapped Circumferentially —Connecting Encircling Pipe Leads to Recording Instrument

By E. A. Dow
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A FEATURE, which, in the case of the average hydro-electric plant, receives far less consideration than its importance justifies, is an adequate provision for water measurement. An accurate and continuous record of stream flow as a guide to efficient operation is of the utmost importance, and the value of an easy and simple method of checking turbine discharge, always available, which will enable the operating superintendent to determine turbine efficiencies at frequent intervals and thus know immediately when his wheels need attention, cannot be overestimated. Nevertheless, probably well over 90 per cent of the power plants in operation today are absolutely without any effective means of metering water, due partly to a failure to

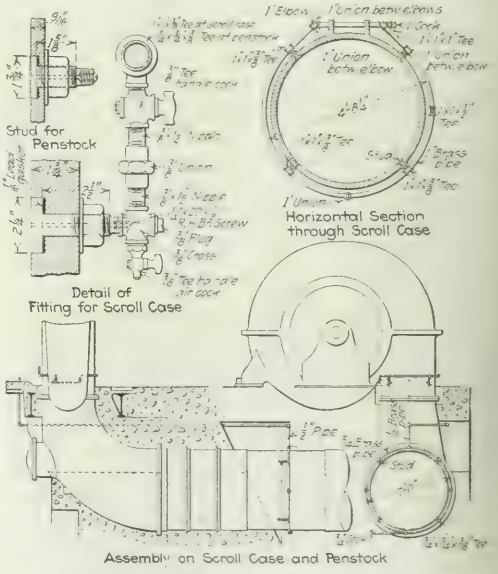


FIG. 1. VENTURI METER PIPE FITTINGS ON PENSTOCK AND SCROLL CASE

appreciate the importance of the subject and partly to the fact that no meter really suited to power-plant requirements has ever been available. A modified venturi meter, having a throat larger, comparatively, than the standard, in order to eliminate the excessive head loss inherent in the older type, would be satis-

factory and should be considered for any new development having a pipe line or penstock, but such a meter is expensive and frequently impossible to install in a plant already in operation. For such a plant the problem is to find a satisfactory substitute. That this is sometimes possible at small cost and without the introduction of additional head losses, is evident from the results obtained recently at Plant 5 of the New England Power Company.

This plant is located on the Deerfield River, three miles above Hoosac Tunnel, Mass., and is equipped with three Allis-Chalmers 8,000-hp. turbines operating under a head of 240 ft. These turbines are of the horizontal type, having cast-iron scroll cases with inlet flanges horizontal. The water is brought to them through three steel penstocks about 590 ft. long, 7 ft. in diameter for the greater part of their length, but tapering to 6½ ft. at the lower ends. The connection between the vertical flange faces of the lower ends of the penstocks with the horizontal flange faces of the scroll case inlets is by means of cast-iron reducing elbows. Within these elbows the water passage is reduced from a diameter of 6½ to 4 feet.

A recent study of water metering possibilities at this plant led to the determination to attempt to make use of the pressure difference due to change in velocity in these elbows as a means of measuring discharge. Unit 3 was selected for the first trial. It was realized, of course, that standard venturi coefficients could not be expected to apply to a section of such shape, consequently calibration by pitometers was decided upon.

In order to obtain pressure differences which would not vary from time to time, some form of venturi connections which would not be affected by the formation of tubercles, etc., inside the penstock and turbine casing were required. For this purpose (see Fig. 1) brass studs were used, the faces being 1¾ in. in diameter for the large penstock section, where the velocity was low and 2¼ in. in diameter in the scroll inlet, where higher velocities prevailed. It was felt that these brass faces were of sufficient area to prevent the indications from being affected by any probable changes in the steel or iron surfaces surrounding them. Four studs, equally spaced around the circumfer-

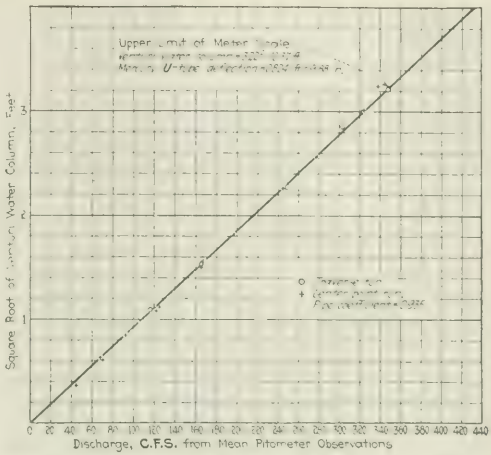


FIG. 2. VENTURI RATING CURVES FOR PENSTOCK AND SCROLL CASE INSTALLATION TEST OF OCT. 23-24, 1920



FIG. 3. FRONT VIEW OF RECORDING INSTRUMENT

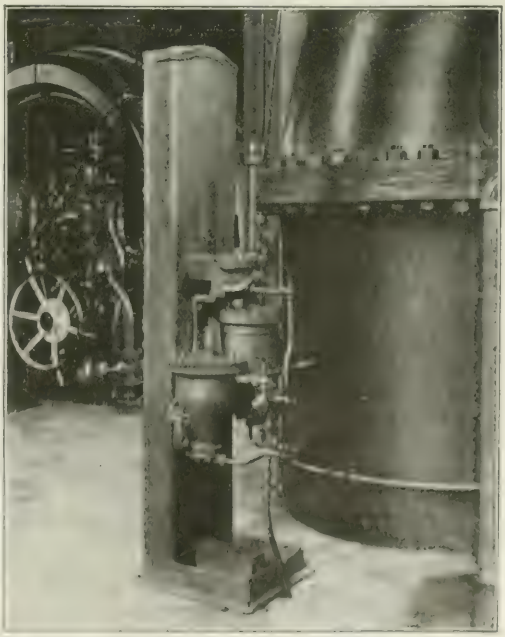


FIG. 4. REAR VIEW OF RECORDING INSTRUMENT

ence, were used at each section. They were connected outside by complete circular pipes of generous size in place of the pressure chambers provided in the standard venturi construction.

For the calibration work, hose connections were made from the two pipe rings to the ends of an ordinary U-tube, and the pressure differences were obtained by the deflection of mercury or bromoform, the former being used for discharges giving a large pressure difference, the latter at the lower discharges. The maximum mercury deflection obtained, corresponding to full gate discharge of the turbine, was 0.82 ft.

The process of calibrating the meter consisted in setting the turbine gate at some fixed opening and running pitometer traverses on two diameters at a section of the 7-ft. diameter penstock, simultaneously noting the deflection of the liquid in the U-tube. Five complete traverses were run and in addition a number of "center point" runs were made for check purposes. These "center point" runs consisted of comparatively short-time observations of velocity at the center point of the pipe, the discharge being determined by applying a ratio known as the "pipe coefficient" obtained from the traverses. The results of the calibration work are shown by Fig. 2, in which the discharge in cubic feet per second is plotted against the square root of the venturi pressure different, expressed in feet of water. It should be noted that the points plot up in a straight line, indicating that the discharge varies exactly as the square root of the venturi pressure difference, or in other words, the venturi coefficient, C, in the formula $Q = CA\sqrt{\frac{2gd}{1-\frac{a^2}{A}}}$ is a constant for all discharges, which, considering the shape of the converging section, is rather surprising. In this formula

A = area at venturi inlet;
a = area at venturi outlet;
d = venturi pressure drop, in feet of water;
g = acceleration due to gravity;
Q = discharge in cubic feet per second.

It is also surprising to note that in spite of the 90-deg. change in the direction of flow, the venturi coefficient is 0.985, practically identical with that of a standard venturi tube. The explanation of the slight loss in this bend is probably to be found in the fact that the velocity is being accelerated so that the formation of eddies is prevented. This is consistent with the well known tendency of a tapered nozzle to eliminate eddies and produce straight line flow.

In order to obtain a continuous record of discharge, as well as a permanent means of quickly checking turbine efficiency, a special indicator-register-recorder instrument, shown in Figs. 3 and 4, has just been installed. This instrument was manufactured by the Builders Iron Foundry, and is of the same general design as their standard instrument for use with the venturi meter. It is, however, provided with an extra large float to insure accurate and positive operation at low flows and is apparently very well suited to the requirements at this plant. The indicating and recording features of the instrument are graduated to show discharge in second-feet, while the register or counter keeps a continuous record to total flow through the meter in second-foot-hours. This latter unit was adopted as being convenient to use and easily understood by the operators on account of its similarity to the kilowatt-hour. It is of course the volume which passes in one hour when the flow is at the rate of one second-foot or 3,600 cu.ft.

Since the layouts of the three units in this plant are identical, it was not considered necessary to calibrate units 1 and 2. The controlling areas—penstock and inlet—of these were carefully measured and discharge curves were obtained by the use of the venturi coefficient obtained for unit 3. Meter pipe connections for these units were made identical with those of unit 3 but indicator-register-recorder instruments have not as yet been installed, mercury manometers, giving instantaneous readings only, being at present employed. These will later probably be replaced with the larger type. Fig. 5 shows the manometer for the No. 1 unit.

This meter outfit has been described at considerable length because it seems to be an exceptionally good example of what can be accomplished in the way of water measurement at very small initial cost and without the introduction of additional head losses, simply by the measurement of pressure variations already present. Moreover, it represents a condition which exists in many plants. While the average case may not be so simple or obvious as this, nevertheless a large percentage of plants of the higher head types will be found to offer possibilities of water metering by measurement of pressure changes or head losses which would be practically constant from year to year and would be of great value if properly utilized. Pressure differences as large as those obtained at these plants are by no means necessary, as instruments are obtainable which operate reliably with smaller differentials.

The meter installations at the Plant 5 were designed by the engineering department of the New England Power Co. and the calibration work was performed by engineers of this company under the direction of Prof. C. M. Allen of Worcester Polytechnic Institute.

Consulting Engineers Rule on Client's Right to Engineering Data

The Council of the American Institute of Consulting Engineers has announced its answer to the following question: "To what data and information is the client entitled from the retained engineer?"

The council considers that no fixed rule will apply to all cases, and that terms of engagement and basis and amount of compensation must often be taken into account. In general, however, the client "is entitled to all data and information obtained or developed during the progress of the engineer's work that may affect, directly, indirectly or incidentally his interest *in the particular project or purpose* regarding which the engineer is retained, and may properly call for such further data, details or explanations as he may think essential to enable him to deal with the contemplated project intelligently."

"Original notes, studies, documents, plans, computations, etc., relating to the engagement are the property of the engineer," says the council, "but the client is entitled to such duplicates or abstracts as may be essential or useful to him in carrying out the specific project to which they relate." When, however, the engineer is retained for personal service or advice alone, plans, documents, etc., prepared or secured by the client at his own expense, although advised or suggested by the engineer, belong to the client.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Building Code Simplification

Sir—I wish to commend your editorial on the Knickerbocker Theater disaster. Whether other contributing causes are found or not in the official investigation the points you outline are vital. One point especially, it appears to me, needs emphasis at this time. It is covered in the statement, "Fostered by excess of detail in code requirements this dependence on formal rule needs to be combated by simplification of code rather than increase of detail and complexity."

Something like two years ago in attending a gathering to complete a state code the writer objected to the tendency toward great detail of specification. It is impossible and undesirable for many reasons, to attempt to cover all possible elements in a code. This should be self-evident. Among other things we restrict flexibility and ingenuity in design and discourage new developments in materials. It takes the time of state or city administrators of the code to instruct the incompetent, and leads to inefficiency and a lowering of standards all along the line. On the other hand the inducement should be towards improvement in plans and workmanship, and this can come only by the owner employing competent engineers or architects.

Our city departments now spend much time and money in checking and supervising to protect the public, including the owner himself, against the owner's indiscretion and mistaken policy of economy.

Compel the owner to employ competent men and the entire sky clears from many disturbing clouds at once.

Altoona, Pa., Feb. 16. W. A. HOYT.

"Wild" Publicity on Licensing

Sir—There are just three things that it is only fair to call to the attention of the readers of your interesting magazine about the editorials on page 264 of the issue of Feb. 16:

1. The American Association of Engineers approves licensing for engineers and has always done so. This is by action in conventions. Your editorial implies that advocating of licensing is not the "mature judgment of the association."

2. Licensing was the issue at stake in the bulletin, not the Knickerbocker Theater. It is assumed the disaster was a responsibility of the profession. The cure consistently advocated by the American Association of Engineers has been licensing. The doctrine of "I told you so" is always justified and even desirable in the case of loss of life.

3. Your editorial assumes that I was uninformed about the disaster. National news services were available to me which were probably unavailable to *Engineering News-Record*. The building failed, did it not? The facts as stated were correct. Where were they wrong? (See *Engineering News-Record*, Feb. 9, p. 221, "it was flimsy and lacked bond"; also Feb. 16, p. 294.)

Chicago Feb. 18, 1922. C. R. THOMAS,
In Charge, Public Information Service
American Association of Engineers

[The above letter refers to an editorial under the caption "Publicity Run Wild" denouncing a circular in which the Public Information Service of the American Association of Engineers exploited the Knickerbocker Theater calamity as an argument for licensing.

The Knickerbocker collapse was so grave that even a rudimentary sense of fitness should have forbidden utilizing it for advertising or propaganda, at least until all the facts were known. Yet Mr. Thomas now blandly offers the plea in extenuation that licensing was the issue at stake—for which stake, presumably, anything goes!

Its author reasons rather wilfully. The publicity circular not only was headed "COMMENT: KNICKERBOCKER THEATRE COLLAPSE. LICENSING ENGINEERS AND ARCHITECTS PROTECTS PUBLIC FROM BUILDING DISASTERS," but in its text it asserted that the causes of the collapse would not have existed had licensed engineers or architects supervised the construction. But Mr. Thomas now claims that the Knickerbocker Theater was not the issue. This singular statement may be chargeable to oversight or to disregard of the reader's point of view.

He is also somewhat disingenuous. The claims as to the cause of the Knickerbocker failure were directly followed by the explanation that license laws prevent "the activities of dabblers and quacks." Looking aside from the fact that even as a general statement this assertion is wild and unfounded, let us ask whether it was really meant to be quite dissociated in the reader's mind from the Knickerbocker case. We believe the reader will not fail to preceive its innuendo character.

Mr. Thomas' reference to "the doctrine of I told you so" can be interpreted in only one way: as an allusion to predictions that buildings erected by unlicensed engineers are liable to failure, and that correspondingly the whole of the past work of engineers is under suspicion. This of course is pure effrontery, and that of a particularly vicious sort. It is of a piece, however, with the tenor of the circular, which represented an attempt to play on the panic susceptibilities of the public in order to stampede it into swallowing the proposed cure.

We fear we must add that our correspondent does not deal very gently with the truth, in his letter. We wrote, "the public will take the press bulletin as representative of the matured judgment of the association." This he distorts into the alleged charge that "advocating of licensing is not the mature judgment of the association," a version hardly explainable on the ground of error in reading.

Strenuous, serious-minded effort backed by the full strength of public and professional support was necessary immediately after the Knickerbocker collapse, to shed light on the obscure facts of the accident. The Washington chapter of the association took up a share of the work right manfully. How mischievous a frivolous publicity blurb may prove under such circumstances is well appreciated by the men who were on the ground. To the credit of the association be it said that the efforts of its Washington chapter were not the least contribution to the result now being reached in clearing up the case; but no thanks to the publicity blurb for this!

This is not the place to discuss licensing. But we believe that many of our readers will join *Engineering News-Record* in the hope that licensing may be saved from some of its friends and publicity managers.—EDITOR.]

Questions Value of Licensing Laws

Sir—I have read with interest a letter addressed to you by L. G. Smith of Montgomery, Ala., entitled "Against Engineer Licensing Laws." [*Engineering News-Record*, Feb. 16, 1922, page 292.]

I am in hearty accord with Mr. Smith's position. I have never been able to understand why the engineers of this country have not protested against the enactment of licensing laws throughout the states. It cannot be shown that the licensing laws for doctors, operating engineers and firemen, barbers, plumbers and other "professions" have resulted in any public good. The present licensing laws for engineers that have been enacted in various states are absolutely of no use so far as the public is concerned and they cause the engineers throughout the country a great deal of trouble because of the necessity of obtaining licenses in different states where an engineer wishes to practice. The mere examination and granting of a license to an engineer by a board in any state shows

not and cannot insure that that engineer or architect will design and supervise the construction of buildings always in a safe and reasonable manner. I know many men who are better qualified to supervise the construction of buildings because of their long experience in construction than many engineers who have obtained licenses in the various states.

I have never yet found an engineer of experience who was in favor of the licensing law. S. M. GREEN.

Springfield, Mass., Feb. 22.

Molded vs. Core Specimens of Concrete

Sir—I note in *Engineering News-Record*, Jan. 26, p. 165, a letter from Fred Kellam, testing engineer of the Indiana State Highway Department on my article in the issue of Jan. 12, p. 73.

Such a simple solution as given by Mr. Kellam would be rather encouraging in studying our concrete variables by means of utilization of a very broad formula, but unfortunately I find many errors in Mr. Kellam's method. For instance, reference is made to a publication by Professor Abrams in Proceedings of the American Society for Testing Materials, 1918, Part II. Two formulas are quoted which I would say, from consulting this publication, are derived from Figs. 13 and 16. Fig. 13 contains curves drawn from tests performed at the University of Illinois, representing 1:2:4 concrete of a normal consistency stored under moist conditions. Fig. 16 is plotted from Prof. Morsch's test, and represents 1:2½:5 concrete. No special reference is made in this case to storage, but I presume it is under normal laboratory moist storage conditions.

It seems to me as though an undue license has been taken in comparing the data which I published, which is a 1:2:3 concrete with a 1:2:4 and 1:2½:5, and finally determining that the 1:2:3 should be a mean value.

Attention is called to Mr. Kellam's Table A which was compiled from Table I of my article. In Table A a mean compressive strength is developed with the age as constant, no recognition is apparently taken of the fact that my table represented a series of tests from fourteen different projects, noted in the table as "Series Number." I took great pains to quote maximum and minimum values in the table so that a reader would not be misled regarding the mean value. The mean compressive strength as given in Table A by Mr. Kellam is really a mean derived from a mean with no recognition taken of any variables but age.

For further enlightenment on this subject I wish to submit the following tabulation which contains the strength data with the ages of individual specimens which are taken from Table II of my article. There might have been some justification if Mr. Kellam used this Table II as a basis for his Table A, in that at least these are all from one project; but even under such conditions, inspection of the last column labeled "per cent increases compression over 28-day specimens," should be indicative to any engineer, regardless of his test experience, that averages in such cases are artifical values. It will be noted that the strength increases from 4.5 per cent to 110.3 per cent regardless of age. Average results from such data is not only unreliable, but misleading.

TABLE X. COMPARATIVE STRENGTH MOLDED AND DRILLED CONCRETE SPECIMENS

Molded Age	Molded Compression Lb. per Sq.In.	Drilled Age	Drilled Compression Lb. per Sq.In.	Difference in Age Between Molded and Drilled Cores Days	Per Cent Increase Compression Over 28 Day Specimens
28	3,526	360	4,757	332	34.9
28	4,054	330	5,353	302	32.0
28	3,331	330	5,141	302	54.4
28	3,061	240	5,070	212	65.6
28	3,304	240	6,070	212	83.7
28	2,783	240	3,980	212	42.6
28	2,211	210	4,650	182	110.3
28	2,821	240	3,931	212	39.3
28	2,489	270	4,640	242	86.4
28	3,152	270	4,025	242	27.7
28	3,146	300	4,405	272	40.0
28	2,528	300	5,024	272	98.7
28	3,834	330	4,008	302	4.5

In submitting my article on the relation between molded and core concrete specimens, I wished to bring out several points, one was that molded specimens are not a positive indicator of the strength of concrete in place, as determined by the drilled specimens. An inspection of Table II readily indicates this. Further I stated that the general tendency of concrete drilled from the structure is to show a higher test in compression than the preliminary molded specimen would indicate. This can also be readily seen by inspection of both Tables I and II, especially noticeable in Table II that all the drilled specimens are about 4,000 lb. and over. This strength is not indicated in the molded specimens, in fact there seems to be a tendency for low molded specimens to show a high gain which would be readily seen in the accompanying table.

Also I wish to forcibly present the fact that we are not at the stage of concrete design where we can pre-determine the strength in the finished structure from a molded specimen.

Oftentimes individual tests or a series of tests represent the quality of the concrete laid on a project. This may vary in different locations of the same project, and under such conditions an average of the results of such tests give a false value. Now if we were to consider averages on tests taken from different projects where the variables are increased, the error would be multiplied to a considerable extent. H. S. MATTIMORE,

Harrisburg, Pa. Engineer of Tests,
Jan. 31. Pennsylvania State Highway Dept.

Fall Extension of Irrigation Season on Valier Project, Montana

Sir—Irrigation engineers in the irrigated districts of the Northwestern United States and in Canada, where the irrigation season is short, may be interested in a change in the irrigation season by the Montana Carey Land Board on Feb. 10, on petition of settlers representing 80 per cent of the 76,000 acres thus far sold in the Valier Project. The season will continue to open on May 1 but its closing time will be changed from Sept. 15 to Oct. 15, thus insuring a large fall acreage irrigated and a greater utilization of the water supply without additional construction outlay. From Aug. 15 to Sept. 15, the water will be shut off, thus affording an opportunity to do a large part of the maintenance work. GEORGE EBNER,

Valier, Mont., Operating Engineer,
Feb. 11. Valier-Montana Land & Water Co.

Aerial Photography in Map-Making

Sir—I am obliged to you for calling my attention to an article in the Feb. 2 issue of *Engineering News-Record*, p. 194, on "Uses of Aerial Photography in Map Making." I had seen the article before but had not been able to read it carefully and had not noticed the statement concerning work of this kind alleged to have been done by the Reclamation Service of the Canadian Government.

If the Canadian Reclamation Service had, as reported, photographed approximately 1,000,000 acres of land in connection with a proposed drainage project, I have no doubt that many of your readers would be interested in learning more about our methods and the results obtained. As a matter of fact, however, the report—like the famous one concerning Mark Twain's death—was "greatly exaggerated." The facts are as follows:

We are conducting surveys to determine the feasibility of draining a very large tract of overflowed land lying between the Saskatchewan and Carrot rivers in the provinces of Manitoba and Saskatchewan. The tract contains, roughly, some 900,000 acres. The interior of this tract is practically inaccessible except in winter, when the swamps and sloughs are frozen. During the summer season the water in many places is not deep enough to permit of the use of boats or canoes, while the water and deep mud make walking practically impossible. The difficulty of surveying lands of this class will be readily appreciated.

The engineer in charge of this work, G. F. Horsey, was at the Pas, Manitoba, when a seaplane, operated by officers

of the Canadian Air Force arrived, and he was fortunately able to arrange—purely as a matter of courtesy—for an observation trip over a part of the district which he was engaged in surveying. The actual trip lasted only two hours and covered approximately 120 miles. I quote the following from Mr. Horsey's letter to me under date Oct. 6, 1921:

"I cannot speak too highly of the benefit derived from a flight of this kind in connection with survey work on a project of the magnitude of the proposed Carrot River Triangle drainage project, involving as it does, an area of from 800,000 to 900,000 acres, a large part of which is practically inaccessible in the summer season on account of the flooded condition of the interior. Much of this district is unsurveyed and very little information regarding the topographical features is obtainable without running a traverse survey. From the air various drainage channels in the interior can be seen quite distinctly, and information of this kind would prove of great value in determining to a large extent where it would be necessary to run our interior traverse lines and where lines would not be necessary, thereby saving time and money. Information regarding the timber in the interior could also be obtained.

"I do not wish to convey the idea that numerous flights of this kind would obviate the necessity of making a detailed survey of a large drainage project, as distance, area, and rise and fall in land could only be obtained by running traverse lines and levels over the district; but I do think, in possibly half a dozen flights, the whole Carrot River triangle could be covered, and this would be of great assistance in enabling the engineers engaged on the work to get a general idea of the interior in a short space of time and would prove of value in planning the general layout of the work.

"From my personal experience I feel confident that I obtained more general information of the area covered in the two hours' flight that I made in the air than I could have learned in a month's trip on foot in the late fall or winter, during which seasons only, is it possible to travel in this section."

I do not know that the information I have been able to give you will be of general interest to any considerable number of your readers, but I am desirous of clearing up any misapprehension that may exist in the minds of your readers due to the inaccurate statement contained in the article of Feb. 2.

E. F. DRAKE,
Director, Reclamation Service,
Department of the Interior.

Ottawa, Canada,
Feb. 24.

Concrete Flumes on the King Hill Project

Sir—I am very much interested in the article which appeared in *Engineering News-Record*, Dec. 8, 1921, p. 196, written by Walter Ward of the King Hill Project. At the outset of that paper Mr. Ward discusses semi-circular wood-stave flume and galvanized flume as compared with concrete flume. Based on the estimates of cost as prepared by him in 1917, he concludes that the concrete flume would be the cheapest type of construction. Information on the following points would be enlightening: [Questions are noted in Mr. Ward's letter followed by his answers.—Editor.]

In view of the article [on "Nashville Concrete Bridges Show Serious Deterioration."—Ed.] appearing in the same issue on page 934, and the past experience that the Reclamation Service has had with concrete flume structures, I am somewhat surprised at Mr. Ward's assumptions as to the length of life and cost, full consideration being given to the cost of maintenance during the useful life as assumed.

E. J. BARTELLS,
Consulting Engineer.

Seattle, Wash., Dec. 29, 1921.

Sir—Referring to the letter from Mr. Bartells, asking certain questions relative to the article on flumes in *Engineering News-Record*, I am submitting below answers to the questions:

Q. What type of semi-circular wood-stave flume was contemplated?

A. Estimates were made on untreated wood-stave flumes of both fir and redwood. The estimated cost of $9.20 per lin.ft. mentioned in the article was based on untreated fir stave flume of the usual type of which a considerable quantity was later installed on the King Hill Project for flume on trestle.

Q. On what data did he base his assumption of a life of 20 years for wood-stave flume and galvanized metal 14-gage?

A. The life of 20 years for untreated stave flume was based largely on the condition of untreated wood-stave pipes (installed above ground) of known age on the King Hill Project and other projects of the Reclamation Service. It was also based on a careful investigation of two installations of untreated wood-stave flume, one of redwood staves which had reached about the end of its useful life after 21 years, and another of fir staves which required building with 36 per cent of the staves replaced after 12 years. At the time the estimates on these flumes were prepared (1917) treated stave flumes had never to my knowledge been used for flume purposes and to only a very limited extent for wood-stave pipe. Treated staves were, therefore, not considered for these flumes.

The life of 20 years for 14-gage galvanized metal flume was based on the known life and estimated remaining life of metal-flume installation on many of the Reclamation Service and other projects. In fixing the comparatively long life for both metal flume and untreated wood-stave flume, it was contemplated that a considerable amount of maintenance work would be necessary. The estimated capitalized costs included a liberal amount for maintenance.

Q. Have the data now in possession of the Reclamation Service on metal flumes been available to Mr. Ward?

A. As most of the data on metal flumes have been collected during the past few years these data were not available in 1917 when the comparative estimates on these flumes were prepared.

Q. How is the useful life of 50 years for concrete flume arrived at?

A. This estimate of the useful life of concrete was, of course, based on the best judgment of the engineers of the Reclamation Service, having in mind the local conditions and materials available on the King Hill Project. The concrete in the flumes is heavily reinforced and of rich mixture, and it is my personal opinion, after completing the construction of these flumes, that their useful life will be very much greater than 50 years.

Q. Mr. Ward states that all estimates were based on a carrying capacity of 300 sec.-ft. Was there any allowance made in the cross-sectional area for the different types of flume due to the difference in the resistance to flow of water? Was this factor included in the cost?

A. The estimates for the different types were based on designs of equal capacity using different values of Kutter's n and the costs were therefore compared on a fair basis.

In the last paragraph of Mr. Bartells' letter he refers to the past experience of the Reclamation Service with concrete flumes. From a letter received by me from Mr. Bartells it is understood that he has in mind the necessary enlargement of the concrete flume on the Tieton Unit of the Yakima Project. The enlargement of this flume was due to the fact that Kutter's n was originally assumed too low and it was in no way necessitated by any failure of the concrete in the flume. Some maintenance work was done on the flume at the time of its enlargement; however, the concrete in this flume is known to be in excellent condition after 14 years.

WALTER WARD,
Project Manager,
U. S. Reclamation Service.

King Hill, Idaho, Jan. 23.

NEWS OF THE WEEK

New York, March 2, 1922

Vast Supplies of Water for Jersey District

Hazen Reports on Additional Project for 5,600,000 People in Metropolitan Area in 1970

Three times the water needed to supply the population of the New Jersey Metropolitan District in 1970, or 2,500 m.g.d. for an estimated population of 5,600,000, could readily be provided by supplementing existing supplies by additional reservoirs and conduits, and still leave untouched a large possible supply in the southern part of the state, according to a report by Allen Hazen, of Hazen, Whipple & Fuller, New York City, submitted to the New Jersey Board of Conservation and Development.

To raise the present yields to the 820 m.g.d. needed in 1970 the choice among several possibilities lies between a reservoir on the Lower Passaic, to be formed by a long dam at Little Falls, and a short dam on the Upper Passaic, at or near Millington, with filtration in either case. The Passaic Great Reservoir , above Little Falls, would not only provide a large water supply, but it would also solve the Passaic flood problem—a smaller reservoir for flood protection was proposed here after the great flood of 1903—and would eliminate large areas of mosquito breeding grounds, but this project would require a large outlay at the start, long before all the stored water would be needed for consumption. The Upper Passaic, or Long Hill Reservoir, has the advantages of (1) proximity to the great centers of consumption—a tunnel only 19 miles long would reach Jersey City, passing beneath Newark en route—and (2) of low initial cost, since the reservoir named would be only the first of a series extending westward to within a mile of the Delaware River, from which large volumes could be pumped to the most westward reservoir and flow thence by gravity through various aqueducts, streams and reservoirs to the Long Hill Reservoir. Further details from Mr. Hazen's report will be printed in a later issue.

Reports on Large Reclamation Project in Washington

A project contemplating the irrigation of 2,000,000 acres of arid land in the central part of the State Washington by pumping water from the Columbia River into a coulee, which will form the main supply canal is the subject of a report to the State Department of Conservation and Development, just completed by Willis T. Batcheller, consulting engineer, of Seattle. About 1,500,000 hp. will be required for pumping purposes and additional amounts of commercial power up to 1,000,000 hp. can be economically developed at the proposed site. Mr. Batcheller's report is now being reviewed by Gen. George W. Goethals, who is spending several weeks in Spokane.

Bids on 168-Mile Road Job in Arizona

(By wire to Engineering News-Record)

Bids for the construction of 168 miles of highway in Maricopa County, Arizona, were opened Feb. 27.

Twohy Bros., Phoenix, were low on concrete at following unit prices per square yard: 6-in., $2.31; 5-in. $2.02. The Independent Asphalt Paving Co., Seattle, bid as follows: 6-in., $2.51; 5-in., $2.28. The bid of the Warren Construction Co., Portland, was: 6-in., $2.49; 5-in., $2.29.

The asphalt bids were: California Construction Co., San Francisco, 6-in. asphaltic concrete, $2.00; 5-in., $1.75. Warren Construction Co., 6-in. asphaltic concrete, $2.10; 5-in., $1.91; Bitulithic, 6-in., $2.21; 5-in. $2.01.

It is expected that the Maricopa County Commission will make an award this week.

Katy To Build $3,000,000 Terminal Yards and Shops in Texas

Announcement has been made that the Missouri, Kansas & Texas Railroad of Texas will soon begin construction on a $3,000,000 terminal in Denison, consisting of a double-hump switching yard, roundhouse, shops, storerooms, warehouses, fuel-oil-storage tanks and other facilities, which, when completed, will cover some 400 acres. The contract for grading the yards and the concrete work has been let to the Cummins Construction Co., of Cleveland, Ohio, and it is estimated that it will require 18 months to complete the terminal.

The Katy is constructing this terminal to facilitate the handling of heavy-freight business from and to Texas with the highest efficiency and a lower cost. The yards proper will extend approximately 3 miles in length and about 2 miles at the widest point, making them the largest west of the Mississippi.

The new yards will begin about a half a mile west of the city limits, extending toward Pottsboro, and a new freight line right-of-way will run from the new terminal to Pottsboro.

Mechanical Engineers To Hold Standardization Conference

The American Society of Mechanical Engineers will take up the question of standardization and research at a five-day meeting to be held in Atlanta, Ga., beginning May 8. In a recent survey of engineering and industrial standardization, the society urges industrial leaders to give serious study to German plans. It is presumed that a large part of the discussion to be undertaken at Atlanta will be based upon comparisons of European and American standardization plans and practices.

E. C. Peck of Cleveland is chairman of the standardization committee of the society.

Practising Engineers Meet To Discuss Problems

Engineers as Advertisers—Selling Services—Retainers and Standard Fees—Licensing Laws

How an engineer in private practice may secure publicity and solicit work and how fees for engineering services may be regulated were the main features of a meeting of practising engineers held in Chicago Feb. 22, at the call of the American Association of Engineers. The attendance was disappointing, barely a score of engineers being present at the two sessions presided over by Langdon Pearse, sanitary engineer of the Sanitary District of Chicago.

The difference between publicity and advertising and the tendency of the practising engineer to shun the latter while courting the former were shown by Morris W. Lee, vice-president of the engineering firm of Frank D. Chase, Inc. An engineer may circulate copies of articles (perhaps written by himself) describing his works, but he will limit his newspaper advertising to a small card and will not mention his work. Mr. Lee advocated a more extensive use of personal advertising in technical papers, pointing out that greater publicity for engineering work will not only benefit the engineer but will have a valuable educational effect upon clients and public opinion.

Whether engineers are business or professional men was a question propounded by one speaker, who took the position that the engineer is a business man, and as such should advertise freely. But another speaker countered by quoting restrictive rules of certain codes of ethics. How to sell engineering services was the subject of a paper by Paul E. Green, consulting engineer. This supplemented Mr. Lee's paper and abstracts of both will appear in a later issue.

Standard for Fees

That the limits of compensation are the value of service to the client and the cost of service to the engineer was a point made by Gardner S. Williams, Ann Arbor, Mich., in a paper on standards of services and fees. All but the simplest cases involve judgment, which is the result of training, ability and experience. Since this introduces the item of individuality, any schedule of fees must be for minimum fees. Maintenance of fees requires such cooperation among engineers as will prevent underbidding and rate-cutting. The engineer of special attainments should capitalize these by demanding higher pay, but too frequently he acts on the assumption that his high attainments enable him to do work for lower pay. In the same way, an engineer employed by a state or municipality for a portion of his time as a consultant, Mr. Williams maintained, should not underbid his fellows and deprive them of ligitimate return, because his possession of a salary enables him to do outside work

Philadelphia Engineers to Enter Local Zoning Campaign

A joint meeting to consider the zoning situation in Philadelphia, including the strong opposition which has temporarily blocked the proposed zoning ordinance recently submitted to the City Council, is to be held on March 6 under the combined auspices of the Engineers' Club of Philadelphia, the Philadelphia sections of the American Society of Civil and of Mechanical Engineers, the Real Estate Board, and other interested bodies.

more cheaply. Mr. Williams referred to well-known conditions of extreme variations of bids made in open competition. He suggested that to ensure adequate compensation for services, the principles of a retainer fee may well be adopted, particularly in consulting practice. This fee might be from $500 for 3-day service up to $2,500 for 10-day service, this to be followed by a per-diem charge of say $100, plus expenses. As long as the engineer works only for per-diem payment, his compensation is measured by physical output rather than by mental attainment.

In the discussion, L. K. Sherman, Chicago, divided practising engineers into three classes: (1) The man with an office and established business; (2) the man in salaried position who takes private work on the side; (3) the man out of work who is trying to pick up some practice. He agreed with Mr. Williams that the basis of fees should be the value of service to the client and not simply the cost of the service, but in general only the latter is considered. In Mr. Sherman's opinion engineers are tending toward the establishment of business organizations to regulate practice, as in other lines and professions. He suggested that such an organization should be composed exclusively of practising engineers. It was contended by D. B. Luten, Indianapolis, that the establishment of minimum fees is not in the public interest.

Cost Accounting

Cost accounting for engineering service was discussed in a paper by Arthur L. Mullergren, Kansas City, who was followed by Clarence W. Hubbell, Detroit, with a talk on the computing of an engineer's income tax. Both of these papers led to discussions on vexed points. Discussion on engineers' license laws followed the reading of a letter from C. S. Hammatt, president of the National Council of Engineering Examiners. Concerning state reciprocity for licensed engineers, Mr. Hammatt explained that since there is no uniformity in legislation for licensing or registration there is no reciprocity, although the various state laws aim to provide for it. Even for the states which have become members of the National Council of State Boards of Examiners this reciprocity cannot exist until the Council agrees upon a uniform set of requirements. Mr. Luten suggested that contractors might in some cases be classed as engineers and he remarked that a large proportion of accidents on construction work are due to the temporary structures employed.

Mr. Williams, in the paper noted above, stated that a law which says all engineers are equal cannot assist in establishing standards worth maintaining.

Urges Federal Action to Advance Commercial Air-Transport

Broad enabling legislation to cover the field of commercial aeronautics is advocated by the board of directors of the Chamber of Commerce of the United States, which has authorized the department of transportation and communication of the chamber to interest itself actively in the subject.

A report of the department advisory committee recommends basic national legislation to provide for the adoption and administration of an aeronautic code, promotion by the Department of Commerce of the development and regulation of interstate and foreign commercial air transport, intra-state action to conform to federal legislation and encouragement of public support for the movement.

Port Authority Plans Approved

Authority to proceed with its comprehensive plan for the development of New York Harbor has been granted to the Port of New York Authority by the states of New York and New Jersey, Governor Miller having signed the New York bill on Feb. 24, and Governor Edwards having signed for New Jersey on Feb. 25.

The plan of the Port Authority was described in *Engineering News-Record* of Jan. 5, 1922, p. 26. Under the terms of the acts the Port Authority has no power to raise money by taxation or by pledging the credit of either state. It must finance its operations out of the proceeds of bonds based on the improvement itself and sold to the investing public. Each state has appropriated $100,000 to meet the expenses of the Port Authority during the current year.

Among the specific and practical steps that have been suggested are the cooperation of localities in providing properly equipped air-harbors and airlanes, provision by the federal government of aerological and radio broadcasting service and continuance of the pioneer development work of the U. S. Air Mail until further progress shall have made it possible for private enterprise to assume this task.

Advisory Committee Named

The department advisory committee that has been considering the subject consists of Howard Elliott, chairman of the board, Northern Pacific Railway Co., Lewis B. Stilwell, consulting engineer, A. J. Brosseau, president, International Motor Co., J. J. Carty, vice-president, American Telephone & Telegraph Co., B. F. Cresson, Jr., chief engineer, The Port of New York Authority, Edwin O. Edgerton, president, East Bay Water Co., San Francisco, Douglas A. Fiske, president Northwest Terminal Co., Minneapolis, Philip H. Gadsden, vice-president, United Gas Improvement Co., George A. Post, president, Hudson River Bridge & Terminal Assn., H. H. Raymond, president, Clyde Line, Wilmer W. Salmon, president, General Railway Signal Co., Lucius Teter, president, Chicago Trust Co., J. M. Whitsitt, president, The Carolina Co., and J. Rowland Bibbins, department manager.

Minnesota's Ten Federated Societies Meet

Engineers Co-operate With Architects —Program Prepared for Year's Activities Extensive

(*Engineering News-Record Staff Report*)

Evidence that Minnesota's engineers and architects are working together in close harmony was furnished by the joint meeting, Feb. 21-23, at Minneapolis, of the Federation of Architectural and Engineering Societies (composed of ten organizations), and the Minnesota Surveyors and Engineers Society. About 350 members and guests were registered. On the last day three simultaneous meetings of the municipal highway and drainage sections, all well attended, were held. The formation of the federation has put added life into the state society, which is looked upon as serving best the needs of those living outside the larger centers — the highway and drainage engineers and the surveyors.

Outstanding features in the program of the federation were the list of achievements and the formidable program for the future as outlined by the committee on resolutions, which the president, with forethought, had appointed ten days previous to the meeting.

Of greatest importance to the state society were: The adoption of a new constitution creating four autonomous societies, for three of which programs had been prepared; the determination to stick by the federation; and a request that the federation amend the registration law, making it compulsory for engineers, architects and surveyors in public work to be registered.

The Federation's Work

Achievements of the federation come under two heads: (1) The *Bulletin*, sent to 1,229 members; and (2) the activities of the 15 members of the board of directors who spend several hours each month on problems of the profession. The work of the board included the following items:

Assistance to the governor in appointing a registration board of examiners, after securing passage of a licensing bill; conference with the University of Minnesota officials regarding a research department which has been established, but without specific appropriation; co-operation with the national committee on the classification and compensation of engineers in Minneapolis railway and federal service; congressional action on the bill for commissioning sanitary engineers in the Public Health Service and another bill on appropriation of funds to complete the typographical map in Minnesota; endorsement of the Great Lakes-St. Lawrence waterway; co-operation with a joint survey committee concerning the duties, classifiaction and compensation of engineers and architects and other employees of the city of Minneapolis; similar co-operation with the St. Paul Research Bureau.

R. A. Shelgren, secretary of the federation, in his annual report suggested extending the scope of the *Bulletin* so that an editorial staff would be necessary in each of the member societies.

In addition to the work noted, George H. Herrold, chairman of the public affairs committee, stated that the ques-

tion of equalizing salaries of engineering professors at the university with those of the other professions had been taken up. This committee also assisted the state committee on unemployment and had conferred with satisfactory results with the State Securities Commission on the methods of handling engineering reports.

The Architects' Small-House Service Bureau is the name of an organization growing out of committee work of the American Institute of Architects, appointed to see what the profession could do to assist the small-house situation. It has produced 100 stock plans of three- to six-room houses drawn by architects and sold to anyone at a nominal cost. It is a professional experiment and is the architects' contribution to the solution of the house-shortage problem. If an inquiry is made for plans of a house of over six rooms the party is advised to consult an architect.

J. A. Childs, assistant engineer, Minnesota State Board of Health, in his paper on "The Status of Sewage Disposal in Minnesota" indicated a liberal policy in that the board requires that sewage be treated to prevent nuisance and preserve fish life, rather than to take the place of water filter plants.

PROGRESS IN RESEARCH

"Engineering Research at the University of Minnesota" was the subject of Dean O. M. Leland's paper in which he noted the fact that the state's agricultural products were worth only $618,000,000 while the manufacturing production was $1,218,000,000. Mining was only $130,000,000. Research was desired, he said, on house heating, building construction, highway construction and maintenance, automobile fuels, and the utilization of waste products of industry. The university has established an engineering experiment station, but as it is as yet without funds, the federation will assist in getting $30,000 for this purpose.

In the report of the State Board of Registration for architects, engineers and land surveyors, Paul Doty, chairman, indicated that only 330 applications had been received. The relative numbers were 100 architects, 214 engineers, and 16 surveyors. There are 1,500 eligibles in the state who should register, he said.

Work laid out for the federation during the coming year is well defined by the numerous resolutions passed. Among them are the following, on which the board of directors will act at its monthly meetings: Financial support for technical research is to be asked from the state legislature. A list of eligible engineers and architects is to be handed the governor, from which he will be urged to choose a member of the board of regents of the University of Minnesota. The legislature is to be asked to provide the university with funds to develop methods of peat manufacture and utilization along commercial lines. A law to control the proper utilization of the water resources of the state will be supported.

Appropriations by the state for hydrographic investigation and topographic surveys to meet equal amounts furnished by the Federal appropriation were endorsed. The present registration law lacks "teeth" and the board was asked to form a committee to prepare a "strengthening" amendment. Endorsement of the St. Lawrence Tidewater project was given.

MUNICIPAL SECTION

In the municipal section of the state society a committee was authorized to consider contracts for engineering services and to co-operate with the Missouri Valley Association of Practising Engineers formed recently in Sioux City, Ia., for the same purpose. Standard specifications and contracts, discussed by L. P. Wolff, consulting engineer, and engineering costs on municipal work, by George M. Shepard, consulting engineer, led to the foregoing action.

Prof. W. L. Huff, University of Minnesota, gave the results of applying copper sulphate to a chain of five summer resort lakes near Fairmont to eradicate algae. Applications at 4 to 5-week intervals cleared up the nuisance which in previous years had often closed the lake resorts long before the season was over.

DRAINAGE SECTION

"The Relation of Surface Run-off and Soil Type and Permeability to Drainage Design" was the subject of a highly technical paper by C. E. Ramser, senior drainage engineer, Washington, D. C. The problem of getting better tile was handled by D. G. Miller, senior drainage engineer, U. S. Bureau of Public Roads, who told of the deleterious effects of alkali on porous tile. Manufacturers present indicated that they proposed to deliver what the engineer specified and to eliminate those of their number who failed to produce dense tile. E. V. Willard, state drainage commissioner, was emphatic in his requests that the companies "clean house" and produce good material.

HIGHWAY SECTION

The new federal highway law was explained by E. O. Hathaway, district engineer, Bureau of Public Roads.

F. C. Lang, testing engineer, Minnesota State Highway Department, gave test results of cores drilled from pavements on at least every half mile of every state concrete pavement.

Maintenance of Minnesota's trunk highway system undertaken first in 1921, was discussed by M. J. Hoffman, assistant maintenance engineer, who explained in detail the methods and results obtained in taking over 7,000 miles of road from the counties, the formation of 16 districts and the expansion of the force until in October $490,000 was expended and more than 3,100 employees were on the payroll.

NEW OFFICERS

The newly elected officers of the state society are as follows: President, John L. Pickles; vice-president, C. L. Mott; and secretary-treasurer, E. G. Briggs, St. Paul. Adolph F. Meyer was re-elected to the society's representation on the board of directors of the federation. William C. Fraser is the hold-over representative.

Utah Announces Road Program

The State Highway Department of Utah has announced its program of highway construction for the year 1922, involving 101.54 miles of road to be built at an estimated cost of $2,530,000. Sixteen projects ranging in length from 1 to 15 miles are included in the proposed work.

Westchester County Park System at $10,000,000 Cost Proposed

A bill authorizing the board of supervisors of Westchester County, N. Y., to appoint a commission of nine members with power to plan a park system for the county and take lands by condemnation was introduced in the New York legislature Feb. 20 by T. Channing Moore, assemblyman from Bronxville. The financing of the project would be controlled by the supervisors. The general plan is to provide parks from the Hudson River to Long Island Sound and from the north to the south end of the county. It is presumed that the Croton reservoirs of the New York water supply would be brought into or connected with the system.

Court Order Compels Seattle to Choose New Reservoir Site

The State Supreme Court of Washington, sitting *en banc* an. 3, reversed its department decision of last August, and upheld the King County Superior Court in declaring that the proposed Volunteer Park storage reservoir for the water-works of Seattle would be a menace to property and therefore cannot be built. It is estimated that an available site on Capitol Hill would cost $432,000. Notes on the earlier stages of the litigation appeared in *Engineering News-Record*, Jan. 6, 1921, p. 47, and Jan. 5, 1922, p. 35.

$7,000,000 for Construction in Duluth and Vicinity

A survey of the construction outlook in Duluth and adjoining districts shows that six projects involving expenditures estimated at $7,000,000 are scheduled for the coming season. Work upon them will be started by April 1 and approximately 6,000 men will be afforded employment during the season. Engineers and contractors assert that sufficient other work is in sight to absorb all the unemployed labor existing in this district today.

The state of Minnesota, under the Babcock law, will expend fully $2,000,000 in road work in St. Louis County this year, the contracts for which have been already let. St. Louis County proper will, in addition, expend $1,481,050 in the construction and maintenance of roads and bridges for which 1,500 men will be employed by contractors.

The program of the City of Duluth for 1922 calls for an expenditure of approximately $1,000,000 in street paving projects for which several contracts have been already let. More than 1,000 men will be employed by contractors on those jobs.

In building construction the projects to be carried through in Duluth include an apartment building, estimated to cost $800,000, for which German & Jenssen, Duluth, are the architects; an addition to St. Luke's hospital, to cost $750,000 for which the same firm is the associate architect; and a new county jail to be built in Duluth at an outlay of $375,000. Bids on the last-named contract will be taken on March 7.

While the projects enumerated are the principal jobs to be done this summer, the survey showed that activity is planned in other circles. House building promises to be on a large scale in Duluth this year.

Two Power Permits Granted for Alaskan Development

A preliminary permit has been authorized for issuance to Maurice J. Leehey of Seattle, Washington, for a proposed development of 15,000 hp. on Revillagigedo Island, Alaska. The plans contemplate the conversion of Lake Mahoney into a storage reservoir by the construction of a dam 50 ft. high. A tunnel 7,000 ft. long through the divide separating Lake Mahoney from upper Beaver Lake will divert this water into Beaver Falls Creek.

A preliminary permit has also been authorized for issuance to the Alaska Development and Mineral Co., a subsidiary of the Kennecott Copper Corp., for a comprehensive water-power development on Tyee and Anan Creeks, both tributary to the Bradfield Canal, Alaska. The power will be used in the manufacture of paper and pulp.

License Authorized for Power Project on American River

A license for a comprehensive power development on the South Fork of the American River, in the vicinity of Placerville, Cal., has been authorized by the Federal Power Commission for issuance to the El Dorado Power Co., a subsidiary of the Western States Gas and Electric Co.

The project as proposed utilizes an existing canal, 25 miles in length, known as the El Dorado ditch which will divert water from American River, a short distance below its confluence with Silver Fork. The canal will be enlarged from a capacity of 40 to 350 cu.ft. per second. From the canal the water will be conducted through a 3-mile conduit to the penstocks which supply the turbines to be located in a power house on the American River about a mile below the mouth of Silver Creek. The turbines will operate under a head of 1,900 ft. The company plans to provide for an ultimate installation of 100,000 hp. to be developed in four stages.

The project includes six storage reservoirs on the headwaters of American River, with an ultimate capacity of 90,000 acre-ft. Three of the reservoirs, to the capacity already constructed, are included in a license recently issued to the Western States Gas and Electric Co. The El Dorado Power Co. will acquire all water and property rights involved in these reservoirs, and it is intended to amend the present license later to include them.

The public hearings on this project brought out data showing that the greatest economic use for irrigation purposes alone demanded that as much as possible of the water on the upper American River be used for power. By generating electric energy in the mountains and transmitting it to the highly productive agricultural area in the vicinity of Stockton, about 3 acres per horsepower can be irrigated by electric pumping. If the water necessary to produce the electric energy were to be diverted to irrigation uses in the upper American River drainage, the equivalent used three of the water would be 1 acre per horsepower. Furthermore, but little of the water diverted to irrigation use on the upper American River drainage could again be productively used, whereas the same water, if used to generate electricity, can be used again for the same purpose at a plant lower down on the stream.

President Signs Patent Office Relief Bill

President Harding signed the Patent Office relief bill on February 18. Since the bill carries only the authorization for the appropriation, the reorganization and installation of additional personnel must await the actual granting of the money. It is probable, however, that the appropriation can be carried in a forthcoming deficiency bill. The change in patent fees does not become effective until April 19.

Porto Rico Irrigation Project

Extensive subsoil investigations by test pits and core drilling are being carried on for the dam of the Isabela irrigation project of the Department of the Interior in Porto Rico at Quebradillas. R. A. Gonzalez, chief engineer, states that two field parties are surveying the reservoir site and making preliminary canal locations. The dam as now projected will be 130 ft. high, and store 33,000 acre-ft. of water which will irrigate 16,000 acres of cane land. About 12 miles from the dam a 100-ft. drop in the main canal will be utilized to develop 800 hp. The project will cost approximately $3,000,000.

Viaduct Planned Over Union Pacific Tracks at Ogden

The State Road Commission of Utan has had plans prepared by the bridge department for a concrete viaduct over the Union Pacific tracks at Ogden, Utah. Plans have to be approved by the engineers of the Bureau of Public Roads and by the bridge department of the Union Pacific. In addition to the viaduct there will be a steel bridge on each end with a span of 132 ft. A clear roadway of 20 ft. will be provided and a 5-ft. sidewalk. The structure will be lighted electrically.

The state road commission will have charge of the construction the estimated cost of which is $200,000.

Major Portion Chicago Building Under Landis Award

Statistics on Chicago building operations of January as announced in *Chicago Commerce* indicate that the Citizens Committee to inforce the Landis award is making substantial progress. Of the $8,063,700 estimated cost of 313 buildings for which permits were taken out in January; the total value of the Landis award jobs was $5,893,450; no report was obtained on work valued at $596,050.

William P. Curran, the president of the Chicago Building Trades Council, who is connected with the plumbers union, one of the ten refusing to accept the award, has been replaced by Fred Mader, head of the fixture hangers union. Mr. Curran was successful in bringing the council to accept the award but his own union repudiated the award.

The Builders' Society of Architects has passed resolutions against signing contracts with the plumbing contractors unless the latter work under the award.

Advertisements in the daily newspapers by the Citizens Committee and contractors Associations are continued at intervals apprising the people of the stand of the committee in maintaining an open shop for the 10 recalcitrant unions and backing the 22 unions which have accepted the award.

Robert Brewster Stanton

Engineer Who Surveyed 1,000-Mile Colorado Canyon Railway in 1889 Died Feb. 23

Robert Brewster Stanton, who surveyed a thousand-mile railway line from Grand Junction, Colo., to the mouth of the Colorado River, through the Grand and Marble and other canyons of the Colorado, died of pneumonia at Stamford, Conn., Feb. 23. He was born at Woodville, Miss., Aug. 5, 1846, and took the degrees of A.B. and A.M. at Miami University in 1871 and 1878. From 1874 to 1880 he was resident engineer of the Cincinnati Southern R.R. and from 1880 to 1884 he was division engineer for the Union Pacific Ry. During the latter engagement he built the celebrated Georgetown Loop Ry. in 1882-3.

Beginning in 1884, Mr. Stanton practised as a consulting civil and mining engineer, making the Grand Canyon Ry. survey in 1889-90 and subsequently being engineer also of various mines in the United States, Canada, Mexico, the West and East Indies, and in Cuba. In 1904 he was engaged in explorations for gold in the Island of Sumatra, Dutch East Indies.

The Grand Canyon survey was made by Mr. Stanton as chief engineer for the Denver, Colorado Canyon & Pacific Ry., a project designed to provide a freight, passenger and scenic railway on favorable grades down the Grand River from Grand Junction, Colo., to the Colorado River, and then down the latter stream to the Needles, Cal., and onward to a point near the Gulf of California. The total distance of the projected line was 1,038 miles, or 1,019 miles in case of adoption of a long tunnel line in Grand Canyon. About 140 miles of this distance was down the Grand River, leaving about an even 1,000 miles, if the longer route were chosen, on the Colorado River, of which 217 were in the Grand Canyon and some 220 miles in various other canyons and "cataract" portions of the river.

First Expedition Fails

The expedition began in 1889 but met with disaster in July, 1889, when, due to the capsizing of a boat on July 10, Frank M. Brown, president of the company, lost his life. Notes by Mr. Stanton describing the first expedition, accompanied by illustrations from his photographs, were published in *Engineering News*, Sept. 21, 1889. A detailed article by Mr. Stanton, with twenty-five illustrations, reviewing the entire survey, occupied some nine pages of *Engineering News* for Oct. 18, 1890. Editorial discussions of the project, in the well known vein of A. M. Wellington, then one of the editors of *Engineering News*, appeared in each of the issues last mentioned. The spirited account of a mishap by which F. A. Nims, the photographer of the party, fell 22 ft. and broke an ankle bone, was published in *Engineering News*, March 8, 1890, this story being based upon one by Mr. Stanton that appeared in the Denver *Republican* of Feb. 16, 1890. Immediately following the accident to the photographer, Mr. Stanton walked 35 miles to Lees Ferry to secure a wagon to take the injured man ashore for treatment. It required eight men working nearly a day to get Nims from the boat to the rim of the canyon.

In the second and fully successful

expedition, ending early in 1890, no more serious accidents appear to have occurred than the one just noted. In this expedition the party passed over no less than 520 rapids. Most of these are described as slight, but in the most troublesome one Mr. Stanton "was sucked downward by a whirlpool and only escaped after an unpleasantly long submersion."

Besides being the author of "The Canyons of the Colorado River of the West for Railway Purposes," published in 1892, Mr. Stanton in 1897 presented a lengthy paper to the Institution of Civil Engineers on "The Great Landslides on the Canadian Pacific Ry. in British Columbia."

Road Building Plans Take Shape in Alabama

On Jan. 30, the date on which the electors of Alabama approved by a 25 to 1 vote a $25,000,000 bond issue for the construction of state roads. Jefferson County also held an election to change from 5 per cent to 6 per cent the interest rate on $2,000,000 of bonds that had been previously authorized in order to make them marketable. This passed by a majority of about 8 to 1.

The Alabama Highway Commission has its plans well developed already and is preparing to dispose of some $3,000,000 of the bonds at once to meet the same amount of federal-aid funds now available.

In the same way Jefferson County is now preparing to begin construction on 200 miles of road in the county. Conferences are being held with the officials of the state highway commission and with those of the City of Birmingham looking to cooperation in the construction of portions of this mileage. About 17 miles will lie within the City of Birmingham and of this the County will pay one-half and the city the balance. About 70 miles will be state roads, connecting county seats, and to this the state and federal aid will pay one-half and the county one half.

Brady Succeeds Miller as Building Superintendent

Charles Brady, former chief inspector of the bureau, has succeeded Rudolph P. Miller, as Superintendent of Buildings, Borough of Manhattan, New York. Mr. Miller resigned recently because of ill health. Mr. Brady has, for a number of years, been in contracting work, having been the head of the Charles Brady Co., New York City. Mr. Miller, it is understood, will rest for a time, and then will enter private engineering practice. The change became effective Jan. 11.

Departments Consolidated Under City Engineer

The departments of engineering, streets and bridges of Raymond, Wash., were combined into a single department of engineering by the City Commission on Feb. 1, and placed under the direction of the city engineer to whom the superintendents of water-works and of streets will report. Louis D. Kelsey is now city engineer. The change was made for purposes of efficiency and economy. The population of Raymond in 1920 was 4,260.

Montreal Harbor Commission Is Reorganized

Through a recent reorganization of the Board of Harbor Commissioners of the Port of Montreal, Canada, the former system of individual control of the various departments has been superseded by the concentration of full executive authority in the hands of a general manager. M. P. Fennell, Jr., has been appointed general manager and secretary by Dr. W. McDougall, the new chairman of the harbor commission. The other officers are T. W. Harvie, chief engineer, replacing F. W. Cowie who is appointed consulting engineer, replacing the late Sir John Kennedy; Paul Leclaire, formerly the engineer in charge of buildings, bridges and water supply for the harbor commission, assistant chief engineer; and Capt. J. F. Symons, former deputy harbor master, harbor master.

Mr. Harvie was on the staff of the Clyde Engineering Trust for six years, and then became engineer for Sir Robert MacAlpine and Sons on the construction of the Yorkhill docks. He was appointed assistant engineer of the Montreal Harbor Commission in 1907. He is an associate member of the Institution of Civil Engineers and of the Engineering Institute of Canada

San Francisco Civil Service Men Volunteer Wage Cut

About 200 employees in the building department of the San Francisco Board of Public Works on Feb. 13 volunteered to accept a cut of 7½ per cent in their wages, effective March 1. The workers include carpenters, cement workers, steam fitters, plumbers and other craftsmen in the building trades.

These men could have continued under the present scale of wages, according to T. A. Reardon, president of the board, who said that funds were available to meet the old scale of wages until July 1 when the board of supervisors will prepare a new budget for the ensuing years. "We have accepted the offer of the men," Mr. Reardon said, "as it shows their willingness to aid the city in its campaign for economy."

Plan Engineers' Building in Denver

A committee has been appointed by the Denver (Col.) Engineering Council to investigate and report on the feasibility of a proposed Engineers Building for Denver. The committee consists of one member from each of the member organizations of the council and is at present considering various plans for financing the project, among which are several co-operative ownership schemes.

It is proposed to submit a questionnaire to the engineers in the vicinity in an endeavor to obtain their opinions regarding the merits of the different plans which have been proposed. The personnel of the joint committee is as follows: W. F. R. Mills (Engineering Council), chairman; Walter L. Drager (Am. Soc. C. E.), R. W. Gordon (Colorado Scientific Society), Fred W. Hart (A.S.M.E.), Richard A. Parker (A.I.M.E.), H. B. Barnes (A.I.E.E.), Ralph J. O'Rourke (Colorado Society of Engineers), secretary.

"No Net Income" Reported by 40% of All Construction Firms

Companies engaged in construction in the United States in 1919 paid a total tax in that year of $67,219,756. The number of companies making returns to the Bureau of Internal Revenue was 8,242. Of that number, 5,927 companies reported a total net income of $162,463,771, the remaining 3,215 companies had no net income and reported deficits aggregating $21,862,285. The number of corporations and the net income for each group were:

Excavation and construction under or upon the ground (not buildings), 919 companies, net income, $5,391,057; jetty, dam, dry-dock, wharf, and bulbhead, 130 companies, net income, $2,875,312; railroad construction, 59 companies, net income, $403,863; shipbuilding, 301 companies, net income, $88,400,530; buildings, 3,049 companies, net income, $22,407,572; equipping and installing machinery and equipment, such as elevators and carrier systems, 1,756 companies, net income, $7,958,418; wrecking, raising or moving (not marine), 94 companies, net income, $556,094; all other construction and contractors, 1,931 companies, net income, $34,470,925.

Market for American Road Machinery in Argentine

The growing interest in the value of serviceable highways throughout Argentina, reports E. F. Feely, U. S. commercial attache at Buenos Aires, will ultimately lead to considerable demand for American road machinery and commercial vehicles. Though little business can be expected at present, owing to the unfavorable exchange situation, Mr. Feely says it is advisable that American manufacturers of road-building machinery and commercial vehicles place literature before the Argentine road engineers. Correspondence of this nature can be addressed to Presidente de la Comision, Primer Congreso de la Vialidad, Touring Club Argentino, Avenida de Mayo 761, Buenos Aires.

Biles Will Be Chief Executive of Penn. Highway Department

Following the death of Commissioner Lewis S. Sadler, it has been announced that George H. Biles, assistant highway commissioner, will direct the affairs of the Pennsylvania State Highway Department. Commissioner Biles joined the staff of the department as chief draftsman in June, 1905, after a service of several years with the Philadelphia Department of Public Works.

In June, 1906, he was made division engineer of the state highway department in charge of the central and a portion of the eastern counties of Pennsylvania and conducted for the state some of the first experiments in bituminous road materials. He was promoted, in 1912, to be assistant to the chief engineer, and a year later became maintenance engineer, organizing the maintenance division and assuming direct charge of all maintenace on state highways and state-aid roads. Mr. Biles was appointed second deputy commissioner in 1915 and three years later, in addition to his supervision of maintenance, was placed in charge of all constructive and administrative work After Mr. Sadler's appointment Mr. Biles became assistant commissioner.

New Company Plans Airship Lines for Commercial Service

Formation of a corporation to engage in commercial air transportation over regular lines has been announced by the Chamber of Commerce of the United States. It will be known as the General Air Service and numbers among its founders Benedict Crowell, formerly assistant secretary of war; L. V. Benet, president, the Hotchkiss Co.; Owen D. Young, vice-president, the General Electric Co.; Marshall Field, 3d.; Col. Charles De Forest Chandler, U. S. Army, retired; Snowden A. Fahnestock; E. M. Herr, president, the Westinghouse Co.; Samuel McRoberts; R. B. Mellon of the Mellon National Bank of Pittsburgh; Theodore Pratt of the Standard Oil Co.; Franklin D. Roosevelt, Benjamin Thaw of Pittsburgh and David Goodrich of New York.

The General Air Service plans to use dirigible airships of a modified Zeppelin type, fabricated in Germany, and assembled in this country. They are to be of 4,000,000 cu.ft. capacity, inflated with helium, and designed for the use of oil fuel rather than gasoline. It is expected that two of these ships, each with accommodations for 100 passengers and 30 tons of mail and express matter will be plying between New York and Chicago by the summer of 1923.

North Dakota Engineers Hold Two Annual Meetings

Meetings of two engineering associations were held in North Dakota Feb. 8-10. At the annual meeting of the North Dakota Society of Engineers, at Jamestown Feb. 8 and 9, the licensing of architects and engineers was discussed by G. R. Horton, architect. Apart from papers on lignite coal, oil-well drilling, radio and the relation of freight rates to construction work, the more technical papers were:

"Water Supply and Distribution," E. J. Thomas, Minot; "Paving for North Dakota Conditions," E. R. Griffin, Mandan; "Water Purification at Fargo," T. R. Jacobson, Fargo; "Sewer Maintenance at Jamestown with Reference to Imhoff Tanks and Ejector Systems," H. H. Hurning, Jamestown; "Reorganizing of Public Health Work in North Dakota," Dr. H. E. French, Grand Forks. E. R. Griffin, county surveyor, Mandan, was elected president; secretary, Prof. E. F. Chandler, University No. Dak. The next meeting will be held at Mandan in January, 1923.

At the meeting of the North Dakota chapter of the American Association of Engineers, held at Bismarck Feb. 9-10, the papers included:

"American Indian Engineering," M. R. Gilmore; "Land Classification and the Engineer," C. C. Converse; "Experiences of a Highway Engineer," J. A. Wallace, Devil's Lake; "Sewage Disposal at Minot," E. J. Thomas; "Irrigation in North Dakota," C. H. McMahon, assistant state engineer. "The Good Superintendent of Highways," T. H. [illegible], Wahpeton; "The Bismarck-Mandan Bridge," W. H. Robinson, state engineer; "Federal Aid for Highways," F. R. Smith, U. S. highway engineer; "Proposed Highway Legislation," F. W. Mees, Mandan. The president for 1922 is William Barneck, Bismarck; secretary, W. H. McGrew, state highway commissioner, Bismarck.

Regional Conference Plan Under Way in Los Angeles County

The Board of Supervisors of Los Angeles County, Cal., has instituted a plan for conferences of representatives from five sections of the county which will consider ways and means of working out solutions of common problems to the best interests of all concerned.

The first meeting was held in Pasadena Jan. 21 with about 100 representatives from various parts of the county present. At this session committee reports were received on highways, subdivisions, parks and boulevards, transportation, garbage and sewage disposal, flood control, zoning and legislation. The next meeting will be in Long Beach about April 1.

U. S. Exposition Building at Rio To Be Built

The contract for the construction of the exposition building to house the exhibits of the United States at the great Brazilian Exposition next September has been awarded to Dwight P. Robinson & Co., which already have large construction work under way for the Brazilian Government in Northeastern Brazil. Representatives of the company and of Frank L. Packard, architect, of Columbus, who will design the building, sailed recently for Brazil to begin the work.

The exposition will open at Rio de Janeiro Sept. 7 and will commemorate 100 years of Brazilian independence. It was recently announced at the White House that the American Building would be of permanent construction and so designed as to permit of its being converted into an embassy for this country's diplomatic representative after the close of the exposition.

Engineering Standards Committee Elects Officers

At the adjourned annual meeting of the American Engineering Standards Committee held in New York, Feb. 9, Albert W. Whitney, a representative of the National Safety Council, was elected chairman, and George C. Stone, a representative of the American Institute of Mining and Metallurgical Engineers, was re-elected vice-chairman. Mr. Whitney is associate general manager of the National Bureau of Casualty and Surety Underwriters. A. A. Stevenson, the retiring Chairman, is a representative of the American Society for Testing Materials.

The following were elected to represent the respective member-bodies on the executive committee:

[illegible]
Architects.
[illegible]
[illegible]
[illegible]

made structural engineer for Walter H. Rae & Associate Engineers, Tiffin, Ohio.

GEORGE F. WOLFE has resigned as chief designing engineer for the International Steel and Iron Co., Evansville, Ind., to open an office at St. Petersburg, Fla., as consulting engineer on structural steel and reinforced concrete structures.

C. T. HENNING, JR., has resigned as county engineer, Hillsboro, Tex., to accept a position with the state highway department as division engineer, with headquarters at Fort Worth.

ALVORD & BURDICK, consulting engineers, Chicago, announce that the firm will hereafter be known as Alvord, Burdick & Howson. Louis R. Howson whose name is now identified with the firm has been a member of the organization for 15 years, successively as assistant, principal assistant and partner. As in the past, the firm will continue in the practice of problems relating to water-works, water purification, sewerage, sewage disposal, flood relief, drainage, power generation and appraisals.

J. W. JOHNSTON, assistant general manager of the Portland Cement Association, until recently located at the general offices at Chicago, has been transferred to the association's New York office. Mr. Johnston has been with the association for six years and was originally in charge of the district office at Parkersburg, W. Va. From there he was transferred to Wisconsin and put in charge of the Milwaukee district office. Upon his promotion to position of assistant general manager he was transferred to the Chicago office.

G. H. NICKERSON, formerly superintendent of construction in the county engineer's office, Merced County, Cal., has been made chief engineer of the Yosemite Valley R.R. with headquarters at Merced.

WALTER A. SILLYMAN, of the firm of Joseph S. Sillyman Co., mining and civil engineers, Altoona, Pa., has been elected engineer for the Cambria County Commissioners, Ebensburg, Pa.

A. R. LOSH, of the construction division in the Washington office of the U. S. Public Roads Bureau, has been detailed as acting district engineer of the bureau in Texas, succeeding Capt. J. D. Fauntleroy, who has been granted leave of absence to become state highway engineer of Texas.

CHARLES H. MOOREFIELD has resigned as state highway engineer of South Carolina.

DANIEL B. SAYER, who organized and managed the construction department of the Communipaw Co., New York City has resigned, effective Feb. 24. He will continue to engage in building construction.

FRED W. THOMAS has been appointed city engineer of Logan, Utah, succeeding A. H. Chambers, resigned. Mr. Thomas has been assistant city engineer since his return for military service in 1919.

L. G. LENERT, assistant sanitary engineer, U. S. Public Health Service, has been granted leave of absence to serve on the International Health Board during 1922. He will have headquarters in Sacramento, Cal.

FRED J. GRUMM, assistant chief engineer of the county highway commission, San Diego, Cal., and president of the San Diego chapters of the American Society of Civil Engineers and the American Association of Engineers, has been appointed assistant engineer in the headquarters office of the California State Highway Commission.

CHARLES H. MOORE, assistant purchasing agent, Pennsylvania State Highway Department for the past 8 years, has resigned to become secretary and traffic manager of the Associated Pennsylvania Highway Contractors, Harrisburg, Pa., succeeding Charles F. Puff, Jr.

C. A. D. BAILEY & CO. a contracting firm has been organized at Atlanta, Ga. The company will do a general contracting, dredging and engineering business. C. A. D. Bailey, president of the new firm, has had wide experience both in engineering work and in general contracting. He is a former vice-president of the Foundation Co., New York City, and previous to his association with that firm was prominently connected with the J. G. White Engineering Corp., and other New York and London contractors.

BUSINESS NOTES

THE UNITED STATES CAST IRON PIPE AND FOUNDRY CO., Burlington, N. J., has opened a new office at Kansas City, Mo., in charge of D. W. Pratt.

C. L. DEWEY, who was associated with Carl Akeley in the invention and development of the Cement-Gun and who has done extensive Cement-Gun-contract work under the names of the Dewey Cement-Gun Co. and the Traylor-Dewey Contracting Co. of Allentown, Pa. has joined the forces of the Cement-Gun Construction Co. of Chicago, Illinois.

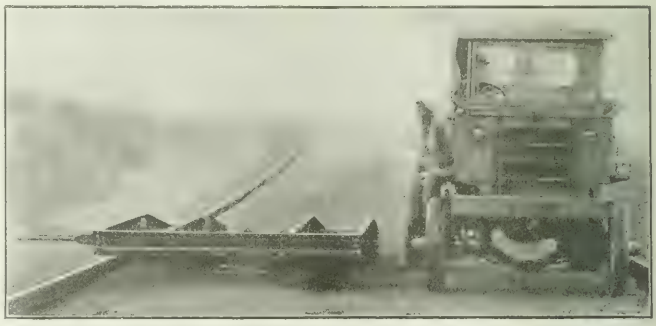
GEORGE S. HEDGE and FREDERIC W. MATTHEIS, dealers in construction equipment, will shortly open offices in Boston, Mass. Both Mr. Hedge and Mr. Mattheis were with Waldo Bros. & Bond, of Boston, for many years. Mr. Hedge has recently been New York sales manager for the Lakewood Engineering Co.

THE CUMMINGS MACHINE CO., INC., Minster, Ohio, announces that the company will hereafter be known as the Industrial Equipment Co., Inc. There will be no change in location, management or personnel of the firm as a result of the change in name.

EQUIPMENT AND MATERIALS

New Motor Truck Turntable

A truck turntable which occupies only one-half the roadway and in turning swings over the side form has been put on the market by the Blaw-Knox Co., Pittsburgh, Pa. Skids, on which it can be hauled, form the base of turntable. A truck after being drawn on the turntable is secured from tipping by supports at each end of the table. When the truck is ready to be turned, a lever is operated which folds up these supports and then acts as a push bar



by means of which one man can turn a 5-ton truck loaded with 4 cu.yd.

The runways, which support the truck are mounted on a circular track of less diameter than the width of the truck. This track is placed immediately above a similar circular track which is rigidly secured to the skids. Between these tracks are a series of rollers so that there are no axles to cause friction. A center pin, rigidly secured to the skid which supports the lower track, holds a spider which keeps the rollers in place and also holds a central bearing for keeping the upper track properly centered.

Rod Type Crushing Mill

The Ruth rod mill, for fine crushing, mainly for ore, as manufactured by the Denver Engineering Works, Denver, Colo., consists of a horizontal cylinder having a charge of loose longitudinal rods which crush the material between



them as the cylinder revolves. The size of feed is 1½-in. to 2-in. and the product varies from 20 to 50 mesh. A large discharge opening provides a gravity flow from the feed end. The driving end is provided with a base plate carrying both the trunnion and pinion shaft bearings, this plate having adjusting screws by which the proper alignment of the gears is maintained.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Value February Contracts Is $57,697,345

Practically Equal to Value for Same Month of 1920, Though Lower Than for January

The value of all contracts let as reported in *Engineering News-Record* was, for the month of February, $57,697,345. This figure takes into account the main classes of construction excluding residential building. The figure is about $1,000,000 less than was reported for the corresponding month of 1921. Inasmuch as the cost of building has dropped considerably the past year, the figure for the month just passed represents in volume at least 30 per cent more construction than was put under contract for February, 1921. The value of contracts let for February of 1920 was in excess of $148,000,000, as shown by the accompanying table. As has been the case in the past months, the highest contract value in February was reported for miscellaneous building, including theaters, schools, banks and office buildings.

Following is the tabulation of the values contracts let, as reported in *Engineering News-Record* for February of 1920, 1921 and 1922:

Classification	1920	1921	1922
Waterworks	$2,171,725	$2,927,307	$777,000
[illegible]	622,874	2,445,075	2,400,000
[illegible]	2,137,393	885,529	1,002,035
[illegible]			
[illegible]	786,943	905,746	415,500
[illegible] roads	21,334,015	12,044,441	16,116,000
[illegible]	63,262,290	4,737,[illegible]	4,744,[illegible]
[illegible]	52,200,466	31,902,608	31,434,916
[illegible]			
[illegible]	2,252,373	1,324,937	731,[illegible]
Miscellaneous	5,468,519	1,[illegible]	3,900,[illegible]
Total	$148,264,596	$58,150,271	$57,697,345

Labor Distribution on House Construction Studied

According to a recent investigation carried on by the Division of Building and Housing of the Department of Commerce, wages paid to carpenters represent practically half of the entire labor cost on a frame house and 32 per cent in a brick house. The cost of other classes of labor on a frame house is as follows: Bricklayers, 6.2 per cent; hod carriers, 2.2 per cent; plasterers, 7.9 per cent; plumbers, 8.7 per cent; electricians, 2.6 per cent; painters, 10 per cent; common laborers, 6.3 per cent; and all others, 6.5 per cent. For a brick house the following cost distribution is made according to the various classes of workers: Carpenters, 32.2 per cent; bricklayers, 21.5 per cent; hod carriers, 6.7 per cent; plasterers, 8.8 per cent; plumbers, 7.6 per cent; electricians, 2.5 per cent; painters, 6.3 per cent; and all others, 4.5 per cent.

Analyses were made from reports covering a large number of six-room brick and frame houses throughout the United States.

January Distribution of Contracts in U. S.

Contracts Classified Geographically and by Kind of Construction

Amount of construction in prospect can be gaged by the value of contracts being awarded. Contracts let in the last quarter of a year give an idea of the volume of construction to be expected in the following spring. These data were presented geographically on p. 174, Jan. 26 issue. The January figures are now available in Table I.

Contracts let on all classes of engineering construction since Oct. 1, 1921, to Feb. 1, 1922, aggregated $380,000,000, according to Construction News. Only those contracts are included which exceed $25,000 in the case of public work, $40,000 for industrial [illegible] and $1,000,000 for buildings.

The January total for the country is $78,550,953, distributed geographically as follows: [illegible] Middle Atlantic, [illegible] West of Mississippi River, [illegible] Far West, [illegible] New England, 4. A particularly hopeful [illegible] is that more [illegible] com-

	[illegible]	Middle [illegible]	[illegible]	[illegible]	Mass.	[illegible]	Total
Water-Works	[illegible]	[illegible]	$230,000	$597,000	$327,000	$452,000	$1,777,000
[illegible]	[illegible]	[illegible]	27,000	322,000	45,000	[illegible]	1,775,383
[illegible]	$175,000	1,728,000	121,000	344,000	456,000	[illegible]	2,994,000
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	25,000	178,000	[illegible]	[illegible]	[illegible]	487,000
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	2,257,000	4,056,000	[illegible]	3,251,000	[illegible]	14,424,000
[illegible]	[illegible]	2,864,000	12,[illegible]	[illegible]	[illegible]	[illegible]	17,912,000
[illegible]	[illegible]	6,599,000	886,000	14,[illegible]	3,611,000	[illegible]	33,146,000
[illegible]	[illegible]	261,000	39,000	[illegible]	[illegible]	[illegible]	1,174,500
[illegible]	[illegible]	570,000	[illegible]	743,810	3,070,460	420,000	4,841,070
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Engineering News-Record Construction Cost Index Number

March, 1922	162.04
February, 1922	168.72
March, 1921	224.27
Peak, June, 1920	273.80
1913	100.00

Engineering News-Record's Construction Cost Index Number is 6.68 points lower than for the last two months, due to declines in steel, cement and labor. Lumber remained firm. Steel now sells for $1.40, Pittsburgh. Cement prices are down slightly in the Middle West. Average hourly rate for common labor over the country is 43c., as against 45c. since Nov. 1, 1921. Thus, general construction cost is 28 per cent cheaper than one year ago and 38 per cent under the peak; it is 62 per cent above the 1913 level.

Engineering News-Record Construction Volume Index Number

Monthly	
February, 1922	100
January, 1922	91
February, 1921	43
1913	100
Yearly	
1921 (entire year)	88
1920 (entire year)	91
1913	100

Engineering News-Record's Construction Volume Index Number is 100 for the month of January, and 88 for the whole of 1921, as against 100 for 1913. This means that the actual volume of construction in 1921 (not the mere money value of the contracts let that year) is 12 per cent under the volume of construction for 1913. Our monthly volume number, 100 for February, 1922, is really the increment of construction, and indicates the rate at which contracts are being let as compared with 1913 awards.

struction was contracted for in January, 1922, than in any month of 1921. Contracts for industrial work in January, 1921, amounted to $12,882,000; January, 1920, $56,000,000; 1913, $2,000,000.

Table II presents F. W. Dodge Co.'s statistics of residential contracts awarded in January, 1922, in the Northeastern quarter of the United States.

TABLE II—RESIDENTIAL CONTRACTS LET IN JANUARY, 1922.

District	Number Projects	Floor Space in Sq. Ft.	Value
Boston	519	1,263,800	$5,090,100
New York	870	8,027,700	35,329,700
Philadelphia	631	3,586,200	12,849,400
Pittsburgh	572	1,970,700	7,966,500
Chicago	667	2,984,100	13,558,300
Minneapolis	151	250,300	934,300
Total	3,410	18,082,800	$75,728,300

The total valuation of contracts let on all classes of construction in the United States in January, 1922, is probably $300,000,000.

California Comment on Uniform Cement Prices

Commenting upon the resolution taken by executive officers of eight Mid-West states not to make any contracts for highway construction involving the use of cement until prices are reduced, the Feb. 2 Bulletin of the California Highway Commission remarks that "the price of cement at present made to the California Highway Commission by all the northern mills in California is $2.35 per bbl., mill base, the mills all quoting the same delivered price and absorbing any freight differentials due to differences in distances from delivery points. Among the mills of Southern California, however, a limited competition exists and the mill base price there is appreciably lower.

"Before the war the California Highway Commission enjoyed a range of price from $1.04 to $1.40 per bbl. mill base. The peak price on account of war time conditions was $2.70 on Sept. 2, 1920. It has since dropped to $2.35 but is still fully $1 per barrel above pre-war prices.

"Informal bids were received from the Northern Cement Companies by the California Highway Commission last week. On 3,000 bbl. for delivery at Suisun-Fairfied all companies bid $2.52 per bbl. On 375 bbl. for delivery at Sacramento all companies bid $2.69. On 232 bbl. for delivery at Altamont all companies bid $2.78.

Freight Traffic on French Railways

During the first 11 months of 1921, the average number of freight cars loaded daily on French railways, including Alsace-Lorraine, according to Commercial Attaché W. C. Huntington, Paris, was as follows:

January	38,434	July	39,607
February	40,137	August	43,087
March	38,679	September	47,191
April	40,266	October	48,956
May	39,000	November	48,931
June	41,590		

On account of the increased average weight per carload, 40,000 loaded freight cars at the present time are equivalent in tonnage to 60,000 pre-war freight cars.

Uniform Prices Inevitable, Says Cement Man

Competition, Not Collusion, Forces Bids to Same Level, Is Statement of Universal President

In the issue of Jan. 19, p. 25 (Construction News) *Engineering News-Record* reproduced the tabulation of bids for furnishing the Wisconsin Highway Department with cement. Uniformity of the bids submitted by four manufacturers led to a request that the situation be explained, as a natural inference might be the existence of an agreement on price among the various cement producers who bid. The following letter from B. F. Affleck, president of the Universal Company, explains the situation in detail—

"There is no collusion. Such uniformity of prices as appears in this list of bids and elsewhere is due not to collusion, but to competition. Cement is a standard commodity conforming to a standard specification adopted by the government, the engineering profession, and cement manufacturers generally. There is no substantial variation in quality. It must all conform to standard specifications and is not required to exceed these specifications. The freight rates on cement, which is a large percentage of the value of the material, are matters of record. The railroads cannot vary them except on notice. The product, being one which is sold to many thousand dealers and consumers, is offered freely by the manufacturers at prices which are not secret, but which are given wide publicity.

"The material is made in a factory which the owner tries to operate continuously with perhaps some seasonal shutdown. He can determine in advance with fair accuracy his manufacturing costs and these do not vary widely except as wage rates and cost of fuel and material advance or decline. Therefore, changes in prices are as a rule infrequent. When prices change, most of the manufacturers notify by circular their customers and others whose business they desire of the new prices.

Quotation Basis Easily Figured

"The conditions recited above make it easy for any given manufacturer by simple arithmetic to ascertain the basis of quotations made by any other manufacturer. In fact, as the cement business is and must be conducted, it is quite impossible for any manufacturer to keep secret his policy with respect to prices. The price at a given destination is made based on a mill price, plus freight. It has been shown above that this mill price or basis quickly becomes a matter of common knowledge. The freight rate also is well known. Therefore it is easy to determine the delivered price. The material being a standard commodity throughout the country, it is practically impossible for any manufacturer to get more for his product delivered at destination than any other manufacturer who can make the delivery is asking at the point of delivery. It is also not to be expected that a manufacturer, knowing what the market is at a given destination, will offer his product at less than that market. Were he to do so the strong probability is that the lower quotation made by him would soon establish itself as the market price and he would find himself obliged to sell all of his product at the lowered market price. And, of course, other manufacturers would also sell at this lowered price, which would quickly again become uniform as between all manufacturers quoting at the same destination.

"It may be assumed that the public has no objection to uniformity of prices unless these prices are too high. If the cement manufacturers were to quote prices only at their mills instead of quoting delivered prices, the effect would be that at most destinations there would be only one brand of cement obtainable at the low price, prices on other brands from more remote mills being higher. This would clearly be a non-competitive condition which would not be to the advantage of the consuming public, but decidedly to its disadvantage.

"In the case of Waukesha, listed in the table of bids referred to, the Universal Company's bid was based on $1.60 at Buffington, the price in effect since Sept. 15, 1921, with 40c. for sacks, and 48c. per barrel freight. This makes $2.48 delivered at Waukesha. Other cement companies, knowing what base price Universal had used since Sept. 15, assumed that its bid at Waukesha would be $2.48 and they could not expect Waukesha business if they bid higher. Therefore the Lehigh and Alpha Companies, whose mills are at La Salle, Ill., with a freight rate of 53c., shrunk the net at their mill to $1.55 to meet Universal competition and the Sandusky Cement Co. whose mill is at Dixon, Ill., with a freight rate of 51c., reduced the net price at its mill to $1.57 to meet Universal competition."

Trend of Business

Bonds — Light issues, active demand, rising quotations. New York Transit Commission set valuations on the local traction properties of about half their book values, which caused a temporary decline in securities of the companies. Foreign government list was feature of the bond market, the activity following the mounting of exchange rates.

Foreign Exchange — Highest in three years. Sterling $4.43⅛ ($4.86⅔ is par).

Net earnings of well known companies compared for 1921 and 1920 are a good index of industrial conditions:

New York Shipbuilding Corporation $2,046,559 in 1921, against $2,395,402 in 1920.

Atlas Powder Co. $634,484 or $1.71 per share of common stock in 1921 against $1,434,693 or $16.32 per share in 1920.

American Locomotive Co. $3,333,785 or $13.34 per share in 1921 against a 1920 showing of $5,361,126 or $21.44 a share.

National Lead Co. were $3,481,512 in 1921, compared with $4,755,508 in 1920.

Restrictive Trade Practices Barred by Federal Court

As a result of a conference held Feb. 24 at the office of the United States Attorney-General between representatives of the Department of Justice and those of the International Organization of Bricklayers, Masons and Plasterers, the executive heads of the union have executed a consent to the entry of a court decree in the United States District Court for the southern district of New York which eliminates certain objectionable trade practices. The decree directs (1) that no limit be set upon the productive capacity of the individual workman; (2) that no limit be placed upon the right of the employer to purchase his materials, whether those materials are union made or not; (3) that no favoritism be shown by organized labor toward employers or trade associations or contractors' associations and that no discrimination be allowed as between members and non-members of such associations; and (4) that labor organizations are not to be used as agencies for the collection of alleged claims by material men, contractors or subcontractors. The decree becomes a constitutional provision of the trade union involved.

Restrictions upon individual output is considered a strictly war-period development and has been condemned by the executive heads of the trade associations involved. The decree is therefore directed against any concerted effort at curtailment of production, though it does not at all prohibit the regulation of hours or conditions of labor.

The second of the principles enunciated in the decree is directed against a certain practice which may be typified

Labor Rates and Conditions Throughout the Country

Of the twenty one cities reporting, thirteen show changes in industrial conditions and only three report actual changes in labor rates. Common labor rates vary from 20c. per hour in the South and in Montreal to 35@50c. elsewhere. The average for the entire country is 43c., against 45c. for the preceeding four months. Hoisting engineers are receiving 87c. as against 87½c. per hr. in Baltimore. Montreal pick and shovel men for excavating work are quoted at 20c.@25c. as compared with 20c.@30c. per hr. one month ago. While the regular St. Louis union scale of 67½c. per hr. for common labor has nominally remained in force, non-union, unskilled common labor is now obtainable at a rate as low as 30c.

Los Angeles reports all classes of work held up this month on account of heavy rains and unsettled weather conditions. Despite this, unemployment, particularly in the common labor class, has shown a slight decrease. As soon as the weather permits, increased construction activity is looked for.

Current labor rates in Cincinnati will remain in force until May 1, when readjustments are expected. Not fewer than 70 per cent of the city's skilled mechanics and 30 per cent of the common laborers are at present employed.

A condition of alternating strikes and lockouts, existing in Philadelphia during 1921, has finally subsided and the builders do not anticipate difficulties for the spring months. Bricklayers, masons and plasterers have returned to work and conditions favor increased construction activities during 1922.

Denver reports a slight increase in the number of employed workmen, but conditions are still far below normal.

Employment in all trades in Detroit shows a slight increase over last month. Favorable weather has permitted uninterrupted construction work on projects started during the winter.

The Minneapolis Board of Park Commissioners has voted a reduction in the common labor rate from $4.50, the rate paid last year, to $4, for eight hours. The common labor rate in all departments under control of the City Council is $5 per day, by ordinance, and is unaffected by the action of the Park Commission. The common labor rate on work other than municipal is 40c.@50c. per hr.

Steamfitters in Syracuse have agreed to a wage cut from $1.12½ to $1.05 per hr., but hoisting engineers and journeymen plumbers have thus far successfully resisted wage reductions.

Cement finishers in St. Louis have accepted a wage reduction from $1.25 to $1 per hr., effective March 1.

Satisfactory adjustments in the building trades' wage scale for the coming season, in Duluth, have stimulated considerable interest in building projects in that section.

Current labor rates in Cleveland were to have expired by agreement on Mar. 1, but negotiations thus far have not produced definite results.

In Chicago, carpenters, plumbers, hoisting engineers, cement finishers, lathers, fixture hangers, sheet metal workers, roofers and laborers' unions have all been refused recognition by the Citizens' Committee to enforce the wage award made by Judge Landis on Sept. 7, 1921. Meanwhile, Judge Landis has resigned as arbitrator of the building trades controversy. The Committee will retain all non-union men now employed and also all union men who sign a pledge to abide by the award and not to strike.

In comparison with other parts of the country, construction work in the New York district has been fairly active all winter and the spring season is expected to witness even a greater activity. San Francisco also reports increased building operations as well as a visibly increased interest in prospective construction.

Labor [illegible] decreases by

Cities	Brick [illegible]	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	[illegible]	[illegible]	[illegible]	$0 30		[illegible]	$0 20@ 25
Baltimore	[illegible]	80	[illegible]	54	$0 74	1 00	30
Birmingham	[illegible]	75		.25		1 00	15@ 25
Boston	[illegible]	75	90	60	[illegible]	[illegible]	40
Cincinnati	1 25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	40
Chicago	[illegible]	1 00	1 10			[illegible]	[illegible] 40
Cleveland	[illegible]	1 04	1 04	[illegible]	[illegible]	1 04	[illegible]
Dallas	[illegible]	[illegible]	[illegible]	60	1 00	[illegible]	[illegible] 45
Denver	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] 40
Detroit	[illegible]	[illegible]	[illegible]	50@ 60	1 00	[illegible]	50
Kansas City	[illegible]	1 00	1 00	80	[illegible]	[illegible]	[illegible]
Los Angeles	[illegible]	1 00	1 00	[illegible]	[illegible]	[illegible]	[illegible]
Minneapolis	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]
Montreal	[illegible]	60	[illegible]	[illegible]	[illegible]	[illegible]	20@ 25
New Orleans	[illegible]	[illegible]	[illegible]	40	[illegible]	1 00	[illegible]
New York	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Pittsburgh	[illegible]	1 00	1 00	80	1 00	1 00	[illegible]
St. Louis	1 25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
San Francisco	[illegible]	[illegible]	[illegible]	[illegible]	1 00	[illegible]	[illegible]
Seattle	1 00	80	[illegible]	70	[illegible]	[illegible]	50
Philadelphia	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

by the fact that in construction work in many of the larger cities labor unions have required that stone be imported in the rough and dressed and finished locally by union labor. The contractor may now purchase his material when, where and from whomever he chooses. It is the belief of the Department of Justice officials that this practice has constituted one of the most potent factors in the high cost of building, and the consequent shortage of housing and large rent increases.

The Department has found many instances wherein a labor organization would, for some bonus or other inducement, agree to grant preference or to furnish some co-operation to the trade association member as against his independent competitor. Numerous cases of the kind were also brought out in the investigations carried on by the Lockwood Committee in New York City. It is against this apparent collusive agreement between labor organization and trade association member that the third of the principles is directed.

Instances have been reported to the department from both Chicago and New York to the effect that contractors and builders have used labor unions as instruments for collection of their debts. For instance, the practice prevailed in certain centers wherein members of labor unions refused to work on the completion of a job although fully compensated for their work and assured of future compensation, merely because some previous owner of the building had defaulted in a payment to some material man. In one case in New York a collection system was used wherein payment for the same claim was extorted two or three times. Threats that the dealer could not secure the labor to complete or finish his job if he did not pay usually had the desired effect.

In its investigation of the masons, bricklayers and plasterers international union the Department of Justice did not feel justified in proceeding to indictment, but believed that the same results could be obtained by the issuance of the decree herein outlined.

Car Surplus, Shortage and Freight Loading

Plenty of freight cars are available, as shown by the table which *Engineering News-Record* has arranged from the latest summary of car surplusages and car shortages compiled by the American Railway Association. The "shortage" columns indicate both that there is no car shortage and that business is light. On the other hand, the surplusage has been decreasing steadily with continued increase of freight loadings.

Loading of revenue freight totaled 788,412 cars during the week which ended on Feb. 11, an increase of 34,526 cars over the week before, according to reports just received from the railroads of the United States by the Car Service Division of the American Railway Association. This was 100,545 cars in excess of the total for the corresponding week in 1921 and 1,779 more than loaded during the corresponding week in 1920.

The increase over the week before was due principally to greater shipments of merchandise and miscellaneous freight which includes manufactured products, as well as of coal and grain and grain products, although appreciable gains were also reported in shipments of live stock and forest products.

Loadings of merchandise and miscellaneous freight totaled 445,581 cars, an increase of 15,876 over the week before and 42,018 more than the corresponding week last year. It was, however, 4,448 cars below the total for the same week in 1920.

SURPLUS AND SHORTAGE STATEMENT — FEB. 1 to 8, 1922

Districts	Box Cars		All Coal Cars		Total All Cars	
	Surplus	Shortage	Surplus	Shortage	Surplus	Shortage
Eastern	23,272	157	35,981	...	63,674	199
Allegheny	22,650	...	61,159	...	88,322	0
Pocahontas	1,395	...	1,437	...	4,455	8
Southern	17,372	...	8,017	...	32,515	11
Northwestern	21,967	...	3,208	...	35,623	15
Central Western	23,438	229	9,146	30	51,552	260
Southwestern	11,434	42	4,171	...	20,518	42
Total	121,528	428	123,119	30	296,659	527
Canadian Roads	29,025	..	1,325	...	42,844	0
Grand total	150,553	428	124,444	30	339,503	527
Jan. 8, 1922	219,345	13	220,774	45	538,387	219

Monthly Prices of Construction Materials

Ups and Downs of the Market

Pig Iron—Average drop of $1 per gross ton in Cincinnati, New York, Birmingham,, Philadelphia, Chicago and Pittsburgh markets. Firmer tone due to increased demand.

Railway Supplies—Slight reduction in light rails f.o.b Pittsburgh. Advance of 12c. per tie on Douglas fir cross-ties in San Francisco. Standard spikes down in Pittsburgh and Chicago; spikes and track bolts down in St. Louis.

Pipe—Advance of two points in wrought steel pipe discounts in Chicago and 3 points in St. Louis. Cast-iron pipe down $2 per ton in San Francisco and Birmingham; slight advances in New York and Chicago. Cast-iron pipe demand fairly heavy. Sewer pipe up 2c. per ft. in St. Louis; slight drop in Denver and Atlanta.

Roads and Paving Materials—Road oils down ½c. per gal. in New York to encourage approaching seasonal demand. Asphalt in package up $5 in St. Louis and $10 in Cincinnati; down $5 per ton in Denver. Asphalt in bulk up 50c. in San Francisco and Philadelphia; $6 in St. Louis and $11 per ton in Cincinnati. Granite paving block down 46c. per sq.yd. in Cincinnati; advance of $5 per M. on basalt blocks in San Francisco. Flagging and bluestone curbing quiet with anticipated upward trend. Wood paving blocks 3 in., down 5c. and 4 in., down 1c. per sq.yd. in New York. Size 3½ in., down 1c., in Baltimore and 4 in., down 30c. per sq.yd. in Cincinnati.

Sand, Gravel and Crushed Stone—Gravel down 20c. in St. Louis and 25c. in Boston; up 15c. per cu.yd. in Los Angeles. Sand down 10c. per ton in Atlanta; up 19c per cu.yd. in Cincinnati and 15c. per ton in Los Angeles. Crushed stone down 10c. in Atlanta; advances 15c. in Los Angeles.

Lime—Hydrated finishing lime is quoted in New York at $15.80@$16.80 as against $16.80 per ton and common lump lime at $2.75@$3.48 as compared with $3@$3.48 per bbl. (280-lb. net) one month ago. Hydrated finishing lime up $1 in St. Louis and $2.75 in Detroit; down $3.30 in Cincinnati, $6 in Denver and $1 per ton in Atlanta. Hydrated common lime advance $1 in St. Louis and $2.75 per ton in Detroit. Common lump lime down 25c. per bbl. (180-lb. net) in Dallas, Denver and Atlanta; up $6.50 per ton in Detroit.

Cement is quoted in New York at $2.30 as against $2.20@$2.30 per bbl. one month ago. Reduction of 3c. per bbl. in Chicago and Cincinnati, 5c. in Milwaukee and 15c. in Peoria, Cedar Rapids and Davenport.

Structural Material—Steel shapes, plates and bars quoted at $1.40@$1.50, Pittsburgh, but $1.40 per 100 lb. accepted on even comparatively small tonnages. Steel shapes quoted at $2.72½ as against $2.97½ in St. Louis warehouses; reinforcing bars ¾ in., $2.50, compared with $2.87 per 100 lb. one month ago. Drop of $2 per 100 yd. in expanded metal lath in St. Louis; also a decrease of 25c. per 100 lb. in structural rivets and an advance of 16c. per keg on wire nails. Steel sheets down 15c. per 100 lb. in San Francisco warehouses; slight declines in St. Louis.

Prepared Roofings — Slate-surfaced roofing (red and green) advance 5c. per roll; slate finished shingles up 10c. per square in Philadelphia.

Lumber—Douglas fir No. 1 common down $2 in San Francisco; long leaf yellow pine drops $1 per M. ft. b.m. in Chicago. Slight advances in pine lumber, base sizes, in Atlanta; down in Baltimore. Fir up $3 in Los Angeles and Seattle. Hemlock advances $3 in Los Angeles and $1 per M. ft. in Minneapolis. Fluctuations in Douglas fir market caused by heavy Asiatic shipments as well as domestic demand.

Scrap—Dealers' selling prices on all iron and steel scrap except re-rolling rails, show decline in St. Louis. New York and Chicago prices unchanged.

Manila Rope—Advance of 1c. in Chicago and decrease of 2c. per lb. in Atlanta.

Linseed Oil—Rapid rise in flaxseed market reflected in raw linseed oil prices throughout the country. New York quotes 87c. as against 77c. and Chicago 91c. as compared with 80c. per gal. (5 bbl. lots) one month ago.

Price advances since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Per Gross Ton—Quotations compiled by The Matthew Addy Co.:

	Current	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25 @ 2.75)	$20.50†	$32.00
Northern Basic	21.00†	29.50
Southern Ohio No. 2 (silicon 1.75 @ 2.25)	22.50†	32.00
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25 @ 2.75)	26.26†	37.76
BIRMINGHAM		
No. 2 Foundry (silicon 2.25 @ 2.75)	16.00†	27.50
PHILADELPHIA		
Eastern Pa., No. 2X, (2.25 @ 2.75 sil.)	21.76†	31.54*
Virginia No. 2 (silicon 2.25 @ 2.75)	27.74†	35.14*
Basic	19.84†	29.00†
Grey Forge	21.50†	29.75*
CHICAGO		
No. 2 Foundry Local (silicon 1.75 @ 2.25)	20.00†	28@29
No. 2 Foundry Southern (silicon 2.25 @ 2.75)	22.82†	35.42
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley (silicon 1.75 @ 2.25)	21.26†	29.96
Basic	19.96†	26.96
Bessemer	21.46†	28.96

*F.o.b. furnace † Delivered

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb is charged extra:

	Pittsburgh			
	Current	One Year Ago	Birmingham	Chicago
Standard bessemer rails	$40.00	$45.00		$40.00
Standard openhearth rails	40.00	47.00	$40.00	40.00
Light rails, 8 to 10 lb	28.00@30.00	2.45@3.00*	1.60*	1.65@1.80*
Light rails, 12 to 14 lb	25.00@30.00	2.41@2.95*	1.60*	1.65@1.80*
Light rails, 25 to 45 lb	28.00@30.00	2.32@2.85*	1.60*	1.65@1.80*
Rerolled Rails	1.45@1.50*			

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8½ Ft.	7 In. x 9 In. by 8½ Ft.
Chicago, White Oak	$1.35	$1.50
Chicago, Hardwood and Red Oak	1.20	1.30
Chicago, Empty Cell Creosoting (add'l)	.45	.50
San Francisco, Green Douglas Fir	.85	1.10
San Francisco, Empty Cell Creosoted Douglas Fir	1.86	2.30
St. Louis, White Oak*	1.10	1.30
St. Louis, Red Oak*	.97	1.17

*Standard specifications 38c. per tie additional. Zinc chloride process 27c. per tie additional.

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh							San Francisco	Birmingham
	Current	One Year Ago	Chicago	St. Louis					
Standard spikes, ⅜-in. and larger	$2.20@2.25	$3.65@3.90	$3.65	$3.40	$4.25	$4.25	$3.25		
Track bolts	3.25	5.50@6.00	3.65	4.00	5.25	4.60			
Standard section angle bars	2.40	2.75@3.75	2.40	3.25	4.00	3.40			

PIPE

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the latest Pittsburgh basing card:

BUTT WELD

Inches	Steel Black	Galv.	Inches	Iron Black	Galv.
to 3	71	58½	⅜ to 1¼	44½	29½

LAP WELD

2	64	51½	2	39½	25½
2½ to 6	68	55½	2½ to 6	42½	29½
7 to 8	65	51½	7 to 12	40½	27½
9 to 12	64	50½			

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1½	69	57½	¾ to 1½	44½	30½
2 to 3	70	58½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	62	50½	2	40½	27½
2½ to 4	66	54½	2½ to 4	43½	31½
4½ to 6	65	53½	4½ to 6	42½	30½
7 to 8	61	47½	7 to 8	35½	23½
9 to 12	55	41½	9 to 12	30½	18½

STEEL—From warehouses at the places named the following discounts hold for steel pipe:

	Black		
	New York	Chicago	St. Louis
1 to 3 in. butt welded	66%	62½%	59%
2½ to 6 in. lap welded	61%	59½%	56%
	Galvanized		
	New York	Chicago	St. Louis
1 to 3 in. butt welded	53%	48½%	45%
2½ to 6 in. lap welded	47%	45½%	42%

Malleable fittings, Class B and C, from New York stock sell at list less 10%. Cast iron, standard sizes, 32-5% off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	New York						
	Current	One Year Ago	Birmingham	Chicago	St. Louis	San Francisco
4 in.	$50.50	$73.30	$32.00	$46.60@48.10	$46.20	$52.00
6 in. and over	47.30@48.30	63.30	33.00	42.60@44.10	43.20	48.00

Gas pipe and Class "A," $4 per ton extra; 16-ft. lengths, $1 per ton.

CLAY DRAIN TILE—The following prices are per 1000 lin. ft.:

	New York					
Size, In.	Current	One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	$40.00	$50.00	.....	$50.00	.....	$55.00
4	50.00	60.10	$80.00	60.00	$90.00	65.00
5	80.00	90.00	.....	80.00	115.00	84.00
6	100.00	115.00	140.00	100.00	150.00	110.00
8	150.00	185.00	200.00	150.00	250.00	181.00

SEWER PIPE—The following prices are in cents per foot for carload lots f.o.b.:

Size, In.	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3	$0 14@$0 087	.....		$0 10	$0.12	$0 12	
4	12	087	$0 09	10	12	15	$0 18
5	21	1305		14	18	18	165
6	21	1305	135	14	18	21	25
8	35	203	225	255	28	30	35
10	52	3045		315	42	42	
12	67	3915	3825	405	54	54	80
15	1 15	522	5625	585	72	90	
18	1 55	725	765	765	1 00	1 32	
20	1 98	87	1 125		1 20		
22	2 64	1 16			1 60		
24	2 97	1 305	1 4625	1 35	1 80	2 16	2 40
27	4 50	1 885		2 25	3 75	3 00	
30	5 00	2 088	3 20	2 70	4 75	3 60	
33	6 55	2 61		3 35	5 50		
36	7 50	2 9725		3 65	6 00		

	3	5	8	12	24	36
Boston	$0 108	$0 162	$0 252	$0 486	$1 62	$4 92
Minneapolis			40	77	2 55	5 66
Denver	135*	18*	25	52	1 70	
Seattle	145		36	72	2 59	
Los Angeles	11*	165*	275	495	1 65	
New Orleans		108	27	459	1 755	
Cincinnati	10	15	233	45	1 50	4 305
Atlanta	09*	135*	195	345	1 0625	
Montreal, *delivered*	30*	45*	70*	1 35	4 50	6 50
Detroit	105	1575	245	4725	2 115	5 4325
Baltimore	1225	2275	35	630	2 29	5 [illegible]
Kansas City, M.	15*	21*	335	60	2 41	4 74
Philadelphia	085	13	20	3925	1 305	3 65

*4-in., 6-in., 9-in. respectively.

ROAD AND PAVING MATERIALS

ROAD OILS—Following are prices per gallon in tank cars 8,000 gal. minimum f.o.b. places named:

		Current	One Year Ago
New York, 45% asphalt	(at terminals)	$0.06	$0.08
New York, 60% asphalt	(at terminals)	.06½	.07½
New York, heavier	(at terminals)	.07	.08½
New York, 75%	(at terminals)	.05½	.07½
New York, [illegible] asphalt	(at terminals)	.06	.09
St. Louis, 40-60 asphalt		.03½	.11
Chicago, 40-50 asphalt		.05	.08½
Chicago, 60-70 asphalt		.05	.08½
Dallas, 40-50 asphalt		.10	.10
Dallas, 65-75 asphalt		.13	.13
Dallas, 75-85 asphalt		.15	.15
San Francisco, heavier, per ton		13.00†	15.00

* Freight $21.75 per ton to Whiting, Ind.
† F.o.b. Oleum, Cal. Freight to San Francisco, $8.00 per ton.

ASPHALT—Price per ton in packages (350-lb. bbl., or 425-lb. drums) and in bulk in carload lots:

	Package	Bulk
New York (Bayonne, N. J.)	$25.00	*$15.00*
Boston	No quotations.	
Chicago	25 85	19 50
San Francisco, *f.o.b. refinery*, Oleum, Cal.	19 50*	**13 50***
Dallas	35 00	27 00
Seattle	25 40	*18 00*
Denver	*30 00*	
Minneapolis		20 50
St. Louis	**30 00**	**25 00**
Baltimore	25 00	20 00
Los Angeles, *at factory*	22 50	15 00
Montreal	28 00	21 00
Atlanta	27 00	
Detroit (petroleum asphalt)	24 50	20 00
Cincinnati	**36 00**	**32 00**
Maurer, N. J. (natural asphalt)	36 00	33 00
Maurer, N. J. (artificial asphalt)	22 00	20 00
Philadelphia	24 00	**17 50**
Kansas City	28 83	22 83

*Freight to San Francisco, 80c. per ton.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums. Rebates of about $1 per bbl., no rebate for drums.

PAVING STONE—

New York	5-in. granite, 28@29 blocks per sq.yd.	$130.00 per M
Chicago	About 4x8x4 dressed	3 35 sq.yd.
	About 4x8x4 common	3 00 sq.yd.
San Francisco	Basalt block 4x7x8	**70 00** per M
Boston	5-in granite	125 00 per M
Atlanta	Granite	2.00 sq.yd.
Detroit	Granite, 26½ blocks per sq.yd.	3.05 sq.yd.
Baltimore	Granite	2.00 sq.yd.
Montreal	Granite	125 00 per M
New Orleans	Granite, 4 x 8 x 4	3.25 sq.yd.
Cincinnati	Granite	*3.84* sq.yd.
St. Louis	4x8x4 dressed	3.25 sq.yd.
	4x8x4 common	**3.00** sq.yd.
Kansas City	No. Granite	3.95 sq.yd.
Philadelphia	Granite	125 00 per M.

FLAGGING—

New York	Bronx	$0 25	sq.ft.
	Manhattan, 4 ft.	26	sq.ft.
	Queens, 5 ft.	26	sq.ft.
	6x20-in. cross-walk	1 00	lin.ft.
Chicago	18 in. wide	99	lin.ft.

CURBING—Bluestone per lineal foot, in New York, costs 77c. for 5x16 in., 88c. for 5x18 in.; in cargo lots.

WOOD BLOCK PAVING—

	Size of Block	Treatment	Per Sq.Yd.
New York (*delivered*)	3	16	*$2.04*
New York (*delivered*)	3½	16	2.17
New York (*delivered*)	4	16	2.16
Boston	3	16	**2.17**
Chicago	4	16	3 00@3.25
Chicago	3½	16	2 50@2.75
St. Louis	3½	16	2.10
St. Louis	4	16	3.00
Seattle	4	16	Off market
Minneapolis	3½	16	2.13
Atlanta	3½	16	2.30
New Orleans	3	16	1.60
New Orleans	3½	16	1.80
New Orleans	4	16	2.00
Dallas	4	18	3.90
Baltimore	3½	16	2.22
Montreal	4	16	4.50
Detroit	3	16	2.84
Detroit	4	16	3.00
Cincinnati	4	16	*3.00*
Kansas City	4	16	2.15
Philadelphia	3½	16	3.50

CONSTRUCTION MATERIALS

SAND AND GRAVEL—Price for cargo or carload lots to contractors as follows, per cu.yd.:

	Gravel 1½ In. Current	Gravel 1½ In. One Year Ago	Gravel ¾ In. Current	Gravel ¾ In. One Year Ago	Sand Current	Sand One Year Ago
New York	$1.75	$3.00	$1.75	$3.00	$1.00	$1.25
Denver	2.50	2.00	2.50	1.80	1.10	1.60
Chicago	2.00	2.75	2.00	2.75	2.00	2.75
St. Louis, *f.o.b. cars*	1.25	**1.15**	*1.50*	1.70	1.20	1.70
Seattle	1.50	1.50	1.50	1.50	1.50	1.50
Dallas	2.00	**1.75**	2.00	**1.75**	2.00	1.75
Minneapolis	1.50	2.00	1.50		1.00	1.00
Cincinnati	**2.00**	2.00	**2.00**	2.00	**1.69**	1.30
San Francisco	2.25	2.50	2.25	2.50	1.50	1.65
Boston	*2.50*	2.65	*2.50*	2.65	*1.25*	2.00
New Orleans	2.08‡	3.00	2.08‡		1.35	1.75
Los Angeles, per ton	**1.50†**	1.45	**1.50†**	1.45	**1.35†**	1.30
Atlanta, per ton	1.85	2.88	1.85	1.15	*1.75*	1.50
Detroit	2.00	1.85	2.00	1.85	2.00	2.50
Baltimore, per ton	1.40	1.40‡	1.60	1.60‡	2.00	
Montreal, per ton	1.25	1.50‡	1.50	1.75	1.25	1.50‡
Birmingham, per ton (Crushed slag used instead of gravel)					1.25	1.25‡
Philadelphia	1.90		1.90		1.60	
Kansas City	2.00	3.25	2.00	3.75	1.20	1.25

* Fine white sand: Pacific, $4 per ton; Ottawa, $4.50

† Freight from quarry to Los Angeles is 85c. per ton, and is included in above price.

‡ Per cu. yd.

CRUSHED STONE—Price for cargo or carload lots f.o.b. city, unless stated otherwise, is as follows, per cu.yd.:

	1½ In. Current	1½ In. One Year Ago	¾ In. Current	¾ In. One Year Ago
New York	$1.75@1.85	$1.90@2.00	$1.75@1.85	$2.15
Chicago	1.60	2.75	1.60	2.75
St. Louis *delivered*	1.65	1.85	1.65	1.85
Dallas, *delivered*	2.93	2.25	2.93	2.25
San Francisco	2.25	2.50	2.25	2.50
Boston, *delivered*	3.00*	3.00* (del.)	3.00*	3.00* (del.
Minneapolis, *at plant*	2.00	2.00	2.25	2.25
Kansas City, *at plant*	2.10	2.35	2.10	2.35
Denver	3.50		3.50	
Seattle *delivered*	3.00	3.50 del.	3.00	3.50 (del.)
Atlanta	*1.90**	3.25*	*1.90**	
Cincinnati *delivered*	2.37½	2.30	2.08	2.15
Los Angeles	**1.75***	1.70*	**1.85***	1.80*
Detroit	1.90*	2.00	*1.90**	2.00*
Baltimore	1.75*	**1.75***	1.65*	**1.75***
Montreal	2.00*	**2.10***	2.10*	**2.40***
Birmingham *delivered*	3.20		3.10	
Philadelphia	1.70*		1.55*	

*Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plants:

	1½-In.	¾-In.	Roofing	Sand
Youngstown District	$1.30	$1.30	$2.00	$1.30
Steubenville District	1 40	1 40	2.00	1.40
Ironton District	1 40	1 40	2.00	1.40
Emporium, Pa.	1 25	1 25		1.25
Easton, Catasaqua, Pa	1 00	1 00	2 00	0.90
Birmingham, Ala.	1 05	1 15	2.05	0.80
Buffalo, N. Y., and Erie, Pa.	1 25	1 25	2.25	1 25
Cleveland, Ohio	1 20	1 20		1.00
Eastern Pennsylvania and Northern New Jersey	1 20	1 20	*2.00*	1 20
Western Pennsylvania	1 25	1 25	*2.00*	1.25

LIME—Warehouse prices:

	Hydrated, per Ton Finishing	Hydrated, per Ton Common	Lump, per Barrel Finishing	Lump, per Barrel Common
New York	*$15.80@$16.80*	$12.50	*$3.68@3.98*	*$2.75@$3.48**
Chicago	18.00			1.40†
St. Louis	**23.20**	**20.00**	2.50†	2.50†
Boston	23.00	20.00	3.35†	3.10†
Dallas	25.00			*2.50†*
Cincinnati	*15.10*			**12.50‡**
San Francisco	22.00	18.00		1.75†
Minneapolis	29.00	22.00 (white)	**1.70†**	1.40†
Denver	*34.00*			*2.70†*
Detroit	**18.00**	**16.00**		**17.00‡**
Seattle	27.00		3.00‡	2.75†
Los Angeles	30.00	30.00		3.00*
Baltimore	15.00	13.00		**12.00‡**
Montreal	26.00	21.00	15.00‡	11.00‡
Atlanta	*18.00*	16.00	2.00†	*1.25†*
New Orleans		17.25		1.75†
Philadelphia	13.00	11.50	10.50‡	9.50‡

*280-lb. bbl. (net). †Per 180-lb. bbl. (net). ‡Per ton—Refund of 10c. per bbl.

Minneapolis quotes brown lime; Kelly Is. white is $1.70, Sheboygan $1.55. Seattle quotes hydrated finishing lime in cloth sacks; paper sacks, $24.00 per ton.

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, f.o.b., exclusive of bags:

	Current	One Year Ago
Minneapolis (Rosendale)	$2.80	$2.80
Kansas City (Ft. Scott)	1.60	1.60
Atlanta (Magnolia)	11.00 ton	11.00
Cincinnati (Utica)	1.93	2.75
Boston (Rosendale) per bag	.85	2.35

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b. points listed *without box*. Cash discount not deducted.

	Current	One Month Ago	One Year Ago
New York*	$2.30	$2.20@2.30	$3.10
New York, alongside dock to dealers	2.00	2.00	
Jersey City	2.12	2.12	2.89*
Boston	2.50	2.50	3.87
Chicago	*1.94*	1.97	2.17
Pittsburgh	2.02	2.02	2.17
Cleveland	2.26	2.26	2.43
Detroit	2.17	2.17	2.51
Indianapolis	2.21	2.21	2.31
Toledo	2.20	2.20	2.51
Milwaukee	*2.13*	2.18	2.39
Duluth	1.95	1.95	2.10
Peoria	*1.98*	2.13	2.43
Cedar Rapids	*2.11*	2.26	2.51
Davenport	*2.06*	2.21	2.47
St. Louis	2.20	2.20	3.40
San Francisco	*2.78*	2.84	3.09
New Orleans	3.20	3.20	3.60
Minneapolis	2.24	2.24	2.41
Denver	2.90	2.90	3.10
Seattle	2.94	2.94	3.10
Dallas	2.40	2.40	2.85
Atlanta	*2.39*	2.69	3.00
Cincinnati	*2.32*	2.35	2.57
Los Angeles	*3.30*	3.31	3.21
Baltimore*	2.50	2.50	2.93
Birmingham	2.27	2.27	
Kansas City	2.40	2.40	2.76
Montreal	*2.40*	3.10*	3.50*
Philadelphia	2.21	2.21	
St. Paul	2.24		2.41

NOTE—Bags 10c. each, 40c. per bbl.

Current mill-prices per barrel in carload lots, without bags; to contractors:

Buffington, Ind.	$1.70
Universal, Pa.	1.75
Steelton, Minn.	1.75
Eastwick, Va.	1.95
Hudson, N. Y.	1.90
Lehigh Valley District	1.70
Kingsport, Tenn.	1.95
Richard City, Tex.	1.95

*Delivered by truck at site of work.

TRIANGLE MESH—Price per 100 sq.ft. in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh, Mill	Warehouse: New York	Chicago	St. Louis	Dallas	San Francisco
032	22	$0 68	$1 08	$0 76	$0.68	$1 15	$1.15
049	28	87	1 33	.98	.87	1 46	1 48
068	35	1 05	1 58	1 18	1.05	1 80	1 80
093	45	1 35	1 99	1 52	1.35	2 30	2 32
126	57	1 65	2 43	1 87	1.65	2 86	2 87
153	68	1 97	2 88	2 23	1.97	3 40	
180	78	2 26	3 28	2 56	2.26	3 93	
245	103	2 99	4 29	3 38	2.99	5 15	
287	119	3 45	4 95	3 90	3.45	5 96	6 01
336	138	4.00	5.72	4 52	4.00	7 32	
395	160	4.64	6 61	5 20	4.64	8 00	

PAVING

036P	17	$0.52	$0 83	$0 58	$0.52	$0.88	
053P	24	73	1 14	82	.73	1 24	
072P	31	91	1 40	1 00	.91	1 57	
097P	40	1 18	1 77	1 29	1 18	2 02	
049R	24	.73	1 14	.67	.73	1 24	
067R	31	.91	1 40	1.00	.91	1 57	
084R	40	1 18	1 77	1.29	1.18	2 02	

In rolls 16-, 20-, 24-, 28-, 32-, 36-, 40-, 44-, 48-, 52-, and 56-in. wide and in 150-, 200- and 300-ft. lengths. Galvanized is abou 15% higher. Size of roll carried in New York warehouses, 48 in wide x 150 ft. long, or 600 sq. f

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted are as follows:

Gage	Weight	*New York	Chicago	St. Louis	San Francisco	Dalla
27BB	2.3	$21 20	$23 36	$21 22	$23 87	$25 50
26BB	2.5	22 65	24 90	22 64	26 21	27 56
25BB	3.0	25 30	27 42			30 71
24BB	3.4	27 10	29 33	27 10	27 90	33 16
22PO	4.33	31 75	34 06			35 10

* Price to contractors at warehouse or delivered on job in Manhattan, Bronx or Brooklyn.

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Inches	Pittsburgh Mill	Birmingham Mill	Warehouse, Uncut: New York	Chicago	St. Louis	Dallas	San Francisco
¼ and larger	$1 40@$1 50	$1 70	$2 53	$2 53	$2 30	$3 50	$2 75
⅜ and larger	1 45@ 1 55	1 75	2 58	2 58	2 35	3 55	2 80
½ and larger	1 50@ 1.60	1 85	2 63	2 63	2 40	3 60	2 85
⅝ and larger	1 65@ 1.75	1 95	2 68	2 78	2 85	3 75	3 00
¾ and larger	1 90@ 2.00	2 05	2 73	3 03	3 00	4 00	3 25

Includes 15c charge for cutting to lengths of 2 ft. and over.
Twisted bars cut to length take extra of 27½c. per 100 lb.

ROLLED FROM RAILS

	Chicago	St. Louis	Dallas		Chicago	St. Louis	Dallas
½ and larger	$1 60	$2 25	$3 25	½	$1 85	$2 60	$3 50
⅝ in.	1 65	2 35	3 30	⅝	2 10	2 75	3 75
¾	1 70	2 35	3 35				

BRICK—Contractors prices per 1 000 in cargo or carload lots is as follows:

	Common: Current	One Month Ago	One Year Ago	Paving Block: 3-inch*	4-inch*
New York (del.)	$21 40	$20.40	$22 70	$44 50	$49 50
New York (at dock)	18 00	14@15			
Chicago	11 00	11 00	15 00	34 00	42 00
St. Louis, salmon	17 00	16 00	15 00	37.50	37.50
Denver, salmon	14 00	14 00	14 00		
Dallas	11 00	11 00	25 00	no market	
San Francisco	15 50	15 50	18 00	44 38	
Los Angeles	15 00	15 50	15 50	(not used)	
Boston (del.)	16 00	17 00	25 00	46 50	52 60
Minneapolis (del.)	15 00	15 00	20@22		43 00
Kansas City	14 50	14 50	22 00		
Seattle	14 00	14 00	19 00	48 00	53 50
Cincinnati	17 00	17 00	21@22	41 00	36 50
Montreal (del.)	16 00	16 00	20 00	100 00	120 00
Detroit (del.)	16 50	16 50@17	18 00	46 00	40 00
Baltimore (del.)	20 00	20 00	20@25	36 00†	
Atlanta	8 25	9 00	13 00		
New Orleans	12 50	12 50	24 00		
Birmingham	10 50	10 50			
Philadelphia	16 00	16.00			42 00

* Log paving blocks 3½x8½x3 and 3½x8½x4 respectively. † Vitrified Co. plant, Baltimore.

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York: Current on Trucks*	New York: One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Portland, Oregon, No. 1 Factory*
4x12x12	$0 11120	$0 2444	$0 0821	$0 095	$0 08	$0 108	
6x12x12	16670	3259	0950		11	136	
8x12x12	20840	4345	1295	175	145	244	$0 17890
10x12x12			1584		19		21670
12x12x12			1811	255	22		27170

* 5 per cent off for cash.

	4x12x12	8x12x12	12x12x12
Boston	$0 0960	$0 182	$0 248
Minneapolis (f.o.b. cars)	0672	105	168
Minneapolis (delivered)	0752	1175	188
Cincinnati	.0670	.126	175
Kansas City	.085	167	.270
Denver	08	14	21
Seattle	10	17	3
Los Angeles factory	095	1	22
New Orleans	13	24	40
Detroit (delivered)	070	135	225
Montreal	20	36	56
Baltimore	14	25	40
Atlanta	07@08	13@15	
Dallas	13		
Birmingham	095	1795	

San Francisco, Philadelphia and New York quote on hollow partition tile.

STRUCTURAL MATERIAL—Following are base prices f. o. b. mill, Pittsburgh and Birmingham together with quotations per 100 lb. from warehouses at places named:

	Pittsburgh, Mill	Birmingham Mill	New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in.	1.40@1 50	$1.75	$2 63	$4 00	$2 73½	$2 63	$3 10
Channel, 3 to 15 in.	1 40@1.50	1.75	2 63	4 00	2 73½	2 63	3 10
Angles, 3 to 6 in., ¼ in. thick	1.40@1.50	1.75	2.63	4.00	2 73½	2 63	3 10
Tees, 3 in. and larger	1 40@1 50	1.75	2 63	4.00	2 73½	2 63	3 10
Plates	1.40@1 50	1 75	2 63	4 00	2.73½	2.63	3 10

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Pittsburgh, Mill	Warehouse: New York, Current	New York, One Yr. Ago	Chicago	St. Louis	San Francisco	Dallas
½ in. and larger	$2.25	$3.50	$5.08	$3.43	$3.52½	$4 50	$5 50

CONE HEAD BOILER

½ in. and larger	2.35	3.60	5.30	3.53	3.62½	4 60	5 65
⅝ and ¾	2.50	3 76	5 45	3 68	3.62½	4.75	5 80
⅞ and 1	2.75	4.00	5 70	4.18	3.62½	6 00	6.05

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in. take an extra of 25c.

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh, Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire	$2 50	$3.15	$3.90	$5 00	$3 62	$4 95
Cut	2 25	5.80	5.90	7.75		5 00

PREPARED ROOFINGS—Standard grade rubbered surface, complete with nails and cement, costs per square as follows:

	New York: 1-Ply l.c.l.	New York: 2-Ply l.c.l.	New York: 3-Ply l.c.l.	Philadelphia: 1-Ply l.c.l.	Philadelphia: 2-Ply l.c.l.	Philadelphia: 3-Ply l.c.l.
No. 1 grade	$2 02	$2 38	$2.80	$1 92	$2 28	$2 70
No. 2 grade	1.77	2 08	2 45	1 67	1 98	2.35

Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs **$1.95** per roll in carload lots and **$2.20** for smaller quantities f.o.b. Philadelphia.

Shingles, red and green slate finish, cost **$5.50** per square in carloads; **$5.75** in smaller quantities, in Philadelphia.

ROOFING MATERIALS—Prices f.o.b. New York:

Tar felt (14 lb. per square of 100 sq.ft.) per roll of 432 sq.ft	$2 00
Tar pitch (in 400-lb. bbl.), per 100 lb	1 85
Asphalt roofing (in barrels), per ton, f.o.b. plant	47 50
Asphalt felt (light), per ton, f.o.b. plant	67 00
Asphalt felt (heavy), per ton, f.o.b. plant*	68.50

* Delivered in Metropolitan Dist., $3.00 additional.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill.

Blue Annealed	Pittsburgh, Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10	$2 25	$3 47½	$3 28	$3.45	$3 28
No. 12	2 30	3 52½	3 43	3.60	3 33
No. 14	2 35	3 57½	3 48	3.65	3 38
No. 16	2 55	3 67½	3 58	3.75	3 48
Black					
*Nos. 18 and 20	2 85	3.55	3 95	3.95	3 80
Nos. 22 and 24	2 90	3 70	4 00	3.85	3 85
*No. 26	2 95	3.85	4 05	3.95	3 90
*No. 28	3 00	4 15	4 15	3.45	4 00
Galvanized					
No. 10	3 00	4 15	4 15		4 00
No. 12	3 10	4 25	4 25	3.40	4 10
No. 14	3 10	4 25	4 25	3.50	4 10
Nos. 17 to 21	3 40	4 45	4 55	3.50	4 40
Nos. 22 and 24	3 55	4 70	4 70	3.65	4 55
Nos. 25 and 26	3 70	4 85	4 85	4.00	4 70
*Nos. 28	4 00	5 15	5 15	4.30	5 00

*1 per cent extra for each 1 000 lb. for 5 to 28 gage. For 29 to 32 gage, 24 gage f

LINSEED OIL—These prices are per gallon:

	New York: Current	New York: One Year Ago	Chicago: Current	Chicago: One Year Ago
Raw in barrels (5 bbl. l.c.l.)	$0 87	$0 73	$0 91	$0 75

WHITE AND RED LEAD—Base price in cents per pound

	Red — Current		Red — 1 Year Ago		White — Current	White — Yr. Ago
	Dry	In Oil	Dry	In Oil	In Oil	In Oil
100-lb. keg	12 25	13 75	13 00	14 50	12.25	13 00
25 and 50-lb. kegs	12 50	14 00	13 25	14.75	12.50	13 25
12½-lb. keg	12 75	14 25	13 50	15 00	12 75	13 50
5-lb. cans	15 25	16 75	16 00	17 50	15.25	16 00
1-lb. cans	17.25	18 75	18 00	19 50	17.25	18 00

LUMBER

Prices wholesale to dealers in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in more than carload lots. To contractors, $2 per M ft. additional

Lumber Prices to Contractors in Yards at San Francisco

	6–8 and 12 Ft.	10–16–18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$32.00	$32.00	$28.00	$34.00
3x6 and 8	28.00	28.00	29.00	34.00
4x4–6 and 8	28.00	29.00	30.00	35.00
3x10 and 12	28.00	29.00	30.00	35.00
3x14	**32.00**	33.00	34.00	38.00
4x10 and 12	28.00	29.00	30.00	35.00
4x14	32.00	33.00	34.00	36.00

	24 Ft and Under	25 to 32 Ft.	33 to 40 Ft
6x10	$30.00	$33.00	$35.00
6x14	32.00	35.00	37.00
8x10	30.00	33.00	35.00
3x14	32.00	35.00	37.00

New York, Chicago, St. Louis and Detroit—Wholesale prices to dealers of long leaf yellow pine.

	New York*— 20 Ft and Under	New York*— 22–24 Ft.	Chicago — 20 Ft and Under	Chicago — 22–24 Ft.
3x 4 to 8x8	$38 00	$39 00	$39.00	$41.00
3x10 to 10x10	41 00	42.00	41.00	43.00
3x12 to 12x12	44 00	45.00	43.00	45.00
3x14 to 14x14	47 50	48 50	47.00	49.00
3x16 to 16x16	52 50	53 50	52.00	54.00
3x18 to 18x18	60 00	61 00	58.00	60.00
4x20 to 20x20	70 00	71 00	65.00	67.00

* Wholesale price to dealers; to contractors, on lighters or cars, about $5 additional. Short leaf pine up to 14 x 14 costs $15 per M. less

St. Louis: Yellow pine, 100@20 ft. long: 3 x 4 to 6 x 6, $20 00; 3 x 8 to 8 x 8 #19; 3 x 12 to 5 x 12, $25; 3 x 14 to 5 x 14, $28; 3 x 16 to 4 x 16, $32; 12 x 14 to 14 x 14, $27; 3 x 10 to 10 x 10, $21; 3 x 18 to 4 x 18, $38; 12 x 16 to 16 x 16, $31

Detroit—Norway pine 2 in. x 4 in., 10 ft. x 16 ft. long, $35, 2 in. x 12 in., 10 ft. x 16 ft. long, $37; short leaf yellow pine 2 in. x 4 in, 9 ft. x 12 ft. long, $27.50 2 in. x 8 in., 18 ft. x 20 ft. long, $31; yellow pine flooring No. 1 common 1 in. x 3 in., $39.75, 1 in. x 4 in., 6 ft. x 12 ft. long, $37.25; yellow pine shiplap $37.00.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12 x 12 and under, for sizes over 12 x 12 add $2. for merchantable add $2 to sizes 10 x 10 and under. For pine add $2 to the price of merchantable for all sizes.

Other Cities

	8 x 8-In. x 20 Ft. and Under — Fir	Hemlock	Spruce	12 x 12-In. 20 Ft and Under — Fir	Fir
Boston	$50 00	$52 00	$55 00	$45 00	$54 00	$52 00
Seattle		**20 00**				20 00
New Orleans	28 00				25 00	
Baltimore	36 45				38 50	
Cincinnati	42 00	50 00			46 00	64 00
Montreal	78 00	85 00	68 00	78 00	78 00	
Los Angeles		**44 00**	**43 00**			**44 00**
Denver		33 75	33 75	33 75	50 00	34 75
Minneapolis	40 00	40 00	**38 00**		47 00	38 00
Atlanta	**31 00**				**37 00**	
Dallas	33 00				34 00	
Kansas City	33 00	34 00			36.00	35 00
Birmingham	20 00				26.00	
Philadelphia	32 00	35.00	30 00	42 00	38.00	35.00

	1-In Rough, 10 In. x 16 Ft. and Under — P	Fir	Hemlock	2-In. T. and Gr. 10 In. x 16 Ft. — P	Fir
Boston	$47 00	$48.00	$32 00	$45 00	$48.00
Seattle		15 00			**20 00**
New Orleans, at mill	65 00			32 00	19 50
Baltimore	35.00			38.45	
Cincinnati	62.50	80 00		33 50	
Montreal		60 00	60 00	80 00	80 00
Los Angeles		**37 00**	**36 00**		**65 00**
Denver		29.25	29 25		30 25
Minneapolis	38 50	36 25	**34 25**	36 00	34 75
Atlanta	**18 00**			**22 00**	
Dallas	32 00	30 00		36 00	
Kansas City	35.00	34 50		20 00	31 00
Birmingham	18 00			18 00	
Philadelphia	30.00	35.40	37 00	28.00	26.00

Montreal—Up to 32 ft.; over which, $3.00 per M. increase up to 30 ft

Birmingham—Quotes carload lots, f.c.b. sidings. $2 additional per M. ft. for delivery.

Boston and Cincinnati—Prices to contractors in carload lots, f.o.b.

Denver—Quotes dealers prices to contractor on large projects.

FREIGHT RATES

On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb

Baltimore	$0 33½	Detroit	$0 32½
Birmingham	.76½	Kansas City	81
Boston	40½	New Orleans	51½
Buffalo	29½	New York	38
Chicago	.38	Pacific Coast (all rail)	1 66½
Cincinnati	.325	Philadelphia	33
Cleveland	.24	St. Louis	47½
Denver	1.35*	St. Paul	66½

* Minimum carload 40,000 lb.

†Minimum carload, 50,000 lb., structural steel only; 80,000, lb. for other iron steel products.

CONTRACTORS' SUPPLIES

STEEL SHEETPILING—The following price is base per 100 lb. f. o. b. Pittsburgh, with a comparison of a month and a year ago:

Current	One Month Ago	One Year Ago
$1.80	$1.55@1 80	$3.00

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows

	Eastern Territor New York and East of Missouri River
Hercules red strand, all constructions	30%
Patent flattened strand, special and cast steel	30%
Patent flattened strand, iron rope	15%
Plow steel round strand rope	45%
Special steel round strand rope	40%
Cast steel round strand rope	32½%
Round strand iron and iron tiller	15%
Galvanized steel rigging and guy rope	17½%
Galvanized iron rigging and guy rope	+2½%

California, Oregon, Nevada and Washington: Discount 5 points less than discount for Eastern territory.

Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastn territory.

Arizona: Discount 10 points less than discount for Eastern territory.

Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.

North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ½-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ¼-in., 8 ft., ½-in., 6; ¾-in., 4½; 1-in., 3½; 1½-in., 2 ft. 10 in.; 1¼-in., 2 ft. 4 in. Following is price per pound for ½-in. and larger, in 1200-ft. coils

Boston	$0 20	New Orleans	$0.17½
New York	18*	Los Angeles	.16½
Chicago	**19**	Seattle	**16½**
Minneapolis	19½	St. Louis	.19½
San Francisco	.17	Montreal	**.30**
Atlanta	.19	Detroit	.19
Denver	20	Baltimore	**20**
Cincinnati	20	Kansas City	**18½**
Dallas	29	Birmingham	**20½**
Philadelphia	17½		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0.2950	$0.3250
Boston	24	275
Kansas City	24	2750
Seattle	1575	1850
Chicago	**2450**	**2750**
Minneapolis	2274	2530
St. Louis	2425	2725
Denver	2950	3250
Dallas	29	375
Los Angeles	25	.29
Atlanta	2525	.2925
Baltimore	2550	.27
Cincinnati	2350	.26
Montreal	225	.255
Birmingham, *delivered*	165	.205
New Orleans	2725	.3075
San Francisco	195	.23
Philadelphia	2525	.2875

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York.

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.14	$0.19
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	0.18½	0.25
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	0.21	0.27½
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	0.24	0.32½
14 in.—2 ft. from butt	6 in.	70 to 79 ft	0.26	0.34½
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	0.33	**0.42**

SCRAP—The prices following are per gross ton paid to dealers and producers in New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

	New York	Chicago	St. Louis
No. 1 railroad wrought	$10 50	$11 50	*$12.00*
Steel plate	10 50	12 00	*12.00*
No. 1 machinery cast	16 50	**16 50**	*14.50*
Machine-shop turning	4 00@5 00	4 00	*5.00*
Cast boring	7 50@8 00	5 50	*5.00*
Railroad malleable cast	8 50	12 50	*9.00*
Re-rolling rails	9.50@10.00	13 00	**15.00**
Relaying rails	27@28	30 00	*15.00*

SHIP SPIKES—Current prices per 100 lb.:

In.	San Francisco — Galv.	San Francisco — Black	Seatt'l Blac
½	$9 10	$7 20	$8.55
⅝	8 65	6 65	8.25
¾	8 50	6.50	8.3

Pittsburgh base in lots of 200 kegs or more $2.25@2.30

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, President

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. Mehren
Editor

Volume 88 — NEW YORK, MARCH 9, 1922 — Number 10

Concerning This Issue

NEXT week the American Railway Engineering Association will open its annual meeting in Chicago. It is appropriate, therefore, that in this issue *Engineering News-Record* should turn to a consideration of railroad problems in so far as they are the concern of engineers. Of such problems the foremost is doubtless that of maintaining a safe and adequate transportation machine. A little later, perhaps, railroad men will be required to take up again the more stimulating work of expansion and new construction; but just now the task is maintenance. The serious character of this problem will be appreciated after a consideration of Mr. Parmelee's review of 1921 maintenance work, while an indication of the lines along which it has been attacked is contained in the article on machine-ditching and in the description of the maintenance-by-contract system that has been used by the Canadian Pacific Railway. In the first case economies are effected by the substitution of machine for hand labor, while in the latter the end is sought by dealing more efficiently with the human element. The article on the reconstruction of French railway structures suggests something of the resourcefulness that French engineers have brought to bear on a tremendous and disheartening task; while the story of the 5-mile tunnel on the Tokyo-Kobe railway may be something of a surprise to those who think of Japan as a land of miniatures. Let us hope that a year hence we may be able to chronicle the beginnings of new railroad undertakings, now long overdue, and worthy of the best engineering talent that America can bring to their service.

Good Work by the F. A. E. S.

THE reorganization of the Patent Office so long demanded by engineers is now a fact. The President has signed the bill reclassifying the examiners and guaranteeing salaries that approach the value of the services rendered; at least they are sufficient to issue retaining capable men for a fair length of time. Credit must be given the Federated American Engineering Societies for their persistent campaign in favor of this bill and for their part, a large one, in the final success.

An Economic Touchstone

ROBBING Peter to pay Paul has always been a favorite form of economic readjustment, both in private and public affairs. Just now it is especially popular at Washington, where conflicting interests, each looking for its own salvation, are playing on the average congressman's desire for re-election. Economic nostrums to bring about the long-awaited return to normalcy, either individual, group or national, are seriously put forward every week, and unless the people, by individual expression and through the press, make known their wishes so strongly that Congress cannot misunderstand, some, at least, of this special interest legislation is going through. The average citizen, honestly looking for his own benefit through benefiting the whole country, may be somewhat at a loss as to what stand he should take on any particular proposal. For such a man the editor of "The World's Work" advances a pretty good touchstone. Of the various measures before Congress, he says "If it proposes to give somebody something, it is bad. If it proposes to buy something for which there is no market, it is bad. It it proposes to tax one class of people or one kind of business, for the purpose of benefiting another class of people or another kind of business, it is bad." In other words, transferring money from one pocket to the other never boosted a credit rating.

Speed Up Departmental Reform

NEARLY a year has gone by since the President appointed the Brown commission to report on a reorganization of the government departments for better efficiency. It is reported that the commission has made its recommendations and that they will be soon submitted to Congress by the President. Unfortunately, if things are allowed to take their normal course, there is much less chance of anything useful or definite being done now than there would have been a year ago when the Administration heads were new to the departmental game and not infected with the bureau pride that so soon gets in its deadly work. Aroused public opinion is needed to renew the effort to put more business in government. To the office man in Washington whatever is is right. A proposal for a change is an invasion of vested rights. Working, as most of them do, for less pecuniary reward than could be won in business fields, they seek compensation in power and they fear any readjustment of functions as a reduction of that power. With a new group of head officials, fresh from business life and with an unprejudiced desire to improve government service by more efficient organization, there were prospects that these existing influences might be overruled. The new officials are fast becoming old government employees and their enthusiasm for a proper rearrangement of the federal bureaus needs the reviving influence of the citizen, who is still looking at government objectively. Societies and individuals should continue their efforts to put the departmental reorganization through.

Local Motor-Truck Restrictions

ENACTMENT or amendment of state laws is generally such a slow process that certain counties, actuated by a desire to protect their highways from damage by motor truck traffic, have taken the initiative in passing local regulations restricting gross weights of vehicles. While such action has justification in certain cases as an emergency measure, it is attended with manifest disadvantages. Unduly restrictive

course has the advantage of providing immediate relief because authority is vested in existing agencies which can protect the investment of county taxpayers in good roads from being wiped out by unreasonable traffic. Nevertheless, if the practice of county regulation of motor vehicles becomes general, the already unsatisfactory condition of traffic legislation by state laws will become chaotic. Even where the states undertake to fix license fees and limit loads, there is the greatest lack of uniformity. This is the condition where forty-eight agencies have a finger in the pie. Increase this number of agencies to many thousands and the result becomes appalling. At certain seasons of the year, particularly in the early spring when the roads are soft, reduction in the normal allowable gross weight is highly desirable and, in fact, a number of the states have passed laws empowering the state highway engineer to impose such temporary restrictions as emergency measures. This sort of seasonal and, in some cases, local regulation is an entirely different matter from that of regulation by such political units as counties. Trouble experienced in protecting highways from excessively heavy vehicular loads is due, in many cases, not to lack of legislation but to laxity in measures of enforcement of existing laws. An investment in loadometers and a few platform scales has been found, in many localities, to be an effective antidote for the overloaded-truck evil. Before counties resort to independent regulation they should experiment for a few weeks, at least, with rigid enforcement of the existing state law.

"Remedies" that Destroy

"DISTORTED" railway rates, as Secretary Hoover calls them, have a much more vital significance to the public than merely to effect a temporary change in the prices of commodities. They produce a distortion of the entire economic structure that is far-reaching in its scope and appallingly wasteful in its effect.

Let us for a moment examine the commercial structure. It may be likened roughly to an open-meshed fabric composed of many strands woven hither and yon, each under a certain stress and each elastic to some degree. Where they cross, these strands are not bound tightly; nevertheless they do tend to concentrate their crossings at certain foci where they adhere more or less.

These strands represent the commercial influences and facilities. Some of them are material, as railway, highway, and water-borne traffic. Some are quite intangible, as credit, railway rates, foreign competition, and the buying habits of the people. At the foci, where the strands cross, are the centers of commerce, production, and population.

So long as commercial conditions are normal, this vast and complicated fabric is in equilibrium, each strand giving a little and taking a little under the slight distortions of changing commercial conditions. A drought in Kansas, a minor change in freight rates in New England, or a bank failure in Texas, may disurb the equilibrium more or less, producing stresses in the strands. These, however, are well within the elastic limit and although the fabric changes shape slightly, it remains intact.

But under violent or far-reaching disturbance this no longer is true. Under such stress some strands are strained almost to breaking, others snap, while still others may be wholly relieved of stress and thrown out of action. New foci are created by the shifting and readjustment of the strands amongst themselves; great investments of capital at existing foci and along certain of the strands may be rendered useless and, for all practical purposes, destroyed. The San Francisco fire was such a disturbance. Let those who doubt ask Seattle and Los Angeles. The opening of the Panama Canal was another, although its effects were, so far as possible, discounted. Hill's steamship lines to the Orient were still another.

But all these were trifling alongside the disturbance that was inflicted upon the fabric by the horizontal increases in railroad rates. As Secretary Hoover has pointed out, these were imposed broadcast without regard to existing conditions. The increased rates since 1914 he tells us have added probably less than 1 per cent to the price of cotton goods while they have added nearly 100 per cent to the cost of assembling the materials for pig iron.

"All this," continues the Secretary, "is artificially forcing our industries to move toward their raw materials. This does not alone represent the starting of a new factory; it is a movement of the whole mechanism of the community, labor, homes, schools, railways and what not—an enormous duplication of plant and loss of capital. We will ultimately have the rates readjusted and then we will destroy the new industries created under them."

What Secretary Hoover points out with respect to railway rates applies with equal force to every sweeping and undiscriminating change in the commercial fabric. His words should be pondered by the panacea-hawkers who infest the land, directing their efforts toward attainment of a single object and forgetting that no fundamental can be changed without affecting the entire structure.

The Maintenance Man's Burden

ALMOST everyone will agree that full benefit cannot be realized from a business revival unless the railroads are in shape to meet the needs of expanding business. Everyone will agree also that the railroads are far from being in such shape today. If there be doubters we refer them to Mr. Parmelee's review, elsewhere in this issue, of 1921 maintenance, and to his conclusion that "maintenance during 1921 was not sufficient to make good the deterioration of the plant during that year, either on the basis of normal traffic or on the basis of the decreased traffic actually handled."

Just what does this mean? It means, in the first place, that in default of adequate appropriations the burden of keeping our railroads going has borne heavily on those executives and engineers who have been responsible for the maintenance of way, structures, and rolling stock. It means that these men have been required to make bricks without straw, and to their credit be it said that they have succeeded admirably. We are prone to hail the builder of a Woolworth Tower or a Panama Canal and to overlook the achievement of the engineer, who, day in and day out, in the face of most adverse and disheartening conditions continues to hold his plant up to operating requirements. But despite the splendid page that these men have written in American engineering history, the fact remains that railroad properties have deteriorated sadly; and if they are to perform the service that will be demanded of them by a business

revival they should be re-established as safe and adequate transportation machines having a reasonable operating factor of safety.

This means money. Where is it to come from? We can figure on no increase in gross earnings from a general increase in rates. Possibly a few dollars may be scraped up from rates here and there, but the possibility is slim. To meet immediate needs we must continue to look to economies in operation as the principal source of revenue.

Incidentally, let us point out in passing that the scamping of maintenance is not economy. To let a property deteriorate does not save expense; it consumes capital. In desperate straits, a man may be forced to draw on his principal, but we should scarcely call such a course an "economy." True economy must be sought elsewhere. Frills may be eliminated; brains may be substituted for brawn; machinery may replace manual labor. In some departments progress has been made in reducing the restrictive influence of labor unions, but along this line there is still opportunity to get more nearly the worth of 100 cents for each dollar of wages paid. These are true economies as opposed to the false economy of inadequate maintenance.

But all that may be saved by these methods does not begin to approach the need for new construction and equipment. We are told, therefore, that from the first slim earnings of the hoped-for revival we must begin to wring dividends which will re-establish the credit of the roads and permit the financing of the more far-reaching improvements. Such a course we believe would be most unfortunate. When the revival comes, deferred maintenance should have a lien on earnings senior to any dividends or rate-cuts, except possibly cuts on primary commodities which might be expected to stimulate a worth-while volume of earnings.

That is one reason why we have looked with favor on the proposal of Secretary Hoover that government credit —not cash—be loaned to the railroads for this purpose. In this way, and in this way only, can the railroads be assured of the capital they need at a reasonable interest rate without being compelled to create a false appearance of prosperity by diverting their earnings from the maintenance that is so essential.

Industrial Relations Court to the Bar

TWO YEARS ago Kansas embarked upon an industrial experiment best known as the Industrial Relations Court. By many employers the court was regarded as a new form of anti-strike or anti-picketing measure and hailed accordingly. Organized labor appeared to agree with these employers for its leaders soon set out to oppose the new agency of government. No less a person than Samuel Gompers locked horns in public debate with Governor Allen, chief proponent of the court. Labor, we are told, dubbed the new law "The Kansas Slave Act."

But times have changed. The economic whip has passed from the hand of labor to that of management and with the passing matters have assumed a different aspect. An association of employers has been set out to "get" the court. Legal action has been brought by one of them, and plans are now hatching to make the court a leading issue in the fall political campaign. Management, we are told, fears that government has gone farther than it should and even the court a tendency to exercise a "paternalistic and managerial jurisdiction" over private industries.

Maybe so. As with most experiments, this effort may have failed to score a hit on its first shot; but if we can judge by the reactions of labor and of management the court seems to have its target fairly bracketed.

Whatever turn the controversy may take, however, it is to be hoped that the people of Kansas will not forget the standard broken out by Governor Allen when he undertook the championship of the Industrial Court measure; viz., that it is a duty of government to protect the people it serves against the evils of industrial warfare no less than against those of external aggression. The Industrial Court, to be successful, must be nobody's weapon; it must be a shield to protect the bystanding public equally against the stray bullets of labor or of management. At this distance we cannot say whether it has done this. Its friends say that it has succeeded splendidly and that since its establishment strikes have been almost eliminated and many radical agitators have left the state. Its enemies, on the other hand, pronounce it a complete failure. They say that it has provoked strife rather than prevented it and that it has driven desirable industries away from the state.

These are questions of fact which the people of Kansas should be in position to answer. Two years may be too short time in which to determine finally the precise agency that will best carry out the idea behind the Industrial Court but surely it is long enough to demonstrate whether the present tribunal is headed in the right direction.

Studying Construction Methods

IMPORTANT work in studying construction equipment and methods will be undertaken this year by the Associated General Contractors. The success of this work will depend very largely upon the co-operation which contractors give the agents of the association whose task it will be to assemble the information. These men can, from their own experience, furnish only a small number of the facts which will be necessary as a basis for conclusions.

Information must be made available from all sections of the country so that variations due to climate, labor conditions, character of soil and the scores of other differences in conditions can be appraised and averaged. This means that contractors widely must contribute liberally from their records. As individual methods and costs will probably in no case be made public, the information given can be complete and candid without fear that business secrets may be revealed. Indeed, the information must be full and frank or the conclusions will be false.

That the contracting industry should determine preferred practices in equipping construction work and preferred methods of doing work does not admit of argument. Bidding prices will be stabilized, average quality of construction will be improved, but most important of all, the standing of the contractor as an expert in construction will be strengthened in the opinion of engineers and owners.

It may even be possible in some instances to approach standards. Obviously, however, standardization has to be accepted with caution. Nothing must be done that will discourage improvement in equipment and methods. Standardization may wisely be left until later.

Railway Ditching Machines and Performance Records

Wing Type Ditchers Clear Track Ditches and Dress Slopes Rapidly and Cheaply—Comparative Costs of Hand, Team and Machine Work

THE substitution of machinery for manual labor in cleaning track ditches and widening cuts has accomplished so much for improvement and economy in maintenance of way work that as a result of present labor conditions it is being considerably extended.

Ditch cleaning by hand is slow, heavy and tedious work, and on a large portion of the track mileage it cannot be handled properly by the section gangs along with their many other duties. Work trains and extra gangs must, therefore, be assigned for periodical ditch cleaning, such trains to include one or more ditching machines or to be manned by a large gang of laborers.

Railway ditching machines are of two general classes. The first, or wing type, consists of a heavy car fitted with a side wing or scraper blade shaped to conform to the standard section of the ditch and roadbed shoulder. This wing cuts the soil and pushes it ahead to some point beyond the cut where it can be thrown

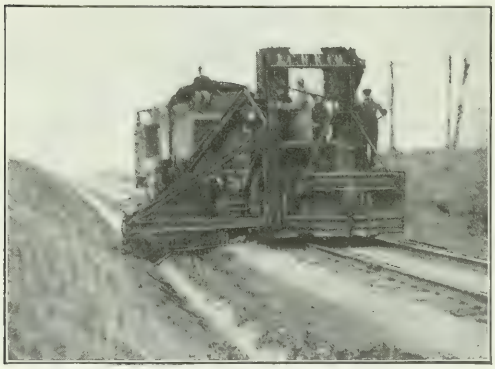


FIG. 1. DITCHING MACHINE OF WING TYPE ON ILLINOIS CENTRAL R.R.

clear of the roadbed. A modification of this type has, instead of a wing, a scoop or bucket hung from a derrick at the side of the car. The wings or buckets, as the case may be, are handled by power equipment on the car, usually operated by compressed air from the locomotive that pushes the car. In general, the ditching is done on one side at a time, but the larger machines have wings on both sides and can clean both ditches at once. In addition to cleaning ditches these machines can also be used advantageously to cut down the shoulders on fills, thus improving drainage without disturbing the ballast shoulder.

The wing type of railway ditcher is a development of the spreader car so extensively used for leveling material dumped or plowed from cars, and several companies manufacture ditching wings that can be attached to spreader cars.

The second type of railway ditcher consists of a small revolving steam shovel mounted on a length of track on the deck of a flat car. Ordinarily the shovel travels along a train of such cars, loading the excavated material behind it. On double track, two work trains are sometimes employed, the ditcher occupying one track while loading a train on the other track. When a work train cannot be allowed to occupy track for any length of time, the car carrying the steam shovel may be attached to a dump car or placed between two dump cars. By quick movements between its working point and a sidetrack this train can keep clear of traffic (see *Engineering News*, March 16, 1916, p. 498).

For ordinary ditching in earth and soft soil on the Illinois Central R.R. a machine of the wing or scraper type is employed, as shown in Fig. 1. If the excavation is heavy or in hard soil and includes the widening of cuts, it is often found desirable to handle the bulk of the excavation with dump or wheel scrapers and teams, or a ditcher of the steam shovel type, using the scraper machine to finish the ditch to the grade of the standard roadbed section. The cost of the steam-shovel work has been found to be greater than that of cleaning by the scraper or wing machine. In general, however, once

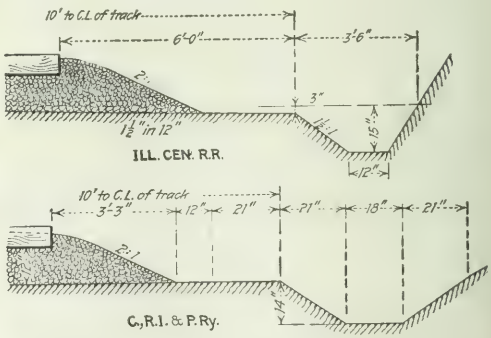


FIG. 2. DITCH AND ROADBED SECTIONS FORMED BY MACHINE

the cuts have been restored to the standard section, the ordinary cleaning of ditches involved in regular spring or fall maintenance work can be done entirely by machines of the wing type.

In operation, the wing ditching machine is pushed through the cut, the wing being adjusted to suit the conditions. As a rule, one or two runs are made, but in some cases as many as five runs are required to cut to the desired depth and width. On the last run a steel template on the bottom of the wing finishes the roadbed shoulder, ditch and side-slope to the standard section, shown in Fig. 2. In the heaviest work the machine can push ahead of the wing about 10 cu.yd. of material which is carried beyond the cut far enough only to throw it over a fill or to spread it. An average day's work is about 400 cu.yd. of material moved and about 4,700 ft. of ditch finished. Several different features of machine ditching work are shown in Fig. 3.

For the best results, a heavy locomotive is used, operated at a speed of from 3 to 10 miles per hour, according to the character and amount of material and the condition of the track. The greatest efficiency is obtained with two wings, since the second wing eliminates much

back haul of the machine. Occasionally both wings can be used at the same time, giving a balanced load which permits a greater speed with safety. The crew consists of an engineman and fireman on the locomotive and one or two men on the ditcher to adjust the wings, the second man being necessary only when two wings are operated at the same time. There is required also the usual number of trainmen. The engine and ditcher constitute a work train which is handled under the usual work-train orders from the dispatcher and which is run to the nearest siding to clear traffic.

It has sometimes been found necessary and economical to ditch certain rock cuts, sliding cuts and tunnels by means other than work trains and ditchers. In such places, push cars have been used, with dump boxes designed for quick unloading. Pony cars, somewhat similar to a track barrow, and running along one rail, have also been used to advantage, especially in rock cuts where work-train service would be costly because of very heavy traffic. A special method of this sort was used by the Illinois Central R.R. to ditch in Head's Cut, Indiana, which gave so much trouble from sliding that day and night watchmen were necessary to protect traffic. A narrow-gage railroad with very light rail was laid between the track and the side of the cut to carry small tram cars. By this means two men have been enabled to keep this cut well ditched.

Machine work is so much more economical that work-train ditching with hand labor is no longer done on this road, except where no other means will serve. For such hand work as is necessary a train of flat cars with low side boards is ordinarily used. This is loaded by a gang of from 40 to 100 men and unloaded on an adjacent fill by means of a rapid-unloader. This consists of a plow that is pulled through the cars by a cable wound on a hoisting engine set on a car next to the locomotive. It is estimated that even under conditions favorable to hand work, a wing ditching machine can do twice as much work in a day as can be done by a gang of 100 men.

Where ditchers of the small revolving steam shovel type are used on this railroad they are practically always operated in pairs, the outfit consisting of two ditchers, each located between two 20-yd. air dump cars. These, with the locomotive and caboose, constitute the work train. With machines of the revolving steam shovel type and the wing ditcher type available the amount of ditching by hand, team or other methods has been greatly reduced. In fact, it is expected that such methods can ultimately be eliminated except for a few cuts where conditions will not permit the use of either type of machine.

No one method of clearing ditches is the most economical or practicable for all conditions on a large railway system. Comparative costs of different methods were given in *Engineering News-Record* of Oct. 9, 1919, p. 700. According to an investigation made on the Illinois Central R.R. the several methods may be compared as follows:

1. The spreader or wing ditcher with ditch-shaping attachment is best for cuts where the material can be pushed through. The work done in this way would cost 10c. to 30c. per cubic yard in places where by any other method it would cost 24c. to 75c.

2. The steam-shovel ditcher with flat cars and unloader plow can be employed to advantage in long cuts where the traffic is light and the haul to dumping point

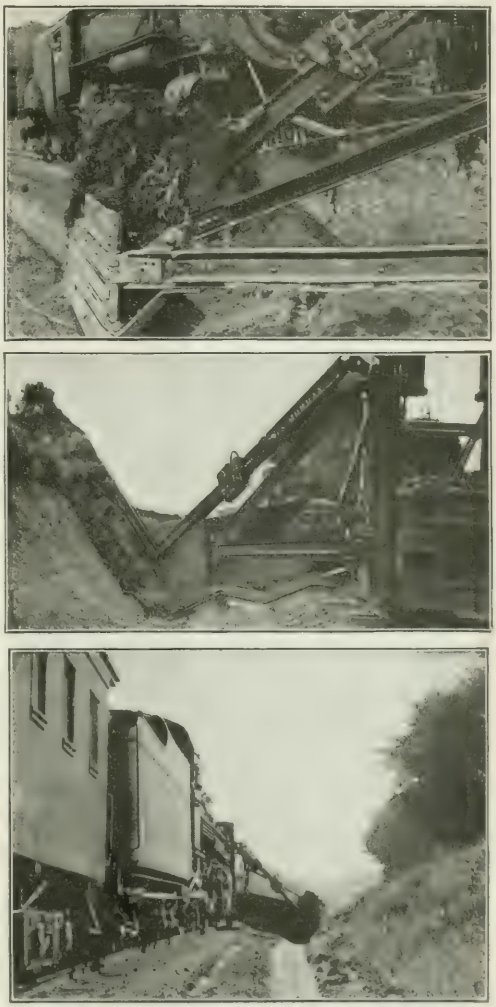


FIG. 3. DITCHING WITH WING MACHINES ON THE ILLINOIS CENTRAL R.R.

A—Main and auxiliary wings form pocket for heavy dragging. B—Finishing the ditch and shoulder to standard section. C—Ditching train at work.

is long. This work would cost from 40c. to $1 per yard in locations where the cost by any other method would be 50 per cent greater.

3. The same type of ditcher used in pairs with dump cars, as described, is in general the most economical method for use in long cuts where teams cannot be used and where the haul is too great for other methods. In such cases the cost would be 20c. to 50c. per yard, where by other methods it would be 50c. to $1.50.

4. Teams may be used where the wing type of ditcher is not available for cuts not more than 600 ft. long or with places where teams can take the earth to the top of the cut. The cost will be from 30c. to 75c. per yard.

5. Men handling push cars and dump trays can be

used to advantage on lines of light traffic with relatively short cuts which are too narrow for other methods or in short deep cut where teams or wing ditchers are not available.

6. A ditcher plow may be used in prairie country with very light ditches, and for light work in shallow cuts where a wing ditcher is not available. The cost would be from 10c. to 30c. per yard.

7. Narrow-gage tracks and monorail cars may be economical in cuts where material is sliding or falling continually and where watchmen must be maintained.

A ditching machine of the wing type has been used extensively on the Iowa division of the Chicago, Rock Island & Pacific Ry., principally in shallow cuts, some of which are 1,200 ft. long. Various kinds of material are encountered, ranging from gravel to earth and wet

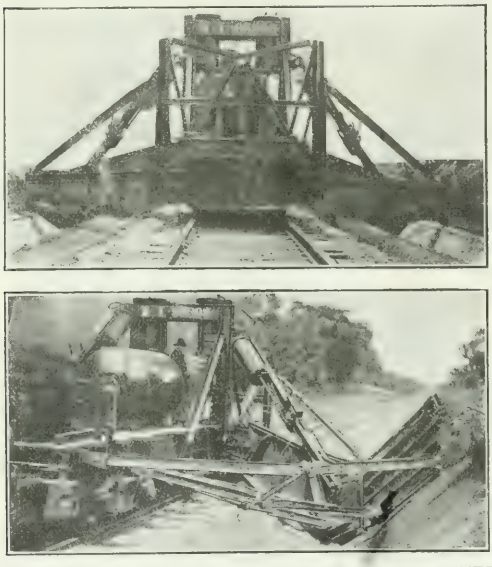


FIG. 4. WING TYPE DITCHER ON THE ROCK ISLAND LINES

Above—Wings extended to cut both ditches at once. Below—Auxiliary wing in position to widen cut.

clay. In order to cut the ditches and dress them to standard section several trips are necessary through the longer cuts. In one 1,200-ft. cut it was necessary to make 36 runs, removing 166 cu.yd. of material. In this work, the 45-ton ditcher is handled by a heavy 2-8-2 engine at a speed of about 6 m.p.h., ditching on either one or both sides of the track as required. The train requires only the train crew and one operator on the ditcher. In operation, the ditching train involves little delay to traffic, since the ditcher wings can be folded back in one minute while the train is moving into a side track.

These machines not only decrease the cost of the work but also make possible a more extensive ditching program. For these reasons it is planned to increase their use, supplanting the hand shoveling and team scraper work so far as possible, except at some places where it may be impracticable to work the machines. Ditchers cleaning both ditches simultaneously and widening one side of a cut are shown in Fig. 4.

According to figures given in the January number of the *Rock Island Magazine*, the expenditure for ditching on this railroad for the past six years have averaged $900,000 and the unit costs have been reduced to a remarkable extent by the introduction of ditching machines of the wing or scraper type. During two months' work in 1921, two wing machines moved 29,000 and

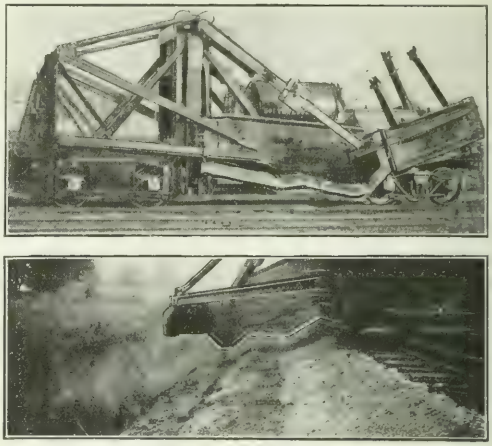


FIG. 5. RAILWAY DITCHING MACHINE

Above—Wings folded for transportation. Below—Wing templet to cut ditch and shoulder

28,000 cu.yd. at a labor cost of 1.33c. and 1.8c. per yard respectively. Two machines of the steam shovel type, operating largely in heavy cuts, moved in one month 7,000 yd. each at a labor cost of 21.8 and 23.5 per yard. From figures of 1920 and 1921 the comparative labor costs for four methods were estimated as follows: Hand ditching, 75c. per yard; teams with scrapers, 40c.; shovel ditcher, 24c. wing ditcher, 1.5c.

The wing type of railway ditching machine used on the work described above consists of a 40-ft. steel flat car with a plow or pilot across its front end fitted with cast-steel cutting shoes, to clear the track of material in front of the machine. This plow is raised and lowered by an air cylinder on the floor of the car. Above the floor and at the rear of the front truck is a steel upright cross frame supporting the vertical air cylinders for operating the main wings, which are on either side or both sides of the car. The wing, made of heavy plate, is approximately 5 ft. deep and 15 ft. long, having its lower edge protected with manganese-steel castings and shaped to cut the standard roadbed and ditch section of the railroad using the machine (see Fig. 2). The ditcher with wings folded for transportation and with one wing extended to show the templet, is shown in Fig. 5.

At the outer end of this templet or main wing is pivoted another wing which can be set and held at any desired vertical angle. This auxiliary wing can also be swung forward on a vertical hinge so that it is nearly parallel with the track, its forward end being then connected with a supporting steel frame on the forward end of the car. In this position when the main wing is swung out to its working position, the two wings form a pocket. This arrangement of the wings is used in dragging material from a heavy cut, as shown in Fig. 3 (A), thus leaving a clean ditch shaped to the standard section.

Heavy structural steel braces from the sides of the

car hold the wings in their working position. These braces are adjustable in length to suit the required horizontal angle of the wing, and are jointed at the middle so as to fold up when the wing is swung back against the car in position for transportation. An inclined tie, pivoted to the top of the upright frame on the car, is attached to the outer tip of the wing and is fitted with a pneumatic cylinder for varying the inclination of the wing. Air cylinders suspended from the frame of the car move the wings in and out.

COST RECORDS BY RAILROAD DITCHING BY WING MACHINES: 1921

Railroad	No. Ft. Ditched In Open	No. Ft. Ditched In Cut	Average Haul	Total Ft. Ditched	Total Cu.Yd. Moved	Total Cost	Cents Per Ft. Ditch	Cents Per Cu.Yd.
H. & T. C....		924	500	924	150*	$116.05		
H. & T. C. .		6,818	500	6,818	1,278	121 11	1.7	9.5
L. & A.† .		4,928		4,928		88 70	1.8	
L. & A.† ...	6,688	2,992		9,680	...	97.59	1.0	
L. & A.†....	36,608			36,608	...	98 28	0.2	
L. & A.†....	23,056			23,056		99.65	0.4	
L. & A.†....	19,712			19,712		96 23	0.5	
L. & A.†.....	15,136			15,136		92 12	0.6	
H. & T. C...	9,140			9,140	1,525	107 00	1.1	7.0
C., R. I. & P.	307,560			307,560		467 64	0.15	
A. & G. W.		1,870	900	1,870	1,402	112 60	6.0	8.0
F. W. & D. C.	27,600			27,600	29,875	108 34	0.4	0.4
F. W. & D. C.	29,600			29,600	34,933	108 34	0.3	0.3
M. K. & T..	116,425			116,425		619.88	0.5	
				609,057		2,333.53		
Average cost per foot of ditch....							0.38	

*In addition to the 150 cu.yd for ditch on the H. & T. C. R. R., a hard clay ridge, extending along the right of way for 15,345 ft. was spread below the ballast level: 4,070 cu yd.

†On the L. & A. R. R no record of yardage was kept. Between Nov. 30, 1920, and March 1, 1921, this railroad completed 200 miles of ditch at an average cost of 1½c per foot of ditch

All operations are controlled through valves located conveniently at the forward end of a large air receiver which is kept charged to about 80-lb. pressure by the air-brake pump on the locomotive. Adjustments of the wings are made easily by one man. The main ditching wing has a vertical operating range from 4 ft. below to 1 ft. above the rail, and the outer end of the wing has a maximum spread of 21½ ft. from center line of track. The machine or car is fitted with a standard air brake, drawbar and coupler, and all U. S. safety appliances, so that it may be hauled in regular trains. It weighs approximately 45 tons. The builder of the wing machine here described is the O. F. Jordan Co., East Chicago, Ind.

Some records of performance and cost of work by this ditching machine on different railroads, as given by the maker, are presented in the accompanying table.

Earthquake Prediction by Geodetic Measurement

A study of the possibility of predicting earthquakes by geodetic measurements is being carried on by the Carnegie Institution, at Washington. According to the report of the director of the U. S. Coast and Geodetic Survey, just issued, "seismologists agree that earthquakes are due to abrupt adjustments of accumulated strains in the earth's crust. It is believed that the strains as they accumulate, prior to the actual convulsion, may cause a gradual distortion of the surface of the earth which can be detected by geodetic methods.

"As a preliminary step, it is necessary to have detailed precise triangulation and levels in regions of seismic activities, in order that studies may be made of gradual distortions" in the earth's crust prior to shock, the character and extent of the displacement during the earthquake, and the extent of the later readjustments.

Improved Lighting and Ventilation for Railway Freight Houses

By G. P. Richardson
Detroit Steel Products Co., Detroit, Mich.

Good lighting in a freight station eliminates dark aisles and gloomy corners, thus increasing the amount of usable floor space. It also facilitates the handling of freight because the tags and markings can be easily read. This consideration caused the engineers of a large railway company recently to make an investigation of their standard design for freight houses, with a view to obtaining better lighting and ventilation at the lowest cost.

The standard plans provided windows with small lights and wood sash, as shown in the upper part of



OLD AND NEW WINDOW ARRANGEMENT

the accompanying drawing. In the offices the wall spaces were dark and uninviting and in the merchandise storage space were plenty of dark nooks. The monitor had single-sash windows spaced about 4 ft. apart, with brick walls between. For a building 200 ft. long and 33 ft. wide this design provided 220 sq.ft. of lighting area and 31 sq.ft. of ventilating area on each side.

The building was redesigned with large bays of steel sash in the office and a continuous run of steel sash windows in the monitor. This revised design provides 790 sq.ft. of lighting area and 62 sq.ft. of ventilating area on each side of the building. The difference is reported by the engineers as, "an increase of 260 per cent in lighting area and 100 per cent in ventilating area." This is due partly to the larger area of opening and partly to the larger effective area on account of the small size of parts of steel sash as compared with those of wood sash. The total cost was slightly reduced, since the extra windows eliminated equal areas of brick wall, which cost more per square foot than the steel sash glazed. The only objection raised was that the extra glass area may increase heating costs, but the additional heating will be required during only five months in the year and it is in these months that good lighting is essential.

Driving a Five-Mile Rock Tunnel for Japan Railway

Volcanic Water-Bearing Strata—Bottom or Side Headings—Brick and Concrete Lining—Force, Plant and Progress

RELOCATION for the elimination of grades of 2½ per cent on the Tokkaido line of the Imperial Government Railways of Japan involves the construction of a 30-mile cut-off in mountainous country and the driving of a double-track tunnel five miles long to avoid the present line over the Hakone Pass. This tunnel will be the longest in that country and one of the longest double-track tunnels in the world. It is being driven from both ends and each heading has advanced over 5,000 ft. Work was commenced on the new line in 1916 and on the tunnel in 1918.

The Tokkaido line, between Tokyo and Kobe, is an important section of the railway system and its double tracking was completed in 1913. Ruling grades are limited to 1 per cent and its curves to 1,000-ft. radius, except at two difficult points where it was necessary to introduce grades of 2 and 2.5 per cent. With increased traffic the operating conditions warrant the expense of grade reduction. One of these heavy-grade sections is that between Kozu and Numadzu, 37 miles, including the Hakone Pass, noted above, as shown in Fig. 1. The other is a 10-mile stretch between Otsu and Kyoto, where a tunnel 2,181 ft. long will give a maximum grade of 1 per cent instead of the 2½ per cent grades over the open pass.

Atami Cutoff—The longer relocation, known as the Atami cutoff or detour (Fig. 1) reduces the distance between Kozu and Numadzu to 30.2 miles, giving maximum grades of 1 per cent and curves of 1,320-ft. radius (about 4 deg., 20 min.) but requiring no less than 23 tunnels and 72 bridges. There will be eight stations. Very heavy construction work is involved, as the line crosses the valleys of two rivers subject to overflow, skirts the rough, rocky country at the foot of the mountains along the shore of Sagami Bay and then pierces the mountain range which extends across the Izu peninsula. This range, forming part of the Fuji volcanic group, has a steep slope on the eastern or Atami side and an easy slope on the western side.

From the profile, Fig. 2, it will be seen that the tunnel is to pass under the Tanna basin, a circular depression about 1.3 miles in diameter at about 770 ft. above sea level. This is fertile land containing two villages and surrounded on all sides by high peaks. The basin is supposed to be the bed of an ancient lake. An elevation of 250 ft. above sea level is reached in the tunnel, as compared with 1,500 ft. at Gotemba on the original line. A comparison of the two routes is given in Table I.

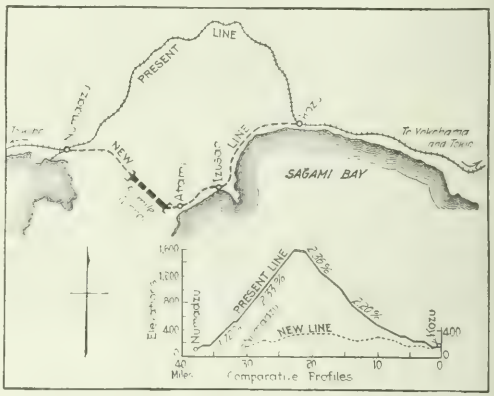


FIG. 1 LOW-GRADE CUT-OFF ON JAPANESE RAILWAY

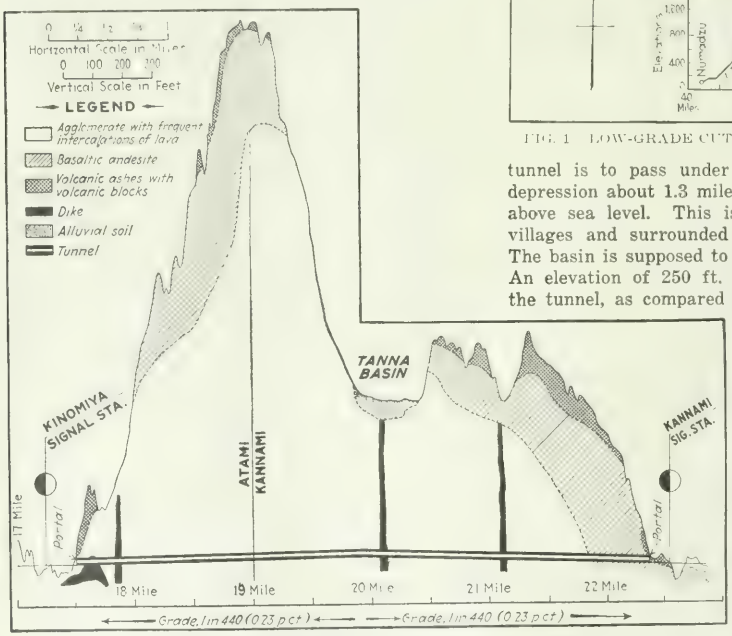


FIG. 2. PROFILE OF FIVE-MILE TANNA TUNNEL

After a rough location of three routes on a topographic map having a scale of 1:20,000, surveys were made for a comparison of these lines and finally a trigonometric survey was made of the selected line. No test holes have been drilled from the surface to the tunnel grade, to check the alignment in driving the tunnel, and it has not been decided whether such holes will be driven. The depth of cover over the tunnel ranges from 200 ft. at the Tanna basin to a maximum of nearly 1,800 ft.

Geological Conditions—Rock strata through which the tunnel will be driven consist mainly of agglomerate containing andesite of various kinds (see Fig. 2). Experience so far indicates that the strata are loose and seamy, containing an abundance of water. Hot geyser springs occur at Atami and Izusan, the latter being close to the shore and 1½ miles northeast of the eastern portal. But neither gas nor hot water are expected to be encountered in the tunnel, since volcanic activity

ceased long ago and the hot springs mentioned are far below the tunnel grade.

Temperatures in the headings are generally higher on the eastern side, probably on account of the proximity of the Atami hot springs, but on the western side the strata contain much more water. On the eastern side the temperature is about 80 deg. F. at 3,800 ft. from the entrance and 960 ft. below the surface. On the western side the temperature is irregular for although it registered 66 deg. at 1,400 ft. from the entrance and 370 ft. below the surface, lower temperatures were encountered at a distance of about 4,800 ft. and greater depth. This condition is due probably to the great amount of water contained in the rock. It is expected that a temperature of about 90 deg. F. will be found at the deepest point, about 1,800 ft. below the surface.

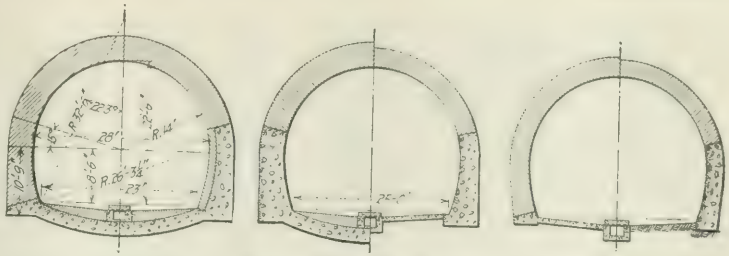


FIG. 3. TYPICAL SECTIONS OF TUNNEL LINING

TABLE I. ATAMI RELOCATION JAPAN GOVERNMENT RAILWAYS

	Present Line	New Line
Length	47 5 miles	30 2 miles
Height of summit above sea level	1,500 ft.	243 ft.
Total rise and fall	3,018 ft.	721 ft.
Ruling grade	2 5 per cent	1 per cent
Length of ruling grade	12 1 miles	6 7 miles
Total curvature	2,061 deg.	1,431 deg.
Total length of bridges	3,100 ft.	5,300 ft
Number of tunnels	7	23
Total length of tunnels	7,560	10 59/6
Equated length of line	72 2 miles	49 3 miles

Tunnel Section—A horseshoe section is employed for the tunnel, with a width of 28 ft. and a height of 22½ ft. above sub-grade to accommodate two tracks of 3½-ft. gage. The semicircular arch has a radius of 14 ft. Lining is to be used throughout, but will vary in form and thickness according to the material penetrated, as shown in Fig. 3. Bricks or concrete blocks will be used for the arch, which varies from 27 to 54 in. but is in general 36 in. thick. Bricks or monolithic concrete, or both in combination, will be used for the side walls. Where an invert is required, this will be of monolithic concrete. A rectangular concrete drain covered with concrete slabs will extend the full length of the tunnel.

The tunnel is being driven mainly on the bottom heading system, but with the widening operated in two different ways. A side heading system will be employed when the nature of the rock makes this advisable.

Principal Bottom Heading System—In ordinary material and for the greater part of the work a bottom heading 7 ft. high and 9 ft. wide is first driven, and is then enlarged to 9 x 12 ft. and timbered, as shown in Fig. 4. A vertical shaft or raise is driven up to the roof line and from this shaft two top headings 7 x 7 ft. are started in opposite directions, the muck being dumped through the raise into cars in the bottom heading.

Each top heading is widened by successive steps, as shown, until it reaches the haunches. Then the roof over the bottom heading is removed and this heading is widened to full section. Finally the forms or centering are placed for the lining.

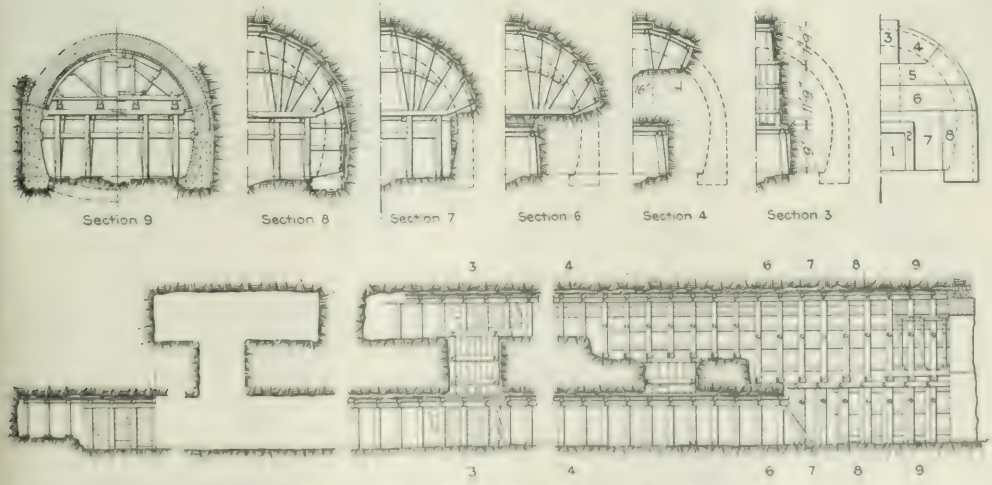


FIG. 4. TUNNELING BY BOTTOM HEADING SYSTEM

Alternative Bottom Heading System—In hard rock, the first step is the heading and its enlargement, as described above. Then a 7-ft. drift is cut in the roof and raised by successive stages until it reaches the level for a top heading. This in turn is widened and deepened until the arch excavation is completed, all excavated

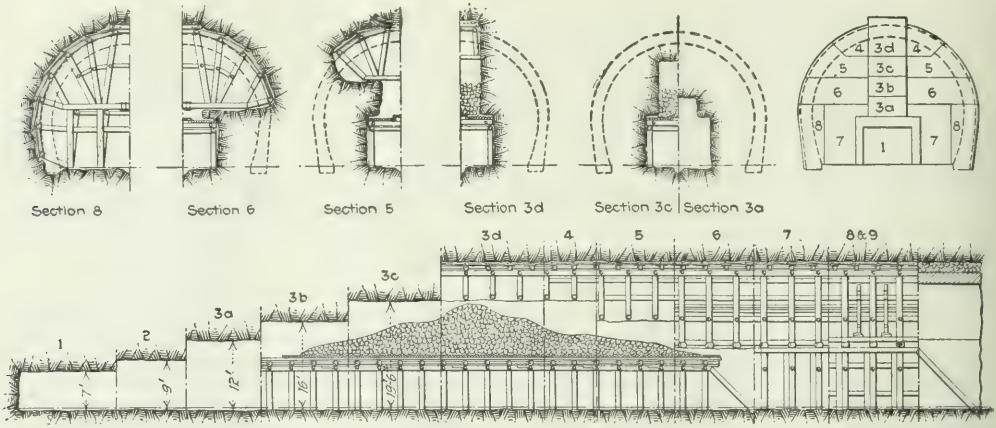


FIG. 5. ALTERNATIVE BOTTOM HEADING SYSTEM

material being dropped on the roof of the bottom heading and loaded through traps into the muck cars. The timbering of the bottom heading is then removed and this heading widened to the full tunnel section.

Side Heading System—In this third method, which is used only under special conditions, two side drifts are first run, just below the haunches. These are widened towards the middle of the tunnel, and at the same time an independent top heading is started. After the side headings have been deepened for the walls and again widened for the invert, the concrete for the side walls is placed. Meanwhile the top heading is being enlarged until the roof excavation is completed. This leaves a middle core of material between the side headings, which is utilized to support the arch centering and forms. Finally this middle core is removed and concrete is placed in the middle section of the invert.

For the ordinary bottom heading system, two compressed air drills are used in the bottom heading and one in the top heading. These drills, working with air at 80-lb. pressure, are mounted on columns wedged against the floor and roof. Dynamite is used for blasting. At the east end, the clearing of the heading after a blast takes about 40 minutes, before men can resume drilling. At the west end this interval is only about 20 minutes.

Three 7-hour shifts are worked in the 24-hour day, the crews being as shown in Table II. Progress in each heading averages 6 ft. per day or 170 ft. per month at the east end, and 7 ft. per day or 200 ft. per month at the west end. In May, 1921, the headings had been advanced 4,000 ft. at the former and 4,800 ft. at the latter.

The muck or blasted rock, with large pieces broken up to convenient size, is loaded into small steel or wood dump cars, on tracks of 30-in. gage. These cars are pulled by men to the point where the tunnel lining has been finished. There the cars are made up in trains

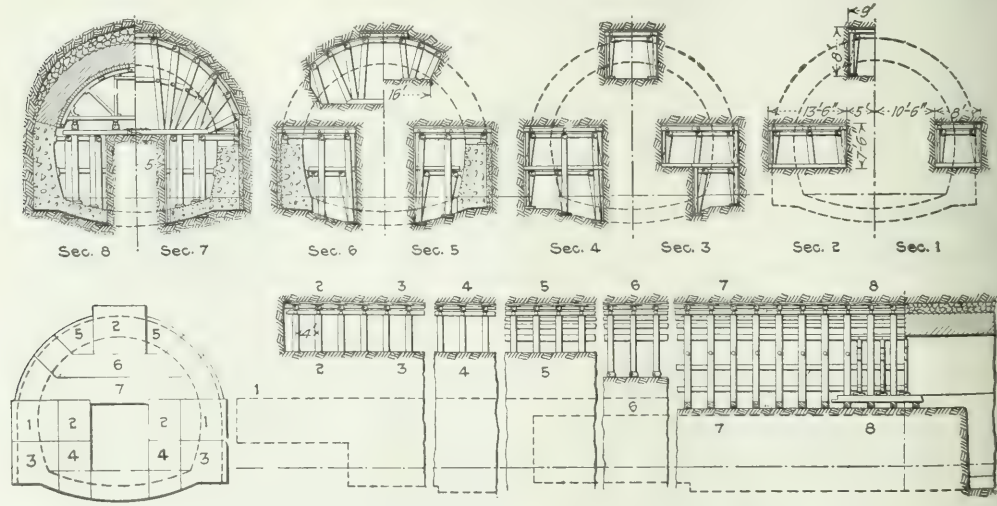


FIG. 6. SPECIAL SIDE HEADING SYSTEM OF TUNNELING

and hauled out by electric locomotives. At first, trains of four dump cars were handled by oxen at the eastern end and by horses at the western end.

At each portal is a compressor plant, the compressors being at first operated by steam. A power plant with turbo-generator has now been built near the west portal, and this furnishes current for both compressor plants and for the ventilating fans, driven by 75-hp. motors. In the first stages of the work, both in driving and widening the headings, the exhaust from the drills was utilized for ventilation. It is not expected that ventilating plant will be needed for the completed tunnel.

TABLE II. TUNNELING CREWS, TANNA TUNNEL, JAPAN

	Bottom Heading		Enlargement	
	East	West	East	West
Drillers	4	4	24	30
Muckers	10	10	30	30
Carpenters	3	2	10	8
Others	4	3	15	12
	21	19	79	80

Engineers and Working Forces.—The total number of men employed per 24-hour day averages 350 at the east end and 400 at the west end. All the engineers, foremen and workmen are Japanese. At each portal there is a camp with offices, houses for the engineers and foremen and quarters for the foremen, as well as offices and accommodation for the contractors. No special hospital arrangements are provided, but there are physicians and surgeons to look after the welfare of the men and take care of any injuries. Baths and other accommodations are available at the Atami hot-spring resort, near the east portal.

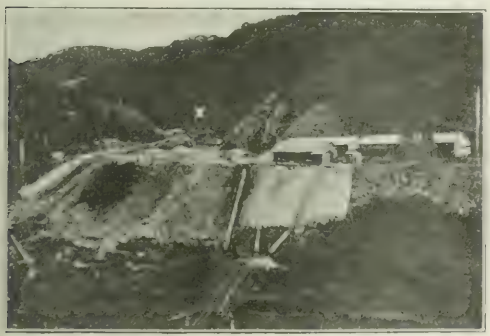


FIG. 7. SOUTH APPROACH TO TANNA TUNNEL

The driving of the headings is carried on by the forces of the government railway department, but the other parts of the work are let to contractors, either as piecework or in sections. The contractors now engaged are the Railway Engineering Co. for the east end and Seiichi Kashima for the west end.

At the beginning of the work, Yasuichizo Tomita was director of construction, with the following engineers in charge: Hitoshi Takiyama, Ichiro Takemata and Shinichi Takai. At the present time Isami Awoki is director of construction, with the following engineers: Kameji Yamada, Yukito Yamane, Yoshiyasu Katagiri and Hyoma Kurasaki.

Rebuilding Railway Structures In Northern France

Unique Operations Employed to Save as Much of Damaged Structures as Possible—Work on Nord and Est Railways Cited

DESTRUCTION of bridges and other works was experienced doubly by the Eastern Railway of France, first by the French during their retreat in 1914 and then by the Germans in their great retreat of 1918. The destruction carried out in 1914 consisted mainly in wrecking steel spans and some of the arches of masonry bridges; tunnels were blocked by exploding mines which blew up the portals and caused a fall that plugged the interior. An account of the reconstruction work has been given by M. Pellarin, chief engineer of maintenance of way, in the *Revue Generale des Chemins de Fer*, from which article the following brief particulars are taken.

After the first battle of the Marne, the engineer regiments made rapid repairs to the structures in the territory held by the French, using military bridges of of the Henry and Marcille types to close the gaps, no greater length than 130 ft. being required. Where the destruction of an arch had led to the collapse of adjacent piers and arches the reconstruction was left until a more favorable time. All the tunnels were in territory still held by the Germans.



FIG. 1. STONE ARCH BEING REPAIRED WITH CONCRETE

Bridge reconstruction on a permanent basis was left to the railway engineers. To rebuild arches in stone would have been slow and difficult work; timber for centering was hard to obtain and it would have been difficult to erect it on the debris blocking the rivers. The plan devised by Mr. Descubes, chief engineer, was to use concrete and to build the arch in two concentric rings, the first and thinner ring having steel reinforcement which formed the centering and gave the arch sufficient strength to carry the second ring until the concrete had set.

At first this reinforcement consisted of 60-lb. rails, bent hot. Fig. 1 shows one of the four arches of the Armentieres bridge near Changis, on the line from Paris to Strasburg, with a steel military bridge over the wrecked arch, the curved steel rails in place for concrete reconstruction and the lower part of the old stone

arch supported by bracing. Breakage of the rails in bending led to the use of light ribs of angles and plates, which were swung into place from the military bridges. Forms for the intrados of the arch were secured either by hook bolts or pieces of old electric cables attached to the ribs. Arch rings and spandrels were faced with stone collected from the wreckage and laid in cement mortar. A layer of asphalt was applied for waterproofing and was covered with lean concrete as a protection.

Much greater difficulties were encountered in the reconstruction work on 580 miles of line released in 1918, as the retreating Germans were not satisfied with destroying the spans sufficiently to check pursuit, but did their utmost to wreck the structures completely, even to the foundations. Culverts were blown up in such a way as to breach the embankments, the destruction of one 13-ft. culvert in a 32-ft. fill causing a gap that had to be spanned by a 122-ft. military bridge. There were 162 steel bridges and 202 masonry bridges almost completely destroyed. Small arches were built in successive rings of concrete, the exposed faces being of portland cement mortar laid against the forms.

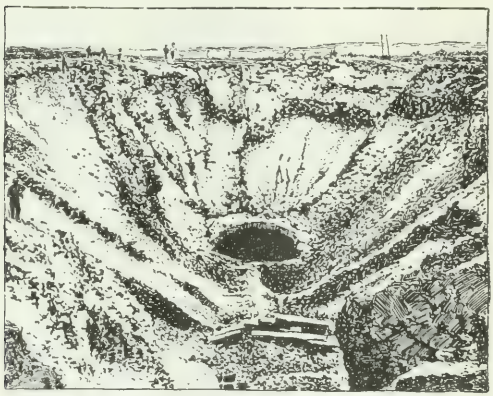


FIG. 2. EFFECT OF EXPLODING MINES IN THE MARNE CANAL

Each tunnel was blown up by the Germans at two or three interior points as well as at the portals, their own men being sometimes buried by the slides. In every case the quantity of explosive was so great as to loosen and disturb the ground for a considerable height above the tunnel. The Marne tunnel, 1,510 ft. long was wrecked for 1,250 ft. by 14 mine holes or wells from the surface, so that this length will have to be rebuilt as an open cut. Fig. 2 shows one of the craters caused by the mines at this tunnel.

Northern Ry. Viaduct Repair—To preserve a viaduct partly destroyed by the Germans, an emergency abutment was built to take the arch thrust while the demolished portion was being rebuilt to enable the line to be reopened for military service. As shown in the illustration (Fig. 3) the support consisted of a heavy timber tower having diagonal members bearing against the last undamaged pier. The top of the tower served as falsework for the removal of a damaged arch. At the right is falsework used in straightening a distorted pier. The Poix viaduct had twelve masonry arches, six of which were destroyed entirely. The seventh arch was badly cracked and the last pier left standing was thrown out of plumb. After the eighth arch had been braced, as shown, the damaged arch was taken down.

To straighten the isolated pier, a horizontal cut about 4 in. deep was made in each face until only a narrow section of solid masonry was left at the middle of the pier. The cutting was done with steel saws working in sharp sand. By means of jacks the pier was then forced into a vertical position and held while the two saw cuts

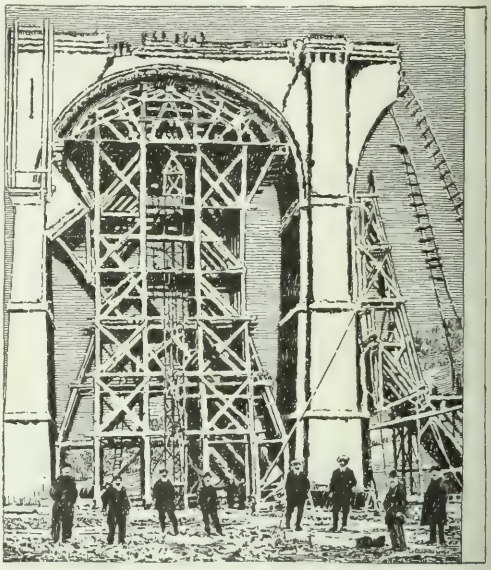


FIG. 3. FALSEWORK FOR VIADUCT REPAIR

were packed with concrete. During this operation the other arches and piers were rebuilt with concrete, a brick facing being applied in order to give an appearance similar to that of the original structure. This facing consisted of bricks collected from the wrecked part of the structure and placed in the forms.

This reconstruction was described in a paper read at Lille, France, by M. Javary, chief engineer of the Northern Ry. No details or dimensions were given, the work being mentioned incidentally as an illustration of the railway's operations during the war. The accompanying view is reproduced from *Revue Generale des Chemins de Fer*, Paris.

Kansas Designates Highway System

In accordance with the Federal-Aid-Highway Act of 1921, which requires the states to designate a system of primary and secondary roads amounting to not more than 7 per cent of the total mileage, Kansas, with a total road mileage in the state of 124,144, has selected a system which includes 3,130 miles of primary roads and 3,445 miles of secondary roads, or a total of 6,575 miles for the state system. The leeway in selection of future routes left by the State commission by not using up the entire one-seventh of the total road mileage is, for primary highways, 594, and for secondary highways, 1,511 miles, or a total of 2,105 miles. In the approved state system there are five primary or interstate highways traversing the state in each direction.

Track Maintenance by Contract on the Canadian Pacific Ry.

Labor Shortage, Heavy Traffic and Short Season Led to Contracting for Extra Gangs—Successful Results of Three Years on 400 Miles

By H. G. Harton
Sydney E. Junkins Co., Engineers & Constructors,
Winnipeg, Canada

SUPPLEMENTING the regular railway section gangs by extra gangs operated by a construction company was the method employed by the Canadian Pacific Ry. for carrying on track maintenance at a time when the labor situation made it more practicable to handle the work through an outside company. The contract system was in use during 1918-1920 on the 400-mile stretch of double track between Winnipeg and Fort William. This division carries a large proportion of the traffic originating west of Winnipeg, and at certain times of the year, especially during the wheat movement in the fall, it is operated under extremely heavy traffic conditions.

Maintenance of track on this division presents a particularly difficult problem, due to the fact that the open season during which maintenance can be done effectively is short; usually from mid-April to mid-October. Further, the severe frost action and consequent heaving of the track largely increases the maintenance of line and surface, quite apart from the action of traffic.

The division lies through a region that is almost uninhabited except at either end, at the engine terminal points in Kenora and Ignace, and at a few small towns. The country is wooded, rocky and interspersed with lakes. Muskeg swamps are often encountered, which tend to cause soft track in spite of large quantities of fill. They also require ample drainage ditches, of which some 25 miles were dug during the work here described. There are a few short tunnels through rock points, a considerable number of culverts over the many small streams connecting the various lakes, and a few larger bridges such as those over the Lake of the Woods outlets and the Kaministiquia River. The profile is regular in general, with a rise of about 900 ft. from the level of Lake Superior to the height of land, then a gradual drop of about 800 ft. to the level of the Red River at Winnipeg. Curvature is considerable, especially in the lake sections.

Track construction comprises 80-lb. and 85-lb. rails with angle splice bars on ties 7 x 9 in. and 8 ft. long, laid in gravel ballast. Treated ties have been used as renewals in recent years for 160 miles east from Winnipeg. Shoulder tie plates are placed on curves and on all creosoted ties. Rail anchors are used at all points where the rails travel under traffic.

Contract Maintenance System

Ordinary maintenance work is done in the usual way by section gangs. Owing to the shortness of the working season, previously mentioned, it is necessary to supplement these gangs, even when filled to strength in the summer, by extra gangs. It is the work of these latter gangs that this article describes. The primary motive of the railroad in contracting outside for this extra gang work was to supplement its own meagre supply of common labor in the difficult three years covering the last year of the war and the next two years of readjustment.

Wage rates for track work were considerably lower than those prevailing elsewhere for industrial and construction work; the work itself was usually located many miles from towns or even telegraph stations; all living had to be done in outfit cars or tents. In general, in a time of severe competition for labor in every direction, the proposition involved a considerable element of selling the job to the laborer as more desirable than the many other opportunities he was being offered.

An outside engineering construction company with a flexible organization was thought to be capable of dealing with this kind of a situation somewhat more quickly and easily than the more rigid organization of a railroad. The undertaking, based on a prearranged fee, involved the primary motive that the work was to be done precisely as a department of the railroad; that is, that the construction company should merge its organization absolutely to the needs and direction of the railroad although at the same time keeping it entirely separate and distinct.

Organization and Supervision

Briefly, the organization consisted of a field office at Kenora, Ont. (the railway division headquarters), reporting to the company's main office in Winnipeg. The latter handled general relations, rates and the recruiting of labor. A field superintendent was primarily responsible for field work. Under him were assistant superintendents, paymaster, traveling timekeeper, camp inspector and, at the field office, a field clerk, stenographer and tool man. Reporting each day by wire to the field office were the gang foremen. Under them were the assistant foremen, if the size of the gang demanded, and the workmen. A timekeeper accompanied the larger gangs and reported to the field clerk.

After determination by the railroad management, the major features of the work were administered by the district engineer; the division superintendent of the railway and the field superintendent of the contractor working in close co-operation. The division superintendent passed his instructions to the roadmasters and these in turn conferred with the field superintendent as to the details of the work desired to be done on their respective districts. The contractor's field superintendent also attended the weekly meetings of the division superintendent and the roadmasters, where the various problems arising from maintenance were threshed out.

The net result of this organization was that the daily problems were promptly settled direct between the railway company's roadmasters, the contractor's field superintendent and the gang foremen, while the general policy, changes, additions or curtailments were settled between the district engineer, the division superintendent and the field superintendent, and were then passed on to the roadmasters and gang foremen. In reverse, questions were passed up by the two latter parties and adjudicated by the three principals above mentioned

This flexibility was especially desirable since over 800 miles of track were being covered, where conditions changed constantly and time was an important element.

Extra gangs organized by the contractor were similar to railway extra gangs. Owing to the nature of the country each unit was entirely self contained, having its own sleeping, dining, cook, store and tool cars. Gangs varied in size from 6 to 100 men. The boarding was done by R. Smith & Co., Winnipeg, who furnished the necessary help, dishes and food in cars supplied by the railroad. As good and sufficient board was a requisite in keeping down labor turnover the closest co-operation was established with the boarding contractor, in order to keep the latter advised of gang movements and strength and of the character of food and service. A second requisite was a clean camp with cars properly roofed and screened, well disposed sanitary arrangements and cook house waste, and a good water-supply.

These were all deemed fundamental requirements and were watched with the closest care. The field superintendent determined these points as his first duty in visiting a camp and any complaints of the men regarding them were at once investigated and, if justified, were promptly corrected. The medical officer of the railroad co-operated in all sanitation matters in addition to purely medical services. Since some one in authority was at every camp in short intervals, living conditions were strictly checked and many of the petty annoyances of the rough living in outfits were relieved.

Although labor during this period was often unreasonable, the response of the men to these attempts in their interest was encouraging. In addition, inquiry was made of each man when quitting to determine the cause for leaving and in this way various minor troubles, not apparent on the surface, were unearthed and corrected. Experience clearly indicated that the handling and housing of casual railroad labor is a broad and considerably neglected field in which conditions have developed making generally for high turnover and low efficiency.

Work of Contract Gangs

Track work that the gangs were called upon to do included practically every class of railway maintenance work, a partial list being as follows:

- Applying tie plates
- Ballasting
- Bank widening
- Changing switches
- Cleaning out old ditches
- Cleaning up station grounds
- Constructing concrete culverts
- Constructing new passing tracks
- Constructing turntable foundations
- Constructing water-tank foundations and water tanks
- Ditching
- Driving foundation piles
- Fencing
- Fighting brush fires
- Grading
- Lining track
- Loading coal
- Loading and unloading cinders
- Loading and unloading new and second-hand steel rails
- Moving water tanks
- Opening and operating new gravel pit and constructing three miles of railroad from the main line
- Operating old gravel pits
- Painting
- Rail renewals
- Tie renewals
- Surfacing
- Tie loading

An equivalent of about 1,000 miles of single-track railroad line was surfaced and generally overhauled. About 175 miles of new steel rails were laid and the old steel loaded and shipped out for branch line and other use. In addition, 325,000 cu.yd. of material were dug from pits and used for filling, ballasting and bank widening.

Jobs somewhat out of the ordinary were done, such as moving a water tank at Pine, Ont. This tank measured about 33 ft. high and 24 ft. in diameter, and weighed about 55 tons. After jacking it up, rollers were inserted and with heavy tackle and a hoisting engine the entire tank was moved on to the tracks and 1,000 ft. west to its new location.

Station Gang System

Much of this work was done in the long established railroad way. The chief difference was the introduction of station-gang methods in tie renewals, ditching and culvert construction. Briefly these consisted in letting small sub-contracts, somewhat as grading and other work is let to station gangs on new construction. The general reason for this was that many men could be found who would not work for the day wages offered but who would work, and work hard, on a small contract of their own, netting slightly in excess of day wages.

Culvert work was done on a unit-price basis, with materials and tools furnished to the gang, which was outfitted and boarded similarly to the extra gangs. The members of the gang were usually known to each other and did the work on a share and share alike basis, one member being elected as foreman and handling reports and instructions. Ditching was done in the same way.

Tie renewal by contract was, it is thought, an entirely new method in maintenance work. The road was divided into sections depending on whether the ballast was hard, fair or easy to dig, and a price per tie renewed was established for each section by the district engineer. Gangs of from six to ten men were made up and after choosing a section were given a contract, usually from 5,000 to 15,000 ties.

For the price per tie agreed upon, the old ties previously marked by the section foreman were dug out, the new tie placed, tamped and partly spiked and the old tie piled. Each section foreman was held responsible for the tie-contract work done on his section, especially for the tamping, which was the part most easily skimped. The field superintendent and his assistants followed the work of each gang closely, but as the section foreman was primarily responsible for his track and was on it all the time, his supervision was usually effective.

Spiking was completed by the section gang. The price established per tie was considerably lower than the cost of ties put in by extra gangs, but owing to the greatly increased output per man per day (averaging around 50 per cent) the tie gang could make better than day wages. Various allowances were made in the base price for long ties in the muskeg sections, switch ties, ties in center tracks, spacing ties, where tie plates were installed and other lesser work than complete renewals. Some half million ties were put in by this method and a great variety of interesting points were developed.

Station gangs were paid on quantities determined by the field superintendent and representatives of the railroad, an advance being usually given them during the work and full payment promptly on completion of the work. As some other section of the line always looked better to the gang than where they were actually work-

ing, contracts were made for rather small quantities. When these were finished, the good gangs were given additional contracts on other sections, so that the same gang would often have four or five contracts in one season.

Payment of the extra gangs was made twice a month by check, payable at par at all banking points on the division, based on payrolls made up in the field office from time books turned in by each gang foreman or timekeeper. A traveling timekeeper checked up the gangs constantly. As a further precaution, paying off was rotated among several men. A special effort was made to pay promptly and accurately, as small but important items in maintaining good-will.

Cost records were kept of the usual major items, such as rail and tie renewals, surfacing and lining, ballasting and similar items, but under war and post-war conditions they gave no useful indication except as between the work of the different gangs and their handling by the gang foremen. Varying wage rates still further upset any standards of comparison. The chief criterion of the work was whether the program outlined in the spring was substantially completed in the autumn. The work assigned was fully completed each year. The wage rates paid were often less and never greater than those paid by the railways and others for similar work. Efficiency per man, while suffering in common with all other work in comparison with pre-war performance, was fully as high as, and in most respects higher than, that obtained by usual maintenance methods.

This system of doing the work by means of an organization outside the railroad was proposed originally by Grant Hall, vice-president of the Canadian Pacific Ry., and the work was done by the Sydney E. Junkins Co., Ltd., engineers and constructors, of Winnipeg and Vancouver. It was operated under the direction of J. C. Holden, district engineer, Canadian Pacific Ry., and by the three division superintendents on this part of the line; J. M. MacArthur, J. L. Jamieson and J. J. Horn.

Canada Has Nearly 9,000,000 Population

The 1921 Census of Canada, announced Feb. 24, shows a total population of 8,772,631, compared with 7,296,643 in 1911, or a gain of about 20 per cent. Of the provinces, Ontario and Quebec are far in the lead, with populations of 2,931,264 and 2,349,069. The order of the other seven provinces and the two territories is: Saskatchewan, 671,390; Manitoba, 613,008; Alberta, 581,995; Nova Scotia, 524,579; British Columbia, 523,369; New Brunswick, 388,092; Prince Edward Island, 88,536; North Western Territories, 6,684; Yukon Territory, 4,162. In addition there were 485 men in the Royal Canadian Navy.

Pere Marquette R.R. Builds New Division Terminal

Operating Conditions Improved by Moving Division Point—Special Features of Roundhouse—Flat Switching in Yards

A CHANGE in operating divisions on the Pere Marquette R.R., for the purpose of effecting increased economy and convenience in freight traffic and engine service, led to the selection of New Buffalo, Mich., as a new division point and made it necessary to construct freight yards and an engine terminal at this point. The principal facilities, as shown in Fig. 1, comprise a classification yard, car repair yard, 16-stall roundhouse, seven open radial tracks (to be covered by a future extension of the roundhouse), concrete coaling station with 250-ton storage bin, two ashpits with mechanical handling equipment, a 100,000-gal. steel elevated tank, and locomotive and car shops for light repair work. As the town afforded no sufficient housing for the local employees and the trainmen transferred to this point the railway company has built a hotel for permanent and transient accommodation, the hotel being operated by the company. A new passenger station, with upper floor for division offices, is to be a later development.

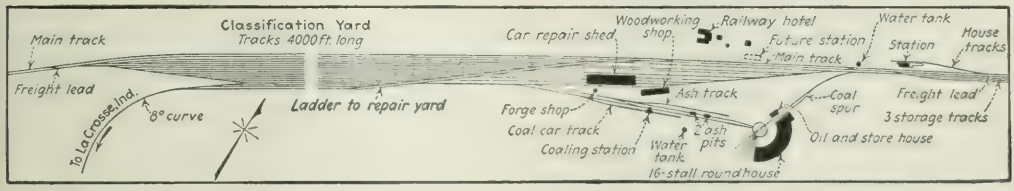


FIG. 1. FREIGHT YARD AND ENGINE TERMINAL AT NEW BUFFALO, MICH.; PERE MARQUETTE R.R.

On the 184-mile line between Chicago and Grand Rapids, Mich., the intermediate division point formerly was at Benton Harbor, Mich., 98 miles from the former, and 86 miles from the latter place. These division lengths were rather short for economical engine and train service. When increased traffic made larger facilities necessary, a study of the conditions showed that it would be advantageous to establish these at New Buffalo as a new division point, since a difference in ruling grades east and west of this place makes it a logical point for making up freight trains. This place is also the junction of the 38-mile branch to La Crosse, Ind., where connection is made with four other roads.

From Chicago to New Buffalo, 69 miles, the tonnage rating of freight trains is 3,200 tons. From New Buffalo to Grand Rapids, 115 miles, the rating is 2,400 tons. The unequal length of the new divisions is an advantage in this case. A short division adjacent to such a busy terminal as Chicago permits frequent movements and round-trips for the engines. With trains made up at the new division point the longer run to Grand Rapids is economical in engine service. At present the average number of freight trains daily, including both eastbound and westbound movements, is six between Chicago and New Buffalo, and eight or ten between New Buffalo and Grand Rapids. Merchandise and general freight constitute the main part of the

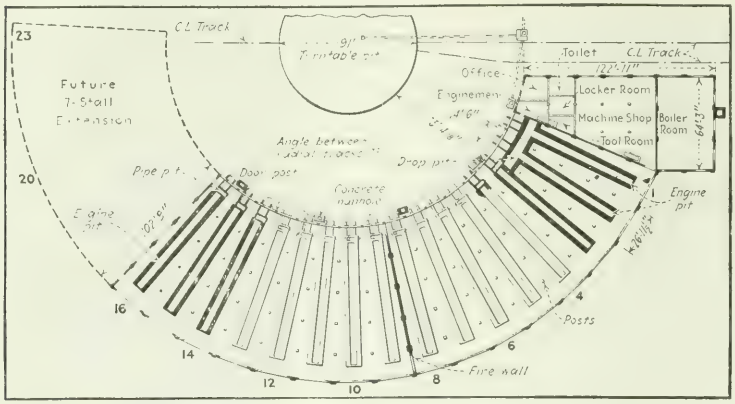


FIG. 2. ROUNDHOUSE WITH DROP PIT AT ENTERING END

freight traffic, and about 20 per cent of the traffic is in solid through merchandise trains which are not broken up at New Buffalo, but simply change engines and crews.

Ample space for the new yard and terminal was available just outside the town. The country is flat and the soil is a fine loamy sand and gravel underlaid by hard blue clay containing sand pockets. There was some difficulty in securing proper drainage, as the clay holds the water in hollows and pockets, so that additional drains have had to be provided at wet spots.

A 15-track classification yard, with tracks about 4,000 ft. long, is situated on the east side of the single main track (see Fig. 1). At the south end, an entrance track or freight lead extends about 4,500 ft. beyond the yard switch, so that freight trains can be kept clear of the main track before they reach the yard. At the north end, there is a similar lead 5,000 ft. long, together with three sidetracks about 2,500 ft. long which are used for storage.

Inbound trains from the main or lead tracks pull into the first two yard tracks. Classification is done on the middle tracks and outbound trains are made up on the outer tracks. All movements are made up by drilling or flat switching, the switch engines working either end of the yard as required. Three switch engines are stationed at this point. The yard tracks have 75-lb. rails and mainly No. 8 frogs, and 15-ft. switch rails for the turnouts from the ladder, and No. 12 frogs for the turnouts at the ends of the yard. All switches are operated by hand.

Parallel with the ladder track at the north end is a ladder serving a car repair yard, caboose track and scale track. The repair yard has four tracks about 1,500 ft. long, and spaced 22 ft. c. to c. Over three of these tracks will be built a car repair shop 64 x 330 ft., of timber construction, adjacent to the present woodworking shop and small blacksmith shop. Switch engines place the cabooses on their tracks and also run cars on the scale track, which has a 300-ton track-scale with 50-ft. table. No general weighing is done at this point, and only certain cars are taken to this scale.

At the north end of the site is the engine terminal, with its turntable approached by one track from the westbound freight lead, and two tracks leading from the classification yard. The former, which has a spur to the coal bin of the boiler room, is used mainly for outgoing engines and for reaching the boiler room and storehouse. Along the other two approach tracks are arranged the coaling station and ashpits, and a water column is located between the tracks. A 90-ft. deck girder turntable of the center bearing type serves the roundhouse and is operated by an electric tractor riding on the circle rail. An open space 73 ft. wide extends between the turntable and the roundhouse.

The roundhouse, Fig. 2, is 102 ft. wide and has 16 stalls, but the layout provides for 23 stalls and four open radial tracks. An annex at one end contains a machine shop, boiler room, locker room and toilets. Only light repair work is provided for, as the main locomotive shops of the railroad are at Grand Rapids and

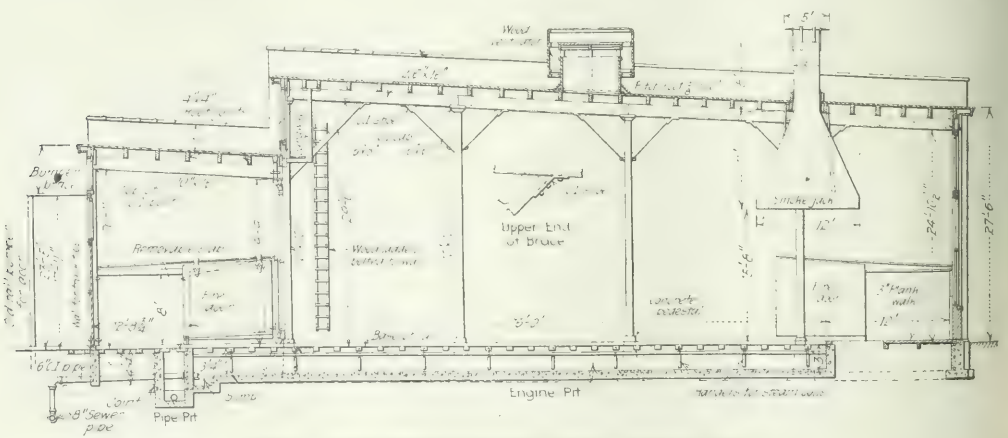


FIG. 3. LOFTY ROUNDHOUSE OF TIMBER CONSTRUCTION

engines can readily be sent to that point. Two 150-hp. boilers supplying steam for heating are served by a steel stack. A separate plant provides for washing out the locomotive boilers with hot water. Brick paving is used in the boiler room and coal bin, asphalt mastic in the machine shop, and concrete in the locker and toilet rooms and under the boilers.

Timber-frame construction of the roundhouse, with brick walls and wood sash, was adopted for reasons of economy. The design is shown in Fig. 3. To secure ample light and ventilation the height is rather greater than usual. The first bay is 20 ft. 11 in. high, but at the second bay this is increased to 29 ft. and then decreased by the roof slope to 24 ft. at the outer wall. In a somewhat similar structure built at Plymouth, Mich., by this same road, the maximum clear height is 32 ft., but this is for a monitor two bays wide. Inside the vertical 8-ft. face of the roof at New Buffalo there is a gangway for convenience in keeping the windows clear.

Four rows of interior posts are supported on concrete pedestals, and have cast-iron caps for the radial beams, which are composed of pairs of 6 x 16-in. timbers with knee braces to the posts. Joists laid parallel with the walls carry plank sheathing covered with tar and gravel roofing. The inner walls consist mainly of rectangular cast-iron door posts. Double swinging doors of wood are used, having glass in the upper panels. When they are open they are latched to posts of old rails 18 ft. high which are braced to the tops of the door posts. This support reduces the tendency of large doors to warp when held only at the bottom. A brick fire wall, with standard fire doors, divides the building into two sections.

Smokejacks of transite board, hung from the roof framing, have hoods 10 ft. long and 12 ft. high, above which they are 36 in. in diameter and extend through the roof. For general ventilation these smokejacks are supplemented by an unusual arrangement of large wooden ventilators in the fourth bay, one over each stall or track. No dampers are provided in either the smoke flues or the ventilators. For general illumination, a well-diffused light is afforded by electric flood lights with 100-watt nitrogen lamps. There are three lamps in each stall, two on the end walls and the third on one of the posts. All the lamps are so mounted as to throw the light horizontally, but they are adjustable in position so that light can be concentrated at points where repair work is being done on the engines.

Concrete is used as usual for the engine pits, Fig. 4, which have convex bottoms and projecting copings to protect the heater coils from falling material. The bottom is reinforced with two layers of steel bars. In the sides are 2-in. iron drain pipes, 6 ft. apart, placed diagonally so as to drain water from the floor into the pit. Each pit drains to an end sump, from which a 6-in. pipe extends to a sewer.

Adjacent to the sump is a pipe pit 30 x 70 in. containing the thermostatic trap and connection to the heating coil in the engine pit. These pipe pits are covered by removable concrete slabs and are connected by a line of 8-in. sewer pipe in which is laid the return pipe for the water of condensation from the coils. Beyond the pipe pit, two concrete walls extend to the wall of the roundhouse and support cross ties for the track (see Fig. 4). This arrangement keeps the tracks

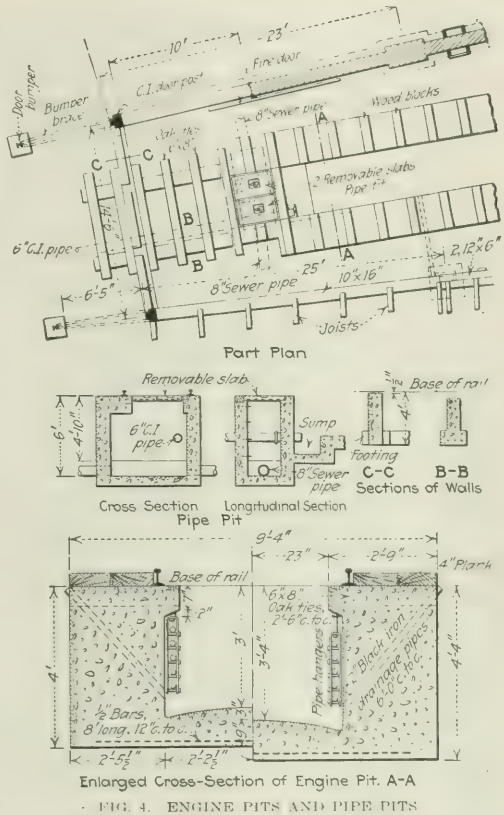


FIG. 4. ENGINE PITS AND PIPE PITS

in surface independent of any settlement of the floor.

Short oak ties embedded in the side walls of the pit carry the 75-lb. track rails and two outside lines of 4-in. planks for jacking. The rails and plank are spiked to the ties. Between the pits the floor is of cinders, but an 8-ft. walk of planks on stringers is laid along the outer wall. An unusual arrangement is that the drop pit connecting two engine pits, to provide for removing an axle and pair of wheels, is located at the entrance end of the roundhouse instead of in the more usual position at the rear end. The reason for this arrangement is that the drop pit is intended to provide only for handling tender wheels, as engines requiring the wheels to be changed will be sent to the main shops. Moveable girders carry the track rails across the drop pit, and when these are to be moved to clear the drop pit they are swung against the sides of the engine pit. The girders slide on angle irons which span the drop pit, but are so placed as not to interfere with the handling of the wheels.

A previous water supply is utilized, with pumping station at the Galien River about a mile distant. From this station a 6-in. main is led to the 100,000-gal. elevated steel tank which serves the general purposes of the terminal and also supplies a 10-in. water column placed between the two engine tracks leading to the terminal.

The 250-ton concrete coaling station serves the two

engine tracks, one of which passes under the storage bin. At the rear is a stub track with track hopper. Coal dumped from cars flows to a single bucket of 2½ tons capacity, which travels intermittently in a steel hoisting tower between the hopper and coal bin and delivers the coal through a chute into the top of the bin. A timber shed over the coal track protects the men working around the cars. As the coal track has a descending grade towards the switch, the cars are moved readily by means of pinch bars. A sand drying plant, with spouts for delivering dry sand to the engines, is an auxiliary to the coaling plant.

At the ashpits, engines drop their ashes into steel buckets which travel on inclined tracks at right angles to the engine track and dump their contents into cars standing on a stub track beyond the engine tracks. There are two ashpits, each with two buckets. Oil and supplies for the use of the terminal are housed in a small concrete store building which has a basement for the storage tanks.

The hotel for the employees is a 50-room two-story and basement structure of red brick. It is U-shaped in plan. On the first floor are a large lobby, the office, lavatory, dining room and first-aid room, with bed rooms in the wings. The upper floor is occupied entirely by bed rooms, with general toilet and bath rooms. Two septic tanks, with effluent discharge to the river, provide sewage disposal for the plant and hotel, as the town has no sewerage system. Electric current for lighting and power is purchased locally.

This terminal was designed and built under the direction of A. L. Grandy, chief engineer, Pere Marquette R.R.; Job Tuthill, assistant chief engineer, and R. J. Williams, superintendent of motive power. Frank Manning was engineer in charge of construction. The general contractors were H. V. Snyder & Son, of Battle Creek, Mich. This new terminal represents an investment of about $700,000.

Railway Bridge Wreck Charged to Crushing of Pier

ON SEPT. 17, 1921, a passenger train on the Pennsylvania R.R., running from Louisville to Indianapolis, was wrecked at a bridge over Blue River near Edinburg, Ind., killing the engine-runner. The wreck destroyed the two spans of the bridge and one end of the bridge pier supporting the two spans; the part of the pier destroyed included the right-hand bridge seat of the two spans. In a report on this accident just issued by the Bureau of Safety of the Interstate Commerce Commission, the wreck is charged to crushing of the pier under the weight of the train, on account of deterioration of the old stone masonry. It is stated, however, that the railway company reached a different conclusion, namely, that "the accident was due to a derailment of the tender from cause unknown." Because of this conflict of opinion and the almost unprecedented cause found by the commission, the facts are here reproduced in abstract from the report.

The bridge was built in 1892, upon old piers and abutments dating from the original construction of the line in 1854. The substructure consisted of native limestone, which had laminated very badly in the course of time. A new coping (or top course) was placed in 1892, but except for one stone replaced in 1916 it is said that no masonry repairs were made since. The superstructure consisted of two through pin-connected truss spans of 126 ft. 3 in. each, carrying single track.

Just to the south of the bridge is a trailing-point switch connecting with a siding on the west side of the main track. The train, running at moderate speed, went into the river to the right (east), and the bridge spans also turned over to the right. The spans came to a position with the floor about vertical; the engine lay upside down at the side of the middle pier, the first car back of the tender lay on its side in the river, and the next car, leaning to the right, hung over the south abutment. The right-hand or upstream end of the middle pier was crumbled away, practically down to water level, on a nearly vertical plane transversely through the pier; in the lower part of the masonry face thus exposed a large mud pocket appeared, which the report explains as a mortar pocket in which silt had been deposited at times of high water.

The condition of the track approaching the bridge and on the bridge, combined with the testimony of the trainmen, presented conflicting evidence as to the occurrence of a derailment. There were marks of derailed wheels from the frog of the switch to the bridge abutment, but none on the bridge ties. The right-hand rail on the approach and on the bridge was turned over to the right, while the left-hand rail was practically uninjured. The right hand end post of the first span of the bridge was broken clean in two, apparently by a blow from an approaching train; a deep mark showed on the right side of the wooden pilot beam of the locomotive, and the front end of the mail car appeared to have received a heavy blow. But in the absence of wheel marks on the bridge ties, it is concluded by the Safety Division of the commission that the engine and tender were not derailed, and that the mail car could not have been 5 or 6 ft. off line when it reached the bridge.

As the general appearance of the wreck indicated a simple turning over to the right, and the bad condition of the masonry warranted the conclusion that it collapsed under the train load, such collapse is concluded to have been the cause of the wreck. On this explanation the train slid over to the right as the bridge turned over and pulled the cars against the bridge members. One of the cars struck the right-hand end post at the entering end of the bridge as a result of this lateral movement while the train was still moving forward, and broke the post.

Engineering Small Part of Road Costs

Primary road engineering in Iowa during the past five years, has been done at an average of 5.91 per cent of the total cost of the improvement. Surveys and plans for 2,225.35 miles of road, since the first law accepting federal aid was passed in April, 1917, cost $472,858.87. This is an average cost of $212.48 per mile for this important part of the work. The estimated cost of construction of the 2,225.35 miles was $26,855,185.97, making the percentage 1.77 for the surveys and plans. Construction work has been carried out on a total of $21,148,242.33 worth of this work at a total cost for supervision, inspection on construction, and inspection and tests of material of $874,403.41, making the percentage 4.14. Thus the total cost of all engineering work chargeable to the primary road projects, the making of surveys, preparation of specification and plans, keeping of records, and all general supervision work, including tests of materials, is 5.91 per cent.

Maintenance in 1921 Failed to Meet Railway Needs

Analysis Shows Deterioration of Fixed Property and Equipment During Year—1922 Must Shoulder Burden of Deferred Maintenance

By Julius H. Parmelee
Director, Bureau of Railway Economics, Washington, D. C.

THAT the roadway, the track, and the equipment of the railways of the United States were in better physical condition at the end than at the beginning of the year 1920 was the opinion expressed by the writer in *Engineering News-Record* of Jan. 6, 1921, p. 33. The facts available at the time that article was prepared warranted nothing more than a general statement, which was based on a summary of opinions secured from railway officials, supplemented by a preliminary study of maintenance expenditures in 1920. During the year considerable information became available, which tended to confirm the opinion cited in the article.

Can the same statement be made of the year 1921? Was the roadway, the track, and the equipment of the railways in better condition at the close than at the beginning of that year? Was railway maintenance in 1921 normal?

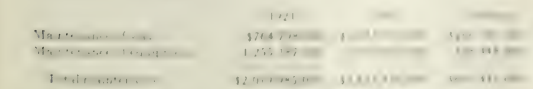
In this analysis railway maintenance during 1921 has been measured by three different standards: money expenditure, physical work done, and relative condition of properties at the beginning and at the end of the year. Using all of these standards Mr. Parmelee concludes that the maintenance work was not sufficient to make good the deterioration of the plant during the year, either on the basis of normal traffic or on the basis of the smaller traffic actually handled.

Rarely has the question of maintenance been so fully discussed, so hotly debated even, as when it has touched the calendar year 1921. The question was particularly important in that year, for it involved the corollary inquiry as to whether the railways had maintained their properties at the level required by the traffic, or whether they had been forced to increase their meager net income by deferring maintenance work to a more prosperous period.

As is always the case, exact answers to these questions are neither very easy to ascertain nor simple to set forth.

There are three methods of approach to the question of adequacy of maintenance in a given year. One is to compile statistics as to the amount of money expended for maintenance work in that year, and to compare this amount with corresponding amounts for other years. A second is to compile statistics as to the actual amount of maintenance work done, expressed in terms of physical units of maintenance. A third is to compare the physical condition of roadway, structures, and equipment at the end of the year with their condition at the beginning of the year.

Let us take these methods in order, starting with money expenditures for maintenance in 1921, compared with corresponding expenditures in 1920. Such a comparison shows, on the face of things, a large decrease in 1921, as follows:



This shows that during 1921 the railways of Class I expended in maintenance of way work, $267,000,000 less than they did in 1920. In maintenance of equipment work, they expended $338,000,000 less than they did in 1920. The reduction in total maintenance expenditures was $605,000,000, or 23 per cent, as compared with 1920.

Considered superficially, these statistics would indicate a large decline in maintenance work in 1921. Before jumping unreservedly to such a conclusion, however, it is necessary to take into account a number of factors such as the relative level of wages and prices during the two years included in the comparison, the relative efficiency of labor, and the volume of traffic in the two years.

Take the matter of wages. In 1920, effective from May 1, there was a general increase in the railway wage level which has been estimated at 21 per cent. This increased level continued through the last eight months of 1920 and the first six months of 1921. On July 1, 1921, there was a general decrease in railway wages, which seems to have averaged about 11 per cent. It is easy to compute the comparative wage levels of the two years 1920 and 1921 as a whole, making allowance for the 21 per cent increase in effect during eight months of 1920, and the 11 per cent decrease in effect during six months of 1921. This computation develops the striking fact that the average level of wages during the two years was almost exactly the same, taking the railway personnel as a whole. Whether this would apply also to the maintenance forces alone cannot be ascertained except by a long, intensive, and not wholly conclusive investigation; but for the purposes of a general discussion, such as the present, I think we may assume that maintenance wages went up and down at about the same rate as railway wages in general. So far as wages are concerned, therefore, we may consider the relation between the amounts of money expended for maintenance labor in 1920 and 1921 as showing approximately the relation between those items expressed in man-hours. For the first three-quarters of 1921, in fact, the total man-hours of railway labor (all classes) were 26 per cent less than during the corresponding period of 1920.

Another inquiry with respect to wage payments in the two years concerns itself with efficiency. In other words, did a thousand hours expended on maintenance work in 1921 produce any more physical result than a thousand hours in 1920? Many railway officials would answer *yes* to this question, although the relative efficiency of the maintenance forces in the two years cannot, of course, be ascertained with precision.

The price level in 1921 was unquestionably lower than in 1920. The wholesale price index number (all commodities) averaged 243 in 1920, and 153 in 1921, a reduction of 90 points, or 37 per cent. This index number cannot be applied exactly to the railway situation, partly because it covers many items not included in railway purchases, partly because the items which do represent railway purchases are not weighted in the average in the proportion of such purchases, and partly because the railways are forced to buy ahead. Their supply of many important materials represents, therefore, the purchases of several months. Some of the railway purchasing is done on a contract basis, and to such purchasing the current changes in price levels have, and can have, but slight relationship.

It follows that the relative price level in 1921 and 1920 cannot be ascertained with any degree of precision, so far as railway purchases are concerned. On the other hand, it can be asserted, with but little fear of contradiction, that railway prices were lower in 1921, in some cases much lower.

Decline in Volume of Traffic

As to relative traffic in the two years, the results for 1921 stand out as incontestably disheartening. Net ton-miles declined 23.3 per cent, and passenger-miles about 20 per cent, the two traffics combined showing a decrease well above 22 per cent. This decline was the greatest, both absolutely and relatively, that the railways have ever experienced in a single year. Not more than a third of maintenance-of-way work is generally supposed to be affected by, or to correspond to, fluctuations in traffic. In the matter of equipment maintenance, the proportion is of course much larger, although it follows the locomotive-miles and the car-miles more closely than the ton-miles and passenger-miles. In the case of locomotives, it has been estimated that maintenance needs vary according to 80 per cent of the changes in miles of performance; in the case of freight and passenger cars, according to 60 per cent. That is, if locomotive-miles increase 10 per cent, maintenance work should increase 8 per cent, other factors (size, tractive power, etc.) being equal. Similarly, if car-miles increase 10 per cent, maintenance work should normally increase 6 per cent. These are approximate assumptions, of course, but represent the best judgment of competent engineers.

Drawing together our discussion of these four factors—namely, the relative levels of wages, efficiency, prices, and traffic—it appears that the 23 per cent reduction in maintenance expenditures did not represent a corresponding reduction in actual maintenance work, nor on the other hand did it all represent a deferring of needed maintenance.

After taking into consideration every possible difference between operations in 1921 and 1920, of which there were many, and making every possible allowance for the much lower traffic in 1921, as well as changes in other factors of operation, it may be estimated that from one-third to one-half of the $605,000,000 reduction in maintenance expenditures in 1921 did represent an actual deferring of maintenance that would not have been deferred had the financial condition of the railways been stronger, while the remainder is accounted for by the difference in use, the difference in prices, and other changes in operating conditions. It would take too long to discuss this very rough estimate in detail, or to describe the general calculations on which it is based, certainly too long for the confines of this article.

Even in the matter of physical units of maintenance in 1921, it is difficult to speak with precision. Statistics are not yet available for the year as a whole, neither will it be possible, even at a later date, to secure complete information as to the maintenance work actually accomplished in 1921.

From such data as are in hand, however, certain general statements can be made, which it is thought closely approximate the actual conditions. Comparing the 1921 figures with the annual average of the three-year test period as a normal or standard, it appears reasonably certain that:

1. The number of ties laid in 1921 was less than the normal of some 100,000,000 ties.

2. Tonnage of new and second-hand rail laid was below normal. The normal is more than 2,000,000 tons.

3. The cubic yards of ballast were less than the normal of nearly 20,000,000 yards. In connection with these first three items, no allowance is made for difference in traffic, which during 1921 was less than 3 per cent smaller than during the test period. On the one-third ratio mentioned above, but little allowance need be made for this factor of difference in use.

4. The number of locomotive repairs was less in 1921 than in the test period in every class except the lightest of the classified repairs. The number of locomotive-miles in 1921 was less by nearly 8 per cent, which on an 80 per cent ratio would mean a decline of 6 per cent in maintenance work due to lessened use, leaving a margin due to the deferring of maintenance. It should be noted in this connection that the decline in repair work particularly affected the heavy work.

5. The number of freight car repairs declined, chiefly in light repairs. Allowing for a difference-in-use factor of something more than 6 per cent, which on a 60 per cent ratio would mean a decline of about 4 per cent in work due to lessened use, a percentage would still remain representing deferred maintenance.

6. The number of passenger car repairs fell off considerably, while their use in 1921 was slightly greater than in the test period. Clearly there was deferred maintenance in this particular branch of equipment.

Changes in Condition of Equipment

Comparative statistics as to physical condition are currently maintained with respect to only two classes of equipment: locomotives and freight cars.

As to locomotives, the percentage reported to the Car Service Division in bad order—in shop or awaiting shop—was 23.3 per cent on Jan. 1, 1921, and 23.8 per cent on Dec. 31, 1921. This was an increase of 0.5 point in the percentage, and of 347 locomotives in physical terms.

As to freight cars, the percentage in bad order increased from 8.5 per cent on Jan. 1, 1921, to 13.7 per cent on Dec. 31, 1921, an increase of 5.2 points in percentage terms. This represented an actual increase of 121,956 bad-order cars during the year.

Thus there was some decline in the physical condition both of locomotives and of freight cars during the year 1921. It might be argued, and by some it has been argued, that in a period of depressed traffic it is proper to allow the number and percentage of bad order locomotives and cars to increase, on the theory that only the deterioration caused by current traffic need be made

good. However this may be, maintenance of equipment cannot be regarded as normal in 1921.

We have now approached the maintenance situation on the railways in 1921 from three angles. Comparing maintenance expenditures in 1921 with those in 1920, it develops that there was a reduction of slightly over $600,000,000, or 23 per cent, of which at least one-third represented an actual postponement of maintenance work that would have been done under normal financial conditions.

Comparing the physical units of maintenance work in 1921 with those of the average year of the test period, after making allowance for the factor of difference in use according to certain accepted ratios, we find a smaller number or amount in 1921 throughout. This represents deferred maintenance measured in physical units rather than money; when reduced to its money equivalent by applying the average cost of repairs in 1921, the result roughly bears out the estimate of deferred maintenance, arrived at above by a consideration of the more general factors involved.

Comparative physical condition is known in only two classes, both of which showed a decline during the year.

In brief, railway maintenance during 1921 was not sufficient to make good the deterioration of the plant during that year either on the basis of normal traffic or on the basis of the decreased traffic actually handled.

The foregoing discussion will have made it clear, I think, that the exact measure of such deficiency in maintenance cannot be computed or indicated, either in physical or in monetary terms. But that there was a shortage in maintenance is the almost universal testimony of competent observers. It is to be hoped that during the year 1922 traffic will furnish such financial support as will enable the railways not only to keep their maintenance current, but also, in part at least, to make up some of the postponed maintenance of the past year.

Tests of Treatment of Tomato Canning Waste

Experiments on the treatment of tomato canning wastes made by the United States Public Health Service indicate that they can be so purified by sedimentation and double filtration as to create no nuisance when the effluent is discharged into relatively small bodies of water. The tests were made at Amelia, Ohio. They are thus described in a circular issued by the United States Public Health Service:

The wastes treated consisted of the liquids from washing down floors and cleaning utensils and apparatus and those from scalding the tomatoes, but did not include tomato cores, skins, or pulp. The solids, including the pulp, which had to be wasted, were hauled away and plowed into the ground. The volume of wastes treated averaged about ½ gal. per No. 3 can of tomatoes packed (1,000 cans to the ton).

The liquid wastes were pumped to settling tanks, in which about 85 per cent of the solid matter held in suspension was removed and the citric acid of the tomatoes was largely converted into lactic acid.

The solids separated in the settling tanks were disposed of on beds composed of a few inches of sand resting on a shallow bed of cinders. An area of 2.4 sq.ft. will take care of waste from each 2,000 No. 3 cans of tomatoes packed.

The effluent from the settling tanks was run through a bed of coarse cinders 4.5 ft. deep and later through a bed of sand of the same depth. The rate of filtration through each filter was 75,000 gal. per day. The sand filter effluent was clear and non-putrescible. Fish lived for six weeks in small concrete basins that were supplied only by the filtered waste.

Car Dumper and Coal Conveyors at Coke Oven Plant

Rotary Cradle Serves Conveying Belts—Traveling Bridge Has Belt for Storing Coal and Grab Bucket to Reclaim It

A NEW type of rotating car dumper, a series of belt conveyors and a traveling bridge carrying conveyors and a grab bucket constitute the main coal handling equipment of the new by-product coke oven plant of the Donner Union Coke Corporation at Buffalo, N. Y. This plant is designed to deal with 3,600 tons of coal daily, which the above equipment must handle in an 8-hour day.

The dumper in its normal and dumping positions is shown in Fig. 1, with the receiving hopper in the foreground. Figs. 2 and 3 show the layout of the plant, with the several conveyors and other parts of the

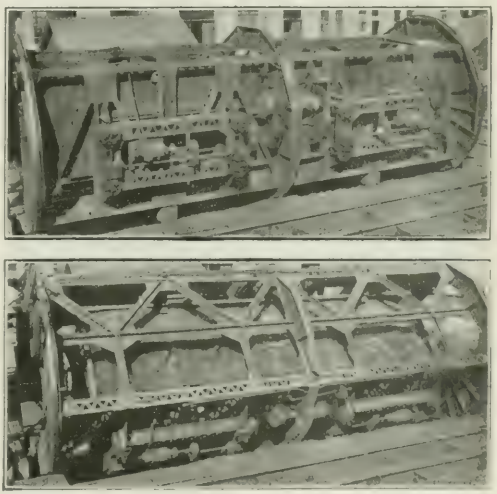


FIG. 1. ROTARY CAR DUMPER FOR 90-TON COAL CARS
Above: Cradle in normal position, showing machinery.
Below: Cradle rolling over to dump coal from car.

equipment. All coal is delivered in open-top cars or gondolas.

Car Dumper—A steel cradle or frame about 50 ft. long, with a circular girder at each end, forms the dumper, the cradle revolving on its horizontal axis and having only a rotary movement. On the periphery of each circular girder is a machined cast-steel ring. This ring rides on rollers mounted in equalizing trucks which are carried by a heavy steel bolster bolted to the foundation (see Fig. 3).

Another circular girder, at the middle of the cradle has attached to it a cast-steel rack engaged by the operating pinion, this pinion being driven by a 40-hp. motor and train of gears. Concrete counterweights balance the cradle, so that its center of gravity coincides with its center of rotation, thus minimizing the power required for operation. In dumping, the cradle revolves through an angle of 150 deg.

Clamping devices to hold the car down upon the rails while being dumped consists of two pairs of top hooks, one on each side, as shown in Fig. 4. Each pair is raised and lowered by a 10-hp. motor with pinion and

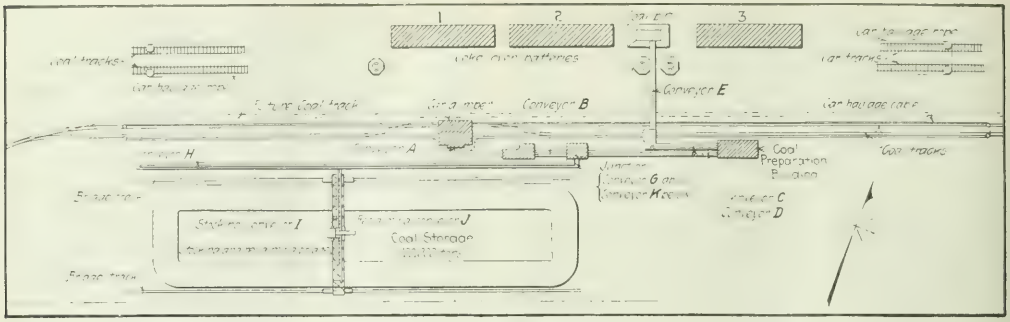


FIG. 2. LAYOUT OF COAL HANDLING PLANT

vertical rack, this mechanism being mounted on the side of the cradle (see Fig. 1). An equalizing device in the gearing insures both hooks coming to a firm bearing on the top of the side of the car.

To support the side of the car when being tilted, two movable side platforms or panels are provided in the dumping side of the cradle, moving horizontally between the truss members. Each is operated by a 6-hp. motor, this mechanism also being shown in Fig. 1. The panels are moved inward until they come in contact with the side of the car. In Fig. 4 these panels are shown advanced, on the left of the track, with the holding-down clamps above them.

An end lock operated by hand secures the dumper at either end of its travel, and is so interlocked mechanically with the control system that it is impossible to operate the dumper unless the top and side clamping devices are in full contact with the car. Limit switches are provided on all the moving parts, and air buffers cushion the cradle at the limits of its rotary motion.

For handling cars to and from the dumper there is an electrically-operated rope-haulage system (see Fig. 2), thus eliminating the necessity for a yard locomotive and switching crew. All yard and dumper tracks are at grade. The movements of the dumper are operated electrically under control of one man in a cabin located above the tracks and at a point where he can observe the cradle and also control the car haulage system. This dumper is designed to handle open-top cars up to 90 tons capacity at the rate of 20 to 25 cars per hour. It can take cars from 26 ft. to 45 ft. in length from 9 ft. to 10½ ft. outside width and from 6 ft. to 11 ft. 3 in. high above the rails.

Conveyor Belts and Bridge.—Coal from the overturned car falls into a receiving hopper (See Fig. 3), at the bottom of which is a duplex shaking feeder which delivers the coal at a uniform rate to a series of belt conveyors. These conveyors deliver the coal either to a storage yard or to a building in which it is crushed and mixed for use in the coke ovens. The storage yard is served by a stocking and reclaiming bridge.

A 42-in. lateral conveyor, *A* (see Figs. 2 and 3), receives the coal from the feeder and delivers it a similar longitudinal conveyor *B* which takes it to the junction house. If the coal is to be prepared for the coke ovens a continuation of this conveyor, *C*, carries it to the crushing and mixing house. The prepared coal goes out from the building over the two 36-in. conveyors *D* and *E*, to be distributed in the coal bin by a 36-in. shuttle conveyor, *F*.

Coal for storage is transferred at the junction house to a 42-in. cross conveyor *G* and fed to a 42-in. longitudinal reversible trunk line conveyor *H*, running parallel with the storage yard. Over this conveyor is mounted a traveling tripper, which, with its accompanying hopper and spout, automatically discharges the coal from the main conveyor to the 42-in. stocking conveyor *I*, on the bridge. Another tripper over the belt discharges the coal from the conveyor at any desired point. In this way the distribution of the coal on the stock pile is accomplished with very little labor and without the use of a grab bucket. There is storage space for 120,000 tons of coal.

For reclaiming coal from storage there is a traveling tower with hoist mounted on the top chords of the bridge and equipped with a 3-ton grab bucket which takes coal from the pile and discharges it into a small receiving hopper. From this hopper the coal flows to

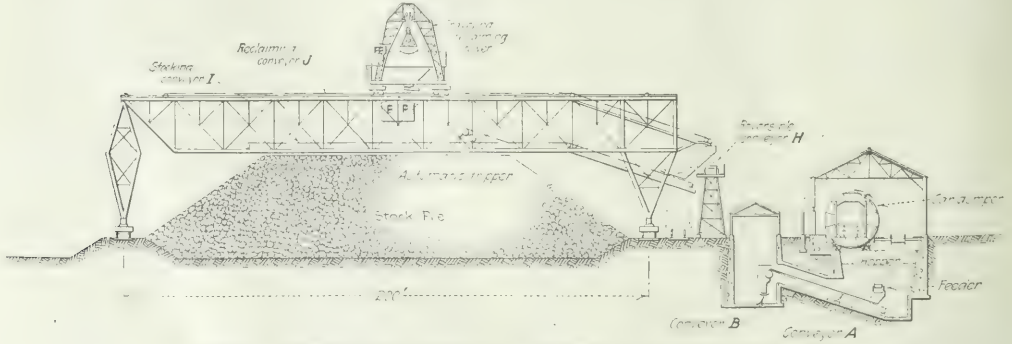


FIG. 3. CROSS-SECTION SHOWS CAR DUMPER AND COALING BRIDGE

a 36-in. reclaiming conveyor *J* on the bridge and is thus delivered to the trunk line conveyor *H*, this latter being reversed to carry the coal back to the junction house. At this point a 42-in. cross conveyor *K*, underneath the conveyor *G*, transfers the coal to conveyor *C* for delivery to the preparation building.

The car dumper was designed by the engineering forces of the Robins Conveying Belt Co., and the

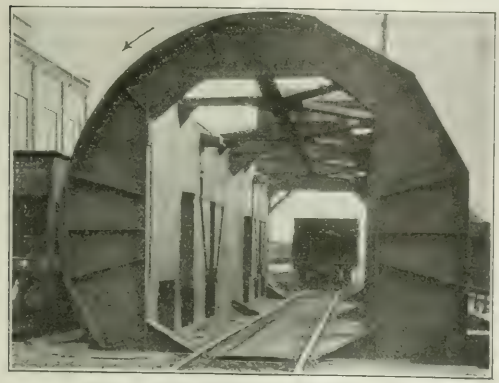


FIG. 4. END VIEW OF DUMPER, WITH LATCHES FOR CAR

Scherzer Rolling Lift Bridge Co., Chicago. Other installations have been made and plans have been prepared for a machine to handle coal cars up to 120 tons capacity. The Robins Conveying Belt Co. built the dumper and also designed and built the conveyor equipment and traveling hoist.

State May Not Dictate Pure Water Source

The State Board of Health of Kentucky has power to require a water company in that state to stop supplying impure water, but no power to dictate the means that shall be employed to provide pure water, according to a decision of the Court of Appeals (Prunell et al *v.* Maysville Water Co., 234 S.W., 967). The decision is really broader in its application than matters of water supply, apparently covering the abatement of any nuisance that is a menace to health, as may be seen from the following extract, as given in a United States *Public Health Reports* for Jan. 27, 1922:

. . . We have no doubt that the state board of health may, under said section 2057, abate any nuisance in this state caused by filth which induces sickness. In this respect the powers of the board are broad, but not unlimited, and must be exercised within a sound discretion; not whimsically or capriciously nor arbitrarily. If the board of health in dealing with such matters does not exceed its powers nor abuse its discretion, its orders will be upheld by courts as final and conclusive. . . .

Although, as said above, the board of health has the power to abate a nuisance, source of filth or cause of sickness, it has no mandatory power enabling it to direct the method by which the result shall be accomplished. It can only cause the abatement of the nuisance, and is not concerned with the method by which it is done. In other words, it may stop the furnishing of impure and dangerous water to a community, but it has no power to direct a water company to install any particular character of plant for sedimentation, filtration, or chlorination of the water, and the water company may adopt any system that may seem best or expedient to it, if the system adopted produces the results desired—clear, soft, wholesome water.

Calcium Chloride in Concrete Highway Construction

Laboratory and Field Tests Indicate Accelerated Setting and More Economical Curing Method Than Usual Practice

By B. H. Piepmeier and H. F. Clemmer
Engineer of Construction Engineer of Tests
Division of Highways of Illinois

During the past year actual practice and laboratory experiments have demonstrated the value of calcium chloride in highway construction to such an extent that the Division of Highways of Illinois has not only allowed its use for accelerating the setting of concrete in cold weather construction but is also advocating it as a simpler and more practical method of curing than any now in actual practice. Laboratory investigations in curing concrete were conducted on a huge scale, every known and advocated method being tried out. Over 450 specimens were made and tested for transverse strength. In all of the experiments made the specimens treated with calcium chloride showed the best results. Several methods of applying this chemical



FIG. 1. MOISTURE ACCUMULATED ON EARTH COVER OF PAVEMENT AFTER USE OF $CaCl_2$

were tried, but the greatest strength was obtained in the specimens which were sprinkled with the granulated chemical in the proportion of 3 lb. per sq.yd. of surface. This method of curing brought greater strength to the specimens at the end of 14 days than did the wetted earth method at the end of 28 days.

It was thought that heavy rains might wash the calcium chloride from the pavements and thus destroy the curing properties of the chemical as far as the pavements were concerned. To determine the exact result of such action, tests were made with specimens from which the granular chemical was washed off at the end of a 12-hour application. It was proved conclusively that the curing process of calcium chloride takes place within the first 24 hours of its stay on the concrete and after that length of time does not aid curing to any appreciable extent. As the chemical is

TABLE I—TRANSVERSE STRENGTH OF [illegible] AT END OF 14 DAYS

Treatment	Specimens	Average
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

applied to the pavement from 8 to 16 hours after the concrete is finished, it would be an easy matter to place

it and protect it from rainfall if the weather looked threatening, or to make the second application in case the first was washed off.

Tables I and II show the results and methods used in a typical series of tests made by the Bureau of Tests. In this series the specimens were made and cured in concrete forms which gave a practical condi-

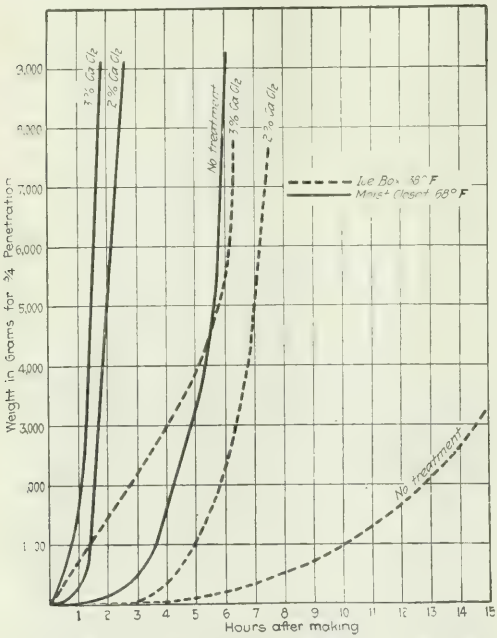


FIG. 2. PENETRATION TESTS MADE FOR SETTING TIME OF TREATED CEMENT

tion of concrete against concrete, approximating that of a slab being cut out of a pavement.

Actual curing of concrete pavement with calcium chloride was accomplished to some extent during the past construction season with favorable results. In one case 7 miles of pavement were cured by first covering the slab with about an inch of earth and then sprinkling the earth covering with a rich solution of calcium chloride. The solution was applied at such a rate as to

TABLE II—TRANSVERSE STRENGTH IN POUNDS PER SQUARE INCH AT END OF 28 DAYS.

Treatment	Modulus of Rupture Average of 5 Specimens
No treatment given. Specimens exposed to air	736
Covered with dirt 2 in. thick, wet for 3 days	785
Covered with dirt 2 in. thick, wet for 7 days	761
Covered with dirt 2 in. thick, wet for 14 days	768
Calcium chloride applied dry to surface, 1 lb. per sq. yd.	822
Calcium chloride 1 lb. per sq. yd. applied with dirt 1 in. thick	794*
Calcium chloride, 3 lb. per sq. yd. applied with dirt 1 in. thick	802*
Covered with asphalt, ½ to ¾ gal. per sq. yd.	820
Calcium chloride applied dry 3 lb. per sq. yd.	907

*Calcium chloride applied in concentrated solution.

insure approximately 4 lb. of the chemical per square yard of surface. The earth covering was used to hold the solution on the surface of the road and to prevent complete loss in case of a heavy rain.

The solution for curing was taken from water barrels which were placed at specified intervals along certain portions of road the day before those particular sections were completed. When the road was finished the proper amount of calcium-chloride solution was applied to the surface of the pavement by use of an ordinary sprinkling can. Inspection was made frequently and it was noted that the earth covering at all times was moist, which proved beyond a doubt that the pavement was satisfactorily cured.

Tests indicate that the granular calcium-chloride method of curing concrete has decided advantages over the method of wetted earth covering or ponding which has been specified for the past few years. The chemical method is as economical and in many cases more so than other methods, as it can be used at a cost of less than 6c. per sq.yd. of surface. A saving in labor is experienced in using calcium chloride, especially where central mixing plants are used since there would be

TABLE III—TENSILE STRENGTH OF STANDARD MORTAR BRIQUETTES

(Average taken of 3 Specimens) in pounds per square inch.

Storage	No Treatment Tested at 2 Days	No Treatment Tested at 7 Days	2% *Calcium Chloride Tested at 2 Days	2% *Calcium Chloride Tested at 7 Days	3% Calcium Chloride* Tested at 2 Days	3% Calcium Chloride* Tested at 7 Days
Damp Closet Temp. 68°	175	320	200	310	208	310
Ice Box Temp. 38°	33	142	57	206	57	191

*Calcium chloride dissolved in mixing water.

no necessity of putting in a pipe line. Further advantages of the calcium-chloride treatment lies in the earlier and more uniform strength that is attained by the concrete when this method is used. Due to this feature, it would be possible to open roads to traffic without danger to the concrete at an earlier date than ever before.

The investigations in regard to placing concrete in low temperatures have indicated that between 2 and 3 per cent of calcium chloride by weight of cement, incorporated in the mix, produces the best results in hastening the setting process of the cement, in securing an earlier strength in the concrete and in preventing injury to the pavements by the action of frost or freezing. Uniform distribution of the chemical is secured by dissolving the material in the mixing water.

The laboratory experiments consisted of making comparisons in strength and setting time of specimens

TABLE IV.—COMPRESSIVE STRENGTH AT END OF SEVEN DAYS

(Average taken of 3 specimens) in pounds per square inch.

Storage	No Treatment	2% *Calcium Chloride	3% *Calcium Chloride
Damp Closet Temp. 68°	2,100	2,185	2,259
Ice Box Temp. 38°	774	1,158	1,136

*Calcium chloride dissolved in mixing water.

containing variable amounts of calcium chloride. The specimens were made up in sets of six, three specimens of each set being placed in an ice box (temperature 38 deg. F.) while the other three were stored in a moist closet (temperature 68 deg. F.). At the end of two and seven days the specimens were tested for tensile strength, and at the end of seven days were tested for compressive strength. The results of these tests are given in Tables III and IV. Small truncated cones of neat cement were made up and stored in the same manner as the other specimens and were used in the penetration test for determining the setting time. A uniform penetration was secured in every test through the use of varied weights on the penetration needle. The idea in causing a fixed penetration to be made was to eliminate any errors which might have been present due to early surface hardening. The penetration used in all cases was $\frac{3}{4}$ in. In Fig. 2 are curves which

illustrate the setting action of cement in relation to the weights causing the penetration.

It is to be noted that in the laboratory tests for tensile and compressive strength the specimens containing 2 per cent of calcium chloride showed higher strength than those containing 3 per cent of the material, while the specimens which contained the higher percentage reached a set earlier than the others. Though no tests were made on specimens containing 2½ per cent of calcium chloride, that amount would probably produce the best results in both strength and early setting time. Due to the variation in action of calcium chloride with different cement, it is thought that no fixed percentage of amount of the chemical should be advised for all cases but rather a sliding percentage should be used, such as, from 2 to 3 per cent.

For the field work the chemical was purchased in granular form, either in steel drums or in 100-lb. bags. It was dissolved in about equal parts of water and then added to the mixer drum before the mixer was charged with the batch. A sufficient amount of the chemical was added to each batch to insure a content of about 2 per cent by weight of the amount of cement. This method permitted the road to be finished much more satisfactorily and within a few hours after the mixer had shut down at the close of the day's work.

A granular calcium chloride was also used in a few instances on the subgrade to keep down the dust and to prevent freezing of the subgrade when a low temperature was expected. In these cases approximately 2 lb. per sq.yd. was sprinkled on the subgrade.

Though calcium chloride will prevent concrete from being injured by moderately low temperatures, it was thought that freezing weather might damage the concrete and contractors were required to cover pavements with straw or earth during extremely cold weather. In spite of the fact that calcium chloride might not safely protect concrete at all times, its use allows considerable fall construction. In consequence many short gaps are closed in stretches of pavements, which would otherwise be left unfinished until the spring construction season.

The German Sewage Sludge Centrifuge

Unwillingness on the part of the makers of the sludge centrifuge in use at the sewage-works of Frankfort, Germany, to certify that the liquid from the centrifuge would contain no larger percentage of suspended solids than liquid from filter presses is noted by Reginald Brown in a letter to *The Surveyor* (London, England) of Feb. 10. Mr. Brown had been impressed with the centrifuge in other respects and offered to install a plant in England if the guarantee mentioned were promised.

Waterproofing, Joints and Drainage in Concrete Bridge

Some Details of Practical Design and Construction for Both Arch and Girder Types of Highway Bridges

Abstract of the Report of Committee S-2 on Reinforced-Concrete Highway Bridges and Culverts, American Concrete Institute; A. B. Cohen, chairman. Presented at Annual Convention, Cleveland, Ohio, Feb. 13-16, 1922.

The embodiment of good practice is not confined to theoretical economies based upon actual quantities of concrete, steel reinforcement and other materials; of equal or greater importance is the surety of a positive water repellent protection, the development of an effective expansion joint, the determination and arrangement of construction joints that will not weaken the structure nor exceed the capacity of a plant layout commensurate with the magnitude of the work and finally the distribution of a drainage system to down-spouts and so arranged as to minimize the concentration of water at the expansion and construction joints or at the termination of the flashings of the waterproofing medium.

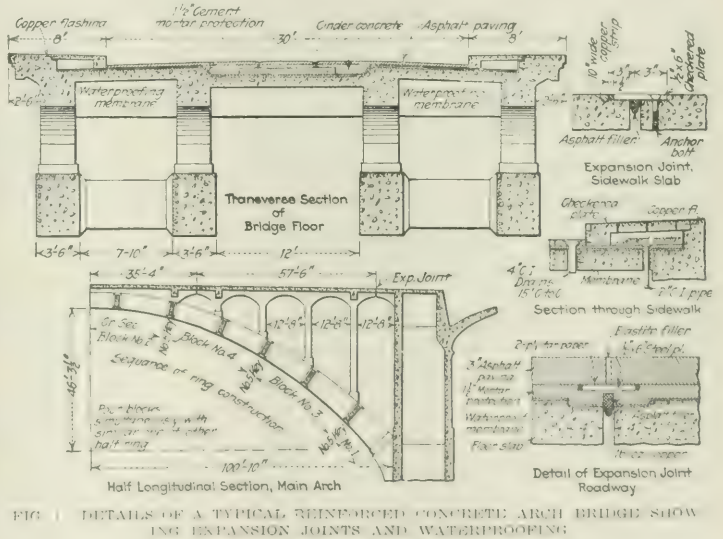


FIG. 1. DETAILS OF A TYPICAL REINFORCED CONCRETE ARCH BRIDGE SHOWING EXPANSION JOINTS AND WATERPROOFING

Waterproofing

In general concrete work, waterproofing systems can be divided into three classes, the membrane, the integral and the painting or plaster treatment.

The membrane system consists of the laying or building up of a water repellent blanket over the surface of the concrete—the bridge floor, the back of a barrel arch, the inner face of a parapet wall or any other surface exposed to drainage or to hydrostatic pressure. The waterproofing medium is a bituminous product, either an asphalt or a coal tar pitch. The bitumen, applied hot to the surface of the concrete, is reinforced and held in place by laying a treated or untreated sheet of felt, paper, burlap, cotton cloth or a combination of these materials after each swabbing of bitumen. The number of plies vary from two to five depending upon the kind of membrane used.

The integral method consists of the incorporation of a compound, either in paste, liquid or powdered form, with the concrete ingredients during the mixing to give greater flowability by lubrication of the surfaces of the aggregate or resulting in further hydration of the cement, both principles intended to produce maximum density at such price economical

action intended to decrease the permeability of the concrete.

The painting or plaster treatment consists of the application of bituminous or other paints, or the integral method used in cement mortar and applied like plaster to the surface of the concrete. A rubbing treatment also has been used in which the compound is worked into the surface of the concrete intended, by act of chemical or physical assimilation, to eliminate permeability of the concrete.

It is not considered that the integral methods have a function in waterproofing concrete bridges of such size that construction joints are unavoidable. The interruptions in the continuity of the surface that is to be protected by reason of both the incipient cracks that do develop regardless of the amount of reinforcement and the necessary expansion and construction joints make such methods inapplicable.

The aggregate may be so proportioned, treated and mixed that the resulting mixture would give a concrete of the highest degree of density, but the fact must not be overlooked, in the final analysis, that the actual density of the finished product depends largely in the manner in which the concrete is deposited in the forms. This is not controlled by the perfection of the mix, physically or chemically, but there remains a personal equation which is not fully controlled on any work.

The membrane system of waterproofing is a guard against possible defects in concrete bridge construction and has been used in a most effective manner. Regardless of the surface porosity or the incipient cracks that may develop, the expansion and construction joints necessary to the work, the membrane system is real insurance against disintegrations known to unprotected structures at these points of susceptive weaknesses.

At present this limits the field to the biuminous compositions, asphalt and coal tar pitch. As between coal tar pitch and a properly refined asphalt your committee is of the opinion that the physical properties of the latter is better suited to meet the outstanding requirements of service; because of the close proximity of the material to the surface of the structure, it is subjected to structural movements and shock of impact through wide range of temperature. Coal tar pitch is more susceptible to changes in temperature than asphalt; its consistency changes from an extremely brittle solid at 40 deg. F. to a very soft fluid at 115 deg. At the lower temperature the quality of ductility is completely lacking.

Not all asphalts, however, are suitable for waterproofing; some of them, in fact, being very poor waterproofing agents by reason of the fact that they lack the essential physical properties, or contain impurities prejudicial to their life.

Waterproofing Details of Design

Plans should show full detail of the waterproofing system, including provisions for flashing ends of the membrane, for folding membrane at expansion joints to guard against fracture due to excessive movement and for flashing at the down-spouts. Plans should avoid the fastening of street car rails with anchor bolts to the floor in an endeavor to eliminate the tie since much trouble has resulted by reason of this detail, which arrangement prohibits a positive continuous waterproofing blanket. If possible, the waterproofing membrane should not be terminated on face of curb in the gutter, as this places the termination at the point of almost perpetual dampness. Several successful schemes covering usual conditions of design are illustrated in Figs. 1 and 2.

Preparation of Surface.—All concrete surfaces to be waterproofed should be carefully floated to a smooth surface, embedding or removing such large projecting aggregate that might puncture the membrane.

Clean surface thoroughly by use of a stiff corn broom followed by a soft broom for removal of dust and finer particles. It is desirable to have the surface perfectly dry, but a little dampness or even a slight greenness of concrete will be allowable when the saving of time is an important element.

Protection of Membrane.—The waterproofing membrane should be protected, in the case of a barrel arch supporting earth fill, by a 1½ in. layer of 1:3 cement-sand mortar or by a layer of common brick laid with open joints, filled with cement or asphalt or by any other equivalent protection. This protection should be applied immediately after the waterproofing has been laid to prevent it from being punctured by subsequent construction operation. An asphalt pavement never should be applied directly over a waterproofing blanket, as subsequent repairs to pavement could not be made without puncturing the membrane; here is another function of the protection coat. Vertical wall work in contact with back fill is protected by one-half inch plaster coating which can be made to adhere readily to the asphaltic surface.

Since the coefficients of expansion of steel and concrete respectively are approximately equal, reinforced-concrete structures of appreciable size require expansion joints in manner similar to practice controlling steel design. By

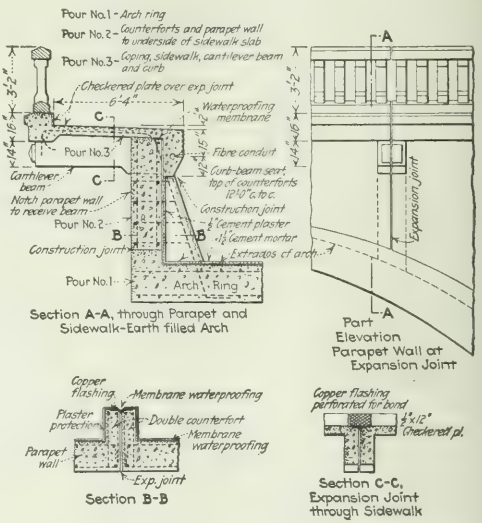


FIG. 2. DETAILS OF EXPANSION JOINTS THROUGH BRIDGE SIDEWALK

reason of the tensile strength of built up sections of a steel member, structural steel carries the stress due to temperature changes over greater lengths without rupture, than the less elastic reinforced-concrete section. Therefore, it is necessary to place expansion joints in concrete construction at even closer intervals than would be necessary in steel structure of similar magnitude.

In concrete structures the distance apart of these joints depends upon the type of structures and no specific recommendations relative thereto can safely be given. Recommendations covering general considerations can be made, however, that will give good index to conclusions for the varying conditions encountered in concrete design.

Broadly speaking, there are three types of highway bridge design requiring expansion joints; first, the arch type with superstructure composed of transverse or longitudinal walls supporting a floor system or with back fill of earth where the sidewalk construction is cantilevered from a parapet wall; second, the T-beam or rectangular slab design supported on columns or bents; third, the multiple way reinforced flat slab structure on columns. The latter type has not been extensively used but there is a wide field for its application.

In the development of expansion joint details the following consideration should be borne in mind. In the arch type with superstructure, expansion joints in the superstructure must provide for movement in both a vertical and horizontal direction—up and down for rise and fall of the arch ring and in a horizontal direction due to elemental changes of length in the various members of the floor system. Where transition for these non-concurrent movements

from one secton to another is attempted in the superstructure by sliding or vertical surfaces in contact, there is the imminent danger of a shearing failure in these sections in contact caused by excess of frictional or torsional action over the strength of the section in shear. The cantilever joint shown in Fig. 1 has been found to circumvent such a failure. The floor beams and slab of a particular span of superstructure are cantilevered from columns or bents to form a clear cut opening at the center of the span, providing free action in either horizontal or vertical direction. Joints placed at the quarter points of the span, approximately at the point of contraflexure in the arch ring, and at the pilasters adjacent to the piers have proved successful for spans of 90 to 200 ft. This arrangement divides the floor system over each arch in three sections and eliminates an extremely large moment in the floor system over the haunch of the arch due to a maximum vertical movement at crown of arch. The amount of moment or tension in the floor system due to vertical movement of the main arch ring varies with the ratio of rise to span; the flat segmental arch causes greater moment than the semi-circular arch of equal span. The principle or effect of the cantilever joint in floor system can be secured in the parapet wall construction of a barrel arch supporting earth fill, by vertical joint through the walls and sidewalk as shown in Fig. 2; here two separate counterforts and cantilever beams take end reactions.

For the second type, the T-beam or rectangular slab design supported on columns or bents, the action to be controlled is in the horizontal direction only. In the T-beam type there arises the difficulty of transferring the movement due to temperature changes from the larger through the smaller members as from the deep beams through the slabs. Regardless of the length of structure the slab should be substantially reinforced in transverse direction to distribute stress or prevent a cumulative strain at change of sections.

For sliding joints, plates of steel, copper, zinc or lead and multiple layers of fabrics or combination of these different plates have been used to reduce friction resistance. Where the bearing covers a wide area there is the danger, if heavy plates are not used, that the sliding medium or plate will conform to a possible uneven surface of a bridge seat and cause a crack. Therefore, great care must be exercised in preparation of the sliding joint, or bridge seat.

The third type, the flat-slab construction, can be built in greater lengths between expansion joints than either of the preceding types. Because of the uniform cross section everywhere of both concrete and steel, the slab offers better resistance to temperature changes, the movement being distributed more uniformly throughout its entire length. Expansion joints in this construction are formed by double row of columns, and have been placed 418 ft. apart in structure over railroad tracks where close lateral clearances precluded double row of columns. A length not exceeding 250 ft. would be better practice.

Construction Joints

Plans should show distinctly the location of possible construction joints. This detail is a decided help to the contractor, enabling a more intelligent analysis of the construction problems and avoids confusion and misunderstanding during the progress of the work. The designer, in arranging the location of these joints, should bear in mind and be able to judge the capacity of plant required commensurate with the magnitude of the work. For example, if a one-yard mixer is sufficient, the average volume of concrete for an 8-hr. operation would be approximately 160 cu.yd., an average of a batch every three minutes. It is possible to exceed this by 40 cu.yd., but operation is without interruption. Therefore, any larger section poured in continuous operation would require overtime or double shift.

The lengths of reinforcing rods should be predetermined so that no excessive length of dangling rods project beyond the construction joint to make the placing of the concrete a very difficult operation. The projecting lengths beyond the bulkhead forming construction joint should be long enough to develop bond strength with the next lift of [illegible]. In beam or slab construction, the joint is placed at point of least shear or maximum moment. No lap of bars should be made at this point unless absolutely necessary; then in addition to the usual lap to develop bond strength the bars should be clamped together by mechanical means.

Construction joints for gravity wall work should not be placed at greater intervals than 30 ft. By addition of temperature steel in reinforced walls, they can be poured with safety in sections 50 ft. in length. Gravity walls should be built preferably in one operation from footing course to the underside of the coping, and this may shorten the length of the section in order that the capacity of the plant is not exceeded. Vertical joints in wall construction are far more desirable than the horizontal joint which usually develops into an unsightly crack by reason of the formation of an efflorescence and gradual surface disintegration in spite of extreme precautions in removal of sludge and cleaning the joint before the subsequent operation. It is good practice to dovetail adjoining vertical sections by form insert and to further seal the joint against percolation of drainage by painting first exposed surface with heavy coat of asphalt. If back fill carries considerable water embed copper flashing in the joint in addition to the above precautions. Before placing the copper strip punch ends to be embedded with holes 2 to 3 in. in diameter to insure good bond. The center of the copper strip should be crimped with 1-in. "V" to allow for movement at the joint.

Avoid placing construction joints at sidewalk level or along plane of extrados of a barrel arch or any other plane where water is liable to be concentrated. In Fig. 1, the coping was carried above the sidewalk level simultaneously with sidewalk construction without measurably increasing the cost of construction. The same figure shows a curb section built with the arch ring. In event of the failure of the waterproofing blanket there is no concentration of water at the construction joint. The figure also shows other construction joints and how the waterproofing membrane was positively hashed and lines of termination sealed by application of waterproofing.

Drainage

The outstanding consideration in detail of drainage of a bridge floor is to lead the water to down-spouts placed at close intervals so that no large amount of water is carried over long distances or no large amount of water led to a single down-spout which would tend to choke up by ice formation in freezing weather. If possible, dikes should be built integrally with the floor slab adjacent to the expansion joint, and the floor ramped away therefrom by grade to down-spouts placed apart from the joint. An objection often given to expansion joints is the difficulty in making them watertight. By effective placement of copper flashing, by carrying membrane continuously over the joint and by further protection of plates, as shown in Fig. 1, the expansion joint can be made absolutely watertight. In sidewalk and coping construction above the floor, copper flashing has been used effectively in the construction joints not fully protected by the membrane seepage followed by slight unsightly surface disintegration.

Avoid placing down-spouts in concrete sections without due regard for the expansion of a metal drain pipe; this consideration has been satisfied by wrapping pipe with several plies of tar paper.

Avoid placing outlet of drain where the drip will pour over a concrete surface or overhead where icicle formation will endanger life. It has been found that formation of icicles can be prevented to a large extent by placing perforated copper baskets filled with rock salt at the top of each drain pipe.

In all retaining wall construction place weep holes at ground level to drain back fill. In case of the back fill carrying unusual amount of water, trench drains have been built up around the weep holes to facilitate free flow of drainage. Special attention should be given to the drainage of U-shaped abutments. There is a tendency in determining the size of weep hole or drain to fix the size by actual amount of water to be carried. These should be made exceptionally large to avoid being clogged by dirt, and if so, that they might readily be cleaned.

Repairing the Rolling Parts of Two Bascule Bridges

Damage to Parts in Rolling Contact Due to Excessive Bearing Pressures Producing Distortion and Crushing of Segmental and Track Girders and Excessive Wear on Tread Castings

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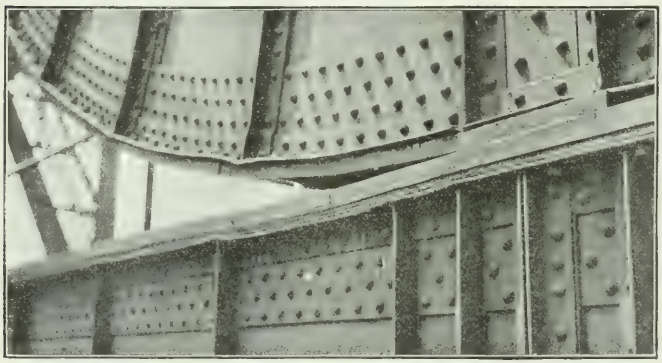
HEAVY repairs have recently been made to two rolling-lift bascule bridges carrying the Cleveland, Cincinnati & St. Louis Ry. across the Cuyahoga River at Cleveland. The repairs were necessary by reason of serious damage to the rolling parts of the bridges that had developed in the course of time. Study of the damage and its relation to the proportioning of the damaged parts indicates quite definitely certain limits that should be observed in the design of members carrying heavy rolling loads if permanent service is to be secured.

The bridges repaired are: Bridge 2, a 120-ft. double-track bascule erected in 1901; and Bridge 4, a 125-ft. single-track span, erected in 1900. They were of an early design, and the defects to be described became evident after a few years' service. In time these defects resulted in such extensive damage that the renewal of some parts and repairs to others were imperative if the bridges were to remain in service.

Description of Damage—The first evidence of distress was the shearing of the bolts connecting the curved tread plates to the segmental girders, followed by the slotting of the bolt holes. This was followed by the cracking and failure of the flange angles in the root, breaking of tread plates and a longitudinal movement of the spans. The stiffeners and diaphragms had cut into the plates, and the webs and flange plates of the segmental and track girders were crushed and broomed to a depth of ½ in. at some points. The tread plates were rolled out and worn.

In the views Figs. 1 and 2 the effect on the flanges of the segmental and track girders is clearly brought out. At the left in Fig. 3 the deformation of the segmental girders is drawn from an actual cross-section. The original sections of the flange and tread plate are shown in light lines and the final sections in heavy lines. Both bridges had been operated more than 50,000 times: the double-track span 53,000 times (in 20 years) and the single-track span 60,000 times (in 21 years' service).

The failure was due, in part, to poor details, but principally to excessive pressures, far too intense for a rolling-lift span. The original and new flange sections for both bridges are given at the bottom in Fig. 3. In Bridge 2 the rolling load per truss was 700,000 lb., which (assuming a longitudinal distribution of 6½ in.) resulted in a bearing pressure between the web plates and tread plates of 14,350 lb. per sq.in. and between the tread plates a pressure per inch width equal to 144 times the diameter of roller. The new section reduced the bearing pressure to 9,000 lb. per sq.in. and 112 D per inch of roller. In Bridge 4, the 125-ft. single-track span, the rolling load per truss was 365,000 lb., resulting in a bearing pressure of 18,250 lb. per sq.in. and a roller bearing per inch width of 156 D. With the new sections the bearing pressure is reduced to 8,300 lb. per sq.in. and the roller bearing to 73 D.





FIGS. 1 AND 2. TWO VIEWS OF THE DAMAGED TREADS AND FLANGES OF GIRDERS, BRIDGE 4

Repair Required—To overcome the defects which had developed it was necessary to renew the tread plates and flanges of the segmental girders on both bridges, the flanges on the track girders of Bridge 4 and the entire track girders of Bridge 2. It was desirable to increase the thickness of the track castings, but at Bridge 4 the thickness was limited by the amount which the grade of the bridge could be raised, and the new castings therefore were made 3½ in. deep. At Bridge 2, the track could not be raised at all, but as the track girder was to be renewed it could be made of slightly less depth; these conditions limited the thickness of the new tread plates to 4⅞ in.

The castings were designed so that the effective tread bearing would come under the web plates only. The top or curved castings had lugs on top, as shown, to tie the old webs together, as it was necessary to cut out the lower part of the old diaphragms. The joints of the bottom castings were cut at an angle, to break joint

with the treads. The castings for the segmental girders were finished straight (to the chords) on the top side to avoid radial planing.

The flange angles and side plates on the segmental girders of both bridges were replaced with new ones of heavier section, and additional stiffeners were provided. The thickness of the new side plates was limited by the small distance between the two webs of the girders, as it was necessary to have clearance between the two inside plates to enter the long rivets from the inside. It was known that the webs were mashed to such an extent that they could not be depended upon to take bearing from the new tread plates; so the radius of the track was increased, to bring the top surface of the tread plates $\frac{3}{4}$ in. from the edge of the old web plates.

Method Adopted—Bridge 2, the double-track span, is high enough to clear tugs and fire boats, and did not have to be operated during the close of navigation. This permitted the renewal of the entire track girders, which was desirable. It was arranged to support the span, while the track girders were being renewed, on a temporary post riveted to the main end post and gusset plate and carried down to the pier. When the work was started this post was riveted on, just clearing the bridge seat; the span was rolled back, a plate was put under the post, and the span was then rocked forward so that the post came to bearing, lifting the entire span clear of the track girders. It was thus carried as a simple span until the completion of the work.

Bridge 4, the single-track span, is so low that it is opened several times daily even in winter for the passage of small boats. This made it impracticable to renew the track girders outright, and it was arranged to renew the top flange only. The flanges and plates on the back end of the girders could be renewed and still allow the bridge to be partially opened; this done, a temporary splice between the old and new work could be provided, the bridge rolled back past the splice, and the work on the front end completed.

The new steel and castings were furnished by the King Bridge Co., of Cleveland, and all shop work possible was done by them. The old side plates were removed and sent to the shop to be used as templets. It was necessary, however, to sub-punch many of the holes, later to be reamed in the field; also, the outstanding legs of the flange angles were left blank and drilled in the field from the castings.

Field Repairs—The actual placing of the material was done by the Ferro Construction Co., of Chicago. Permission to close the bridges to navigation was not received until Jan. 24, 1921, and the permit required that the bridges be restored to service March 15. Work was at once started on both bridges and a large part of the time three shifts were worked, completing it on time. Great care was used to align the spans and surface the tread plates properly, but no unusual difficulties were encountered. As the work developed, more field work was found necessary than at first anticipated. The main posts were found to be badly crushed at the bottom, and in order to get proper bearing on the new plates it was necessary to cut off about $\frac{3}{4}$ in. and resurface them in the field. This was done by a motor-driven grinder mounted on a table moving in two directions, as shown in Fig. 5.

The weight of the new material applied was 350,000 lb., and the total cost was approximately $90,000.

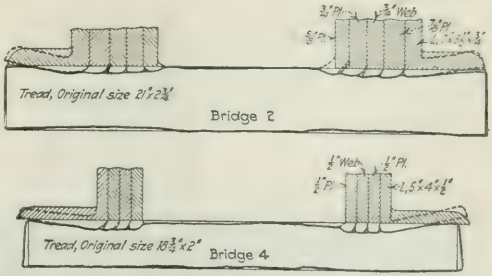
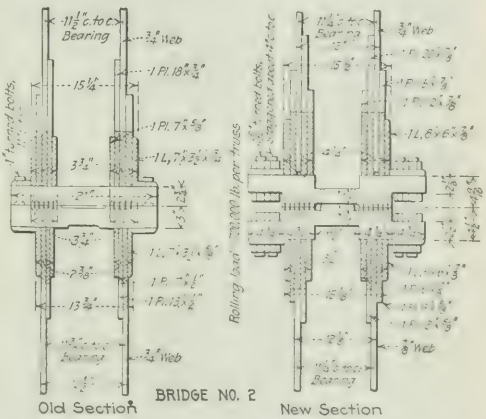
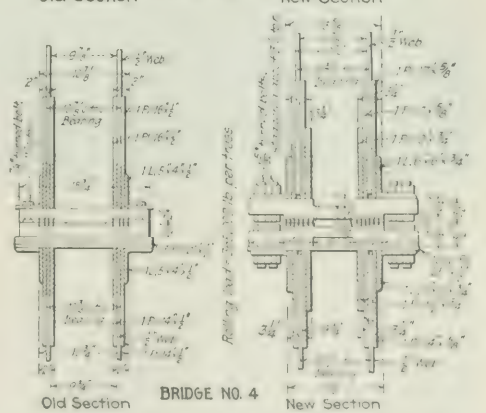


FIG. 3. DISTORTED SEGMENT GIRDERS AND TREADS, AND OLD AND NEW TRACK CONSTRUCTION





If more height had been available the castings would have been made about 8 in. deep to provide better longitudinal distribution of the load, but it was felt that the plates as installed would give satisfactory service during the probable remaining life of the structure as a whole. While great care was taken in bending and finishing the flange angles on these segmental girders in order to insure uniform bearing on the castings, it is difficult to make the bend sharp enough at the chord points to give bearing at the extreme end of the castings. If it were practical to finish the top surface of the upper castings to an arc, it would probably be well to curve these angles.

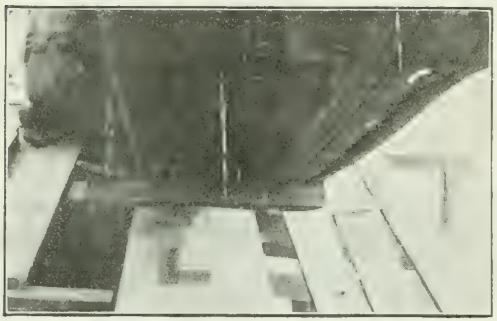
Since the repairs were made, the two bridges have been in service about one year, and while no defects have had time to develop it is believed that with the reduced intensity of bearing and improved details no further trouble will be experienced. Both bridges now operate with noticeably less power than before the repairs were made.

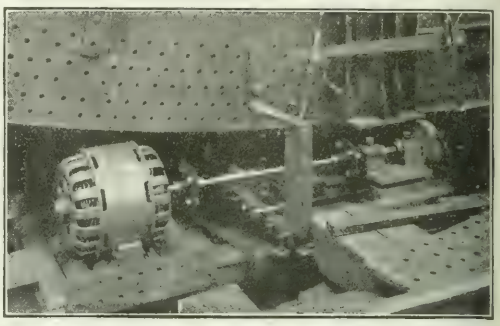
Conclusions As To Bascule Design—While the above description may be of general interest in that it illustrates one method of correcting defects which had reached a very acute stage in two rolling-lift bridges, the cause of the failure and remedies suggested by what was found here which might be applied in new designs are perhaps of greater interest and importance.

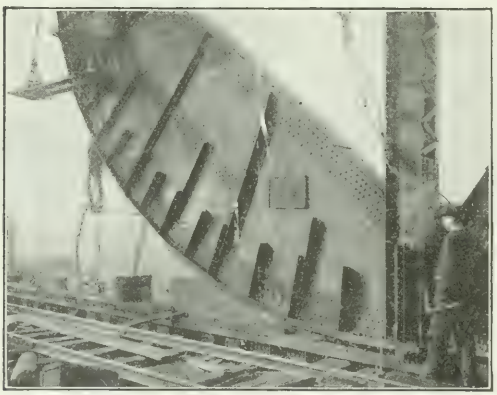
These bridges were of an early design, and among the first of the heavier railroad spans built. The stresses used for bearing and rolling were probably at that time considered conservative. They proved, however, to be far in excess of what should be permitted under such conditions of service. It must be remembered that in such bridges of any great length the load is heavy and is rolling, and almost in line contact under the roller. The metal in the contact surfaces is subject to an action similar (to use a homely illustration) to that on pie dough under the rolling pin, and is rolled out in the same manner, if to a lesser degree. This is clearly shown in the sections of the plates which were removed.

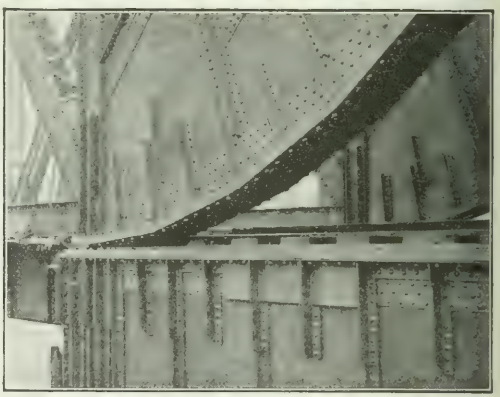
From what occurred at these two bridges, it is probable that in such rolling-shift bridges the bearing between the tread plates and the girders should not exceed 8,000 lb. per sq.in., and the bearing per inch width of roller should not exceed 125 times the diameter (in inches). It is necessary to make some assumption as to the longitudinal distribution of the load from the tread plates to the girders. Where the castings are thick enough to prevent deflection and the load is applied near the center of a tread section, it would be reasonable to assume a distribution along the line of shear or for a length equal approximately to twice the depth of the casting.

When the load is applied just at the end of a tread section the longitudinal distribution would be reduced about one-half if the castings were absolutely fixed in reference to the girder, but under actual conditions the intensity of bearing at the end of the section probably is considerably greater than the average. This is particularly true with shallow castings, and the old girders removed showed clearly where the ends of the sections had cut into the webs and plates of the girders. On some of the recent bridges of this type the castings have been forked at the ends to provide a partially continuous bearing over the joints, but with perfect workmanship only 50 per cent of the load could be assumed as carried over the joint into the next section. To provide for this critical condition at the ends of the sec-









FIGS. 4 TO 7. DAMAGED TRACK OF ROLLING-LIFT BASCULES AND ITS REPAIR

Above: Fig. 4. Crushing of webs, failure of flange angles and cutting of tread castings, Bridge 4

Above: Fig. 5. Grinding bottom of main post where severe crushing had destroyed the bearing, Bridge 2

Below: Fig. 6. Fitting new flange to segment girder, Bridge 2; new track girder already in place

Below: Bridge 4 after completion of repairs; new track castings and flanges and extra stiffeners

tions of the tread plates, it would seem better to assume a longitudinal distribution approximately equal to the depth of the castings. This would not result in abnormal sections, as for example, with 2,000,000 lb. rolling load per truss and the castings 20 in. deep a total width of bearing of 12½ in. would be required, or 6¼ in. for each side of the girder. The bearing width of the tread plates, assuming a segmental girder radius of 30 ft., and based on 125 D, would be 22 in., which is practicable.

Modern bridges of this type show modifications designed to overcome some of the difficulties as experienced with the two bridges whose repair has been described. In designing that portion of the structure which takes the rolling load (that is, the girders and tread plate) for new bridges and where possible for the repair of old bridges, the following points might well be given consideration as governing requirements:

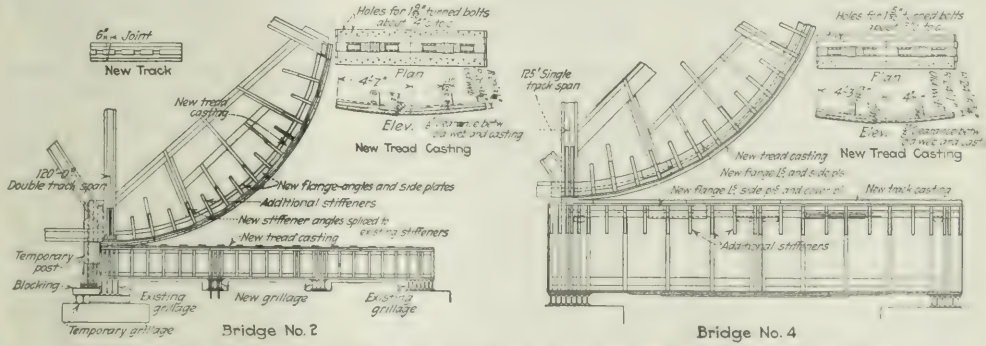


FIG. 8. RENEWALS AND CHANGES IN ROLLING PARTS OF TWO BASCULE LIFT BRIDGES

(1) Low bearing stresses (as compared with practice in fixed spans) at the contact surface between the tread plates and girders and between the tread plates;

(2) Symmetrical arrangement of side plates of the girder flanges about the center of the web, and placing the center of the webs of the segmental girders in line with center of the webs of the track girders;

(3) Deep tread castings (probably not less than 8 in. for light rolling loads, so rigidly attached to the girders as to prevent rocking and longitudinal movement, so designed that the bearing surfaces between the upper and lower castings will be symmetrical about and directly below or above the webs of the girders, and of such section that no bearing will be imposed upon the outstanding legs of the flange angles.

Uniflow Engines Drive Centrifugal Pumps

To fill the Littleton storage reservoir of the London Metropolitan Water Board, England, from the River Thames, uniflow engines and centrifugal pumps will be used. There will be four pumping units, each with a capacity of 75 Imp. m.g.d., working against a head of 37 ft. and delivering water through three 72-in. steel force mains laid over the reservoir embankment. The engines which are designed for a 25 per cent overload, will have a total pump horsepower of 3,120. The pumping plant is being built by Worthington-Simpson, Ltd., London, England. The Littleton reservoir, now under construction will have a capacity of 6½ billion Imp. gal.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Need for National Standard in Motor-Vehicle Legislation

Sir—The writer desires to endorse the idea in the Feb. 2 issue of *Engineering News-Record*, p. 178, with reference to the advisability of establishing definite weight and speed standards for motor vehicles by some national authority. We must design our roads to carry greater weight than we have used in the past, and in the design of roads we should adopt definite standards of weight and speed of vehicles. Otherwise, the designs of different engineers are bound to vary greatly, with a consequent variation in the amount and character of the service which the highway will be able to render.

If such standards are not nationally established, how else can they be established? With the advent of motor haulage the sphere of action of the vehicle has been transferred from local and urban traffic to intercounty and interstate traffic. It is certainly an unfortunate condition which compels the owner of a vehicle engaged in such interstate traffic to study the laws of each state through which he must travel.

We note in the daily papers an agitation that cities shall, in order to preserve their roadways, establish standards of weight and speed for motor vehicles. I consider such an idea as extremely irrational and unfortunate; not only should road rules be uniform within the state, but they should be uniform throughout the country.

Carrying the idea further, the writer desires to begin the agitation of another subject along related lines. Why should we not have a nationally adopted system of highway sign posts, guide posts and signals? The present system, at least in Pennsylvania, is an abomination. The state highway department has its own standards and each county has different standards, depending on the whim of its county road authorities.

The driver of a motor vehicle going along the road with his attention concentrated on the traffic conditions cannot derive the same benefit and instruction from these varying signs that he would if a uniform system of signs were used. There are the same reasons for such a uniform system as there are for the present uniform system of railroad signals.

Pittsburgh, Pa. Louis P. Blum
Feb. 12. Blum, Weldin & Co.,
Engineers and Surveyors.

NEWS OF THE WEEK

New York, March 9, 1922

Outlines Broad Project to Develop Cork Harbor

Comprehensive Plan Aims to Establish Cork as Foremost National Port of Irish Free State

Plans looking to the establishment of Cork Harbor as a national port of the Irish Free State have been submitted to the harbor commissioners by George F. Nicholson of Seattle, consulting engineer to the board.

The plans include the construction of a new pier, including a warehouse, cold storage plant, grain elevator, railway yards and mechanical handling equipment; a groin to increase scour in the main channel, dredging in the main channel and turning basin, improvement of existing water-front plant, reclamation and development of tidal flats, and completion of dredging between Cork and Cobh (Queenstown). The estimated cost of these improvements is placed at £2,000,000.

Mr. Nicholson recommends also that the provisional government of the Irish Free State be requested to effect a consolidation of the city of Cork and the town of Cobh, and to empower the Cork Harbor Commissioners to construct and operate warehouses, grain elevators, cold storage plants, coal terminals, tugs, barges and all other harbor facilities, to control ship-repair plants in the harbor, to have jurisdiction over water-front streets, to acquire, or at least to control, water-front railway trackage and to establish a lease period for terminal properties of 30 years subject to reappraisement every five years.

In submitting his report, Mr. Nicholson suggested that the provisional government be requested to appoint a commission of three outside experts to investigate and report to the government as to all the Irish ports in order to provide for intelligent development that will meet most effectively and economically the national commercial needs of the Free State.

New Engineering Company to Operate in Mexico

The J. G. White Engineering Corp. and the Raymond Concrete Pile Co. have announced the formation of the Raymond-White Co. to engage as engineers and contractors in Mexico. The company's office in Mexico City was opened March 1 under the direction of S. Bradshaw Jacobs, vice-president in charge of Mexican operations.

Consider $500,000 Bond Issue for Rhode Island Bridges

The General Assembly of Rhode Island has referred to the House finance committee a resolution calling for a $500,000 bond issue for the construction of highway bridges. If approved by the legislature, the project will be submitted for ratification by popular vote at next November's election.

Machinery Corporation Gets Large Brazilian Contract

Robert Morris, head of the Austin Machinery Corp. of Louisiana, recently closed a deal with the Brazilian Government whereby his company will furnish about $4,000,000 worth of machinery for use in public improvements in Sao Paolo, Brazil. It is possible that in view of the extensive public improvements proposed for Brazil the Austin company will secure further contracts. In such an event it is probable that a branch office will be established either in Sao Paolo or Rio.

To Study Basic Causes of Unemployment

The fundamentals of unemployment and control of the business cycle are to be the subjects of a thorough investigation by a special committee of the President's Conference on Unemployment, selected Feb. 20 at a meeting in the Department of Commerce. Owen D. Young, vice-president, General Electric Co., New York, was named chairman. Joseph H. Defrees, president of the Chamber of Commerce of the United States, Clarence Mott Woolley, president of the American Radiator Co., New York; Matthew Woll, vice-president of the American Federation of Labor; and Miss Mary Van Kleeck, Russell Sage Foundation, New York, are the other members of the committee. Edward Eyre Hunt, secretary of the President's Conference on Unemployment was appointed secretary of the new committee, and Wesley C. Mitchell of New York, field director of the investigation.

The committee is to report to the President's Conference on Unemployment and the public in about six months.

Am. Soc. C. E. Acts on Amendments

Ballots on six proposed amendments to its constitution were canvassed by the American Society of Civil Engineers at the meeting in New York City March 1, resulting in the adoption of those three amendments which had been sent out with a recommendation in favor of their adoption and the defeat of the other three. In each case the vote was decisive.

The three amendments which were passed by substantial majorities covered: Change of the membership grade of "associate" to "affiliate"; dues for members residing outside of North America; and voting by zones or districts for vice-presidents and directors.

The defeated amendments included one on a proposed plan of electing officers by local section representation; provision for an annual conference of representatives of local sections to consider the welfare of the society; and the establishment of local sections in each geographical district of the society and compulsory membership in a local section.

To Oppose Water-Rate Increase by East Jersey Water Co.

A committee of mayors of New Jersey cities and towns in the district supplied by the East Jersey, Passaic, Montclair, and allied water companies has engaged Cylde Potts, consulting engineer, New York City, and John Milton, formerly city attorney of Jersey City, to contest the proposed new schedule of water rates filed by the companies with the New Jersey Board of Public Utilities. H. F. McConnell, mayor of Montclair, is chairman of the mayor's committee. A public hearing is to be given by the utility board at its Newark offices on the forenoon of March 29.

National Construction Conference to Be Held in Chicago

A national construction conference is to be held in Chicago, April 3, 4 and 5, under the auspices of the National Federation of Construction Industries. During the week of the conference numerous associations interested in construction are to hold meetings in Chicago. The lumber industry has arranged for the fourth American lumber congress on April 6 and 7 and various national lumber associations will also hold individual meetings during the week. The National Lime Association will hold a district meeting and other bodies are making like arrangements.

Water-Supply Material Men Get Recognition

At the final meeting of the season of the New York Section of the American Water-Works Association, March 2, in New York City, Beekman C. Little, superintendent of water-works, Rochester, N. Y., advocated the giving of greater recognition to the associate members of the association. He pointed out that the equipment and material men had contributed much to progress in the water-works field by research work along various lines designed to improve materials and machinery. Among the instances mentioned was the co-operation of the meter manufacturers in the standardization of water meters. While on the subject of meters Mr. Little remarked that a water meter sold to the city of Rochester 32 years ago by the late John C. Tully was still in use.

Frank T. Kimball, secretary, New Rochelle Water Co., New Rochelle, N. Y., was elected as governor of the section to succeed Col. George A. Johnson.

Johns Hopkins School of Public Health Receives $6,000,000

To place the Johns Hopkins School of Hygiene and Public Health on a solid financial basis the Rockefeller Foundation, New York City, has given the school $6,000,000. Money will be used partly as an endowment fund and partly for buildings adjacent to the Johns Hopkins Medical School and Hospital.

Detroit Engineering Societies Form Federation

After several years of discussion as to the advisability of establishing a central association, engineers, architects, chemists and other technical men of Detroit have formed a federation. A federation of twelve societies was effected Jan. 1 by the ratification of a constitution and by-laws, acceptance of membership of the various societies, and the election of counselors by the following twelve bodies: Detroit Section, American Society of Civil Engineers; Detroit Chapter, American Association of Engineers; Michigan Chapter, American Society of Heating and Ventilating Engineers; Detroit Post, Society of American Military Engineers; Detroit Section, American Society of Mechanical Engineers; Detroit-Ann Arbor Section, American Institute of Electrical Engineers; American Institute of Chemical Engineers, Detroit Engineering Society, American Chemical Society and Detroit Chemists; Michigan Chapter, American Institute of Architects; Detroit Section, Michigan Society of Architects; and the Detroit Chapter of the American Society for Steel Treating.

The permanent council has elected the following officers for 1922: Chairman, P. W. Keating; vice-chairman, A. A. Meyer; secretary-treasurer, Walter R. Meier.

The federation will take an active interest in all matters wherein engineering, architectural and technical subjects are important factors. The council will study the opinions of the membership and will assist in furnishing definite and accurate information to the public. The federation will offer its assistance and advice to city and state officials whenever required. The aim and purpose of these activities will be the provision of the most reliable technical information for the proper consideration of public improvements and public undertakings in which all Detroit citizens are interested.

Louisiana Building Contract Commission Appointed

The Legislature of Louisiana at the recent extraordinary session passed a law creating a building contract commission and clothed Governor John M. Parker with authority to appoint the five members who were to compose it. Announcement has just been made of these appointees.

W. O. Hart, a prominent attorney of this city, is made chairman, with the following associates: T. J. Grier, of Shreveport, president of the State Federation of Labor; George J. Glover, of New Orleans, builder and contractor; W. W. Carre, of New Orleans, lumber dealer, and W. B. Connell, of Baton Rouge, banker.

The purpose of the commission, whose members serve without compensation, is to investigate all bonds and codal provisions bearing on building contracts in this state, contractors' bonds and laborers' and material men's liens and privileges.

It is also the intention to make a study of similar legislation in other states and to give interested individuals an opportunity of presenting their views. A report on the subjects so investigated will then be made by the commission to the legislature during the first week of the next regular session in 1922.

Employment Among Engineers in the New York District

Little improvement since Jan. 1 in the unemployment situation is reported by the Employment Service of the American Engineering Council of the Federated American Engineering Societies. The total number of men registered by the service, which is located in the Engineering Societies' Building, New York City, up to January was 3,209. This included those out of work or who were filling temporary jobs. During January 142 new registrations were received and 131 men obtained jobs. The number of positions filled was 186. An average of eight jobs filled per day is being maintained. Most of the unemployed engineers are college or technical school graduates and some have earned salaries as high as $15,000 per year.

Marine Borers and Their Work Shown in Exhibit

The Committee on Marine Piling Investigations of the National Research Council, in preparation for a meeting to be held by the Municipal Engineers of the City of New York in the Engineering Societies' Building on March 22, has collected a large number of specimens of marine borers and their work. These specimens represent a number of species of borers and are from various locations on the Atlantic, Gulf and Pacific coasts. These specimens have been placed in the lobby of the Engineering Societies' Building for the inspection of all who are interested.

The committee, of which Col. W. G. Atwood is director, feels that the recent discovery in Barnegat Bay, N. J., of the same species of teredo which did such great damage in San Francisco, makes the study which it is initiating of extreme importance in New York and other Eastern harbors. This species, the Teredo Navalis, has not been identified on the Atlantic Coast previously. It is by far the most destructive of the various species.

Zoning and Traffic To Be Taken Up at Indianapolis

Zoning and traffic problems will be considered early this year by the City Planning Commission of Indianapolis and consultants engaged. Lawrence V. Sheridan is executive secretary of the commission.

Tax Exemption of New Dwellings Upset in New Jersey

The New Jersey statute of 1920 authorizing exemption from taxes for five years of new dwellings erected during the year ending Oct. 1, 1922, has been declared unconstitutional by the State Supreme Court (Julius Koch against Essex County Board of Tax Equalization). The court holds that the exemption of new dwellings violates the constitutional provision that all property must be assessed for taxation under general laws and uniform rules, according to its true value. Reversal of the decision by the Court of Errors and Appeals is a possibility but is not considered likely.

Wisconsin Societies Plan Registration Co-operation

Engineers Urge Passage of Bill—Other Matters Discussed at Society Meeting in Madison

Registration of engineers in Wisconsin was approved by the Engineering Society of Wisconsin at its meeting Feb. 24 and 25 at Madison. For this purpose and for other engineering problems of state-wide interest the organization voted to co-operate with other technical societies. Affiliation with other organizations in the state is to be studied by a committee. Consideration of joining the Federation of American Engineering Societies was put over for another year. In urging registration P. H. Connolly, chairman of a committee which brought in a new draft of the bill, which failed to pass at the last session of the legislature, stated that Wisconsin was surrounded by states which had such laws. In consequence the incompetents could practice in Wisconsin while the competent consultants of Wisconsin were under a handicap when they sought business in other states. Although the legislature does not meet until next winter, the secretary was instructed to name engineers in the various political sub-divisions to make the acquaintance of every legislator and if possible secure his support of the bill.

Attendance Was 250

The society is in flourishing condition, having increased its membership from 50 five years ago to 210 now. About 250 engineers and guests attended the dinner-meeting which was given jointly with the Technical Club of Madison. Daniel W. Mead, consulting engineer, Madison, addressed this meeting on "Engineer Ethics" which he interpreted tersely by the term "square deal." A committee was authorized to draw up a code of ethics.

Following a plea for funds for the Land Marks Commission by J. G. D. Mack, state engineer, $50 was appropriated in connection with a marker of the site of the first electric-light installation at Appleton in August, 1882.

Of technical interest to the civil engineer were papers on roads, land drainage and bridge construction.

A. R. Hirst, chief engineer, Wisconsin Highway Commission, outlined the state's 1922 road program.

A general discussion on [illegible] was precipitated by Prof. E. R. Jones of the University department of agricultural engineering. A committee on drainage was authorized to study drainage contracts and specifications and to submit approved forms next year.

The society urged the enactment of a law whereby plats showing drainage and other surveys may be recorded for the benefit of the land owner as only county surveyors can now record results of surveys.

L. J. Klug, consulting engineer, Milwaukee, described the methods used in the construction of the 1,350-ft. North Avenue reinforced-concrete arch bridge in Milwaukee. Speed was essential because of a threatened $200,000 suit by ice companies which were apprehensive that the lowered water level required behind a dam below the bridge would interfere with their ice harvest. To expedite progress on the [illegible] three tanks were designed in the drifting

room, cut in the shop and each piece numbered. It was stored on the old bridge above the piers and quickly dropped into place with a minimum of carpenter work as soon as the excavation was completed. The two ribs of each of the three main arches were cast separately over structural steel trusses fabricated on the job. After a setting period of 28 days forms under the first set of arches were struck. It required only 10 hours to lower the trusses roll them transversely and jack them to position ready for the concrete for the second set of ribs.

The officers elected for the ensuing year are as follows: President, Jerry Donohue; vice-president, John C. White; new trustees, C. I. Corp and A. L. Hillis; secretary-treasurer, Leonard S. Smith, Madison.

Vanderbilt University to Build Stadium

Vanderbilt University, Nashville, Tenn., has through the co-operation and assistance of the Alumni Association and the Nashville Chamber of Commerce, raised $150,000 for the erection of a concrete stadium. Freeland, Roberts and Acker, Nashville, have been selected as designing engineers, and Hart and Nevins, also a Nashville firm, will take care of the architectural features of the project. Construction is expected to start this spring. It is hoped that the structure will be completed in time for the opening of the football season.

New Railroad Valuations Announced

Additional tentative valuation of common carrier properties, as of June 30, 1916, have been handed down recently by the Interstate Commerce Commission.

American Association Employment Report for January

Applications for employment to the American Association of Engineers in January numbered 1,872. A year ago they were 2,192 and in December, 1921, they numbered 1,877. Of the January figure the Chicago office received 170, New York and New Jersey 100, Los Angeles 100 and northern California 140.

Positions received were 323 in January, 652 a year ago and 308 in December, 1921. Men referred numbered 156 in January, 274 one year ago and 175 in December, 1921.

Gets Option on Spruce Railroad

E. S. Grammer, Seattle, head of the Admiralty Logging Co., has been granted an option for the purchase of the U. S. Spruce Production Corporation's railroad, built during the war on the Olympic Peninsula; he expects to close the option and take over the property within the next month or six weeks. The option also covers the big sawmill that the spruce corporation built at Port Angles to be operated in connection with the railroad. The purchase price agreed upon has not been made public, but it is stated that negotiations have been based upon a price of $1,500,000 for both properties.

The government railroad, known among lumbermen as the "spruce railroad" is 36 miles long, and is estimated to have cost the government about $4,000,000. It has never been operated except to transport construction materials. The saw mill was about 90 per cent completed when the armistice came, and much of the machinery and equipment is at Vancouver, Wash. It is estimated to have cost the government approximately $1,200,000, and was planned to cut 400,000 ft. in 8 hr.

Name of Road	Final Value	Cost of Reproduction New	Less depreciation	Liabilities (Capital Stock plus Long term debt)
Boston Terminal Company	$19,910,500	$6,527,116	$5,224,722	$15,000,000 00
Chicago, Indianapolis & Louisville Ry. Co..	27,270,223	9,654,015	7,841,230	33,710,930.00
Indianapolis & Louisville Ry. Co..	1,900,000	2,033,367	1,748,523	1,939,902.73
Charleston & Western Carolina Ry. Co..	10,402,096	9,814,315	7,469,440	6,900,000.00
New York, Philadelphia & Norfolk R. R. Co...	10,976,927	11,465,512	8,549,839	6,800,000.00
Nelson & Albemarle Ry. Co.....	141.825	150,172	123,113	385,000 00
New York, Ontario and Western Ry. Co.....	34,495,193	37,481,743	28,902,147	88,245,982.84
Louisville & Jeffersonville Bridge Co.	2,977,210	2,371,227	1,630,139	5,925,000 00
Rock Island-Frisco Terminal Ry. Co....	2,006,781	589,868	499,189	3,890,000.00
Southern Illinois & Missouri Bridge Co.	3,182,660	3,374,016	2,968,974	3,270,045.67
Ulster & Delaware Railroad Co.....	6,468,019	6,825,669	5,536,780	4,900,000 00
Sandy River & Rangeley Lakes, Railroad...	1,359,427	1,585,417	1,242,202	1,177,000 00
New Mexico Central R. R. Co.....	1,365,024	1,621,448	1,271,082	8,250,000 00
Southern Ry. in Mississippi.	4,470,534	5,276,956	3,740,805	886,148.76
Indiana Stone Railroad Co.....	550,000	579,604	519,919	431,909.40
Little Rock, Maumelle & Western R. R. Co..	300,530	307,975	249,816	391,493.57
Rhode Island Company	310,000	369,816	251,508	203,800 00
Pecos Valley Southern Ry. Co.....	373,409	420,356	312,238	445,000 00
Norwood & St. Lawrence R. R. Co.	533,078	573,369	466,528	446,000 00
Norfolk and Portsmouth Belt Line	971,831	895,663	668,146	486,308.51
Chesapeake Western Railway	343,837	380,303	306,628	2,838,600.00
Baltimore & Sparrows Point R. R. Co.	349,237	317,369	229,997	150,000 00
East Jersey Terminal Co.....	359,390	434,704	332,025	257,000 00
Paris & Mt. Pleasant R. R. Co	813,771	797,589	625,666	675,000.00
Sault Ste. Marie Bridge Co..	500,750	564,811	435,378	1,856,969 31
Artesian Belt Railroad.....	443,281	492,452	387,562	70,000.00
Rome and Clinton Railroad Co..	405,000	442,692	367,796	345,360.00
Utica, Clinton & Binghamton R. R. Co	1,275,000	1,341,073	1,089,312	1,649,224.00
Wharton Valley Ry. Co.....	200,000	232,352	186,304	145,000 00
Ontario, Carbondale & Scranton Ry. Co...	6,250,000	6,047,536	5,187,957	3,000,000 00
Pecksport Connecting Ry. Co.....	100,000	108,092	87,789	80,060 50
Ellensville & Kingston R. R. Co.	900,000	994,637	765,533	950,000 00
Port Jervis & Summitville R. R. Co.	875,000	1,031,208	842,128	560,000.00
Central Union Depot & Ry. Co. of Cincinnati	670,808	704,947	513,023	962,500.00
Butler County R. R. Co.....	907,490	1,022,852	831,022	355,000.00
Tuckerton R. R. Co.....	503,946	577,244	458,391	652,241.54
Durham & South Carolina R. R. Co	460,796	544,430	426,213	800,000 00
Rosslyn Connecting R. R. Co.	230,000	108,924	85,188	149,118.15
Augusta Union Station Co.....	193,649	150,400	129,268	300,000 00
Angola Transfer Co.....	160,000	186,161	149,514	75,000.00
Cape Charles R. R. Co.....	143,412	114,670	84,816	131,000.00
Pickens R. R. Co.....	126,426	131,525	103,798	115,000.00
Virginia Southern R. R. Co...	127,551	148,264	119,938	43,000.00
Ft. Worth Union Station Co....	210,230	89,122	69,207	91,866.05
Waupaca-Green Bay Ry.....	114,201	123,530	100,652	130,400 00

Seawall and Boulevard Project Planned at Tampa

Four miles of boulevard, bordering on Hillsborough Bay, is almost sure to be an aftermath of the recent storm that struck Tampa, Fla., washing away a part of the brick pavement that composed the highway to Ballast Point Park. The work includes a seawall, a fill, a parkway, two 8-ft. sidewalks and two 24-ft. roadways. It is planned to issue $3,000,000 in county bonds for this work and 54 miles of pavement in other sections of the county.

The project, first urged by the Board of Trade in Tampa has been endorsed by every civic organization in the county and the county commissioners have tentatively promised to permit the county to vote on the bonds for the project some time this month. J. J. Hedrick is the county engineer and has prepared the preliminary plans.

The city of Tampa already has a 40-ft. boulevard drive with two 8-ft. sidewalks and a concrete seawall for two miles of the way within the city limits.

Pamphlets on Engineering Subjects Available

At different times *Engineering News-Record* has prepared for distribution reprints of certain classes of articles. There are in stock several hundred copies of each of these pamphlets, substantially bound in stiff-board covers. Since they have value in the right hands, *Engineering News-Record* will be glad to send copies to its readers, as long as the supplies last, on receipt of 25c. per copy in stamps to cover postage and handling charges.

The pamphlets available are:

Building Subways in New York—A series of articles printed in 1915 and written by Fred Lavis from studies made especially for *Engineering News*. It covers the details of the design and construction of the New York subways, and contains data regarding the organization and personnel of the engineering staff. Included, also, is a description of the design of the new elevated railway structures of the New York Rapid Transit System, written by Maurice E. Griest, former assistant designing engineer of the Public Service Commission. The pamphlet contains 13 pages, is 9 x 12 in. in size, and is well illustrated.

American Engineers Behind the Battle Lines in France—A series of nineteen articles (reprinted in 1918) upon the operations of American engineer units in France, written by Robert K. Tomlin, Jr., associate editor, and former war correspondent of *Engineering News-Record*. This pamphlet should be a valuable addition to the library of any one who served in the American Expeditionary Forces. It is 9 x 12 in. in size and contains 91 well-illustrated pages.

The Engineer in Field and Office—A collection of short-cuts culled from practically every branch of civil engineering, presented in short articles or notes. The 164 pages of text and illustrations cover fourteen groups of subjects. The articles in each group stress design and construction equally. In the highway engineering group, for example, there are nineteen separate items. The pamphlet measures 6 x 9 in. and was published in 1918.

Plan Drainage Program in Texas

A movement is under way to form a permanent organization and prepare a permanent program for the drainage and improvement of the coastal counties of Texas. A meeting of all interested parties was held in Houston, Texas, Feb. 8 and 9 at which L. A. Jones, senior drainage engineer, represented the Public Roads Bureau. The Association plans to ask the cooperation of the department in studying the situation and preparing a plan for development.

Engineering Council Executive Board to Meet in Chicago

The Executive Board of the Engineering Council, Federated American Engineering Societies, will hold a meeting at the headquarters of the Western Society of Engineers, Chicago, March 10. A wide range of subjects will be discussed, embracing both technical and public service matters. Dean Mortimer E. Cooley, of the University of Michigan, president of the council, will preside.

In the evening the Michigan Engineers Club of Chicago will give a dinner in honor of Dean Cooley and President Marion Le Roy Burton, at which function the members of the Executive Board of the Council will be guests.

New York Ship Canal Again Projected

A bill has been introduced into the House of Representatives by Representative Reed of New York to incorporate the Lakes-to-Hudson Ship Canal Co., which grants to Millard F. Bowen and his associates the rights in a corporation which is to build and operate a canal cut around Niagara on the American side between Lake Erie and Lake Ontario, starting again just east of Oswego, down to the Hudson River just south of Albany. The company is to have all the water rights on the canal to the extent of the use of 26,000 sec.ft. of water.

Propose Bridge to Shorten Ferry Trip on San Francisco Bay

The San Francisco & Oakland Terminal Rys. has made application to heads of the departments of war, commerce and the navy, at Washington, D. C., for permission to extend its East Bay terminus to Goat Island. This, it is stated, would shorten the water trip by 1½ miles and would reduce the time on the ferry from 20 to 10 min. The company would be willing, it is stated, to to build whatever type of bridge government authorities require and in addition to the rail lines would provide a roadway to make the Goat Island terminal accessible to vehicular traffic.

The present fill would be extended as far as practicable and the terminal on the island would be built on the north side where there are deep water that could readily be reclaimed for terminal purposes. The application expresses a willingness either to finance the entire project or to join with other transportation companies in a joint terminal program. The plan is, in principle, the same as that suggested by Admiral J. I. Jayne, formerly stationed at San Francisco as commandant of the Twelfth Naval District.

Zoning Integrity Upheld by Court in New York City

The Appellate Division of the New York Supreme Court has upheld the decision of a Supreme Court judge favorable to the effort of J. P. Morgan and other property owners to prevent the putting up of a seven-story office building on a portion of Madison Ave., New York City, that had been placed in the residence district by the Board of Estimate and Apportionment, which is the zoning authority of New York City. Both courts held that the City Board of Appeals had encroached upon the authority of the Board of Estimate in granting the Astor Estate a permit for a business block. It is expected that the case will be carried to the Court of Appeals of New York State.

New Orleans Engineers Organize

Engineers of New Orleans have organized an engineers' club, the purpose of which is the development of a fraternal spirit among engineers of the vicinity through the medium of luncheon-meetings. The meetings are to be held on the third Monday of each month. At the first meeting in February there were sixty-five members present representing the following societies: American Society of Civil Engineers, Louisiana Engineering Society, American Society of Mechanical Engineers, American Chemical Society, and the American Association of Engineers. The following officers were elected: president, Ole L. Olsen; vice-president; J. F. Coleman; secretary, F. A. Muth; and treasurer, J. F. Villavasso.

Two Lumber Companies Build Railroads in California

Two standard-gage railroads are now being built in California for lumber companies; one 18 mi. long in northern California for the Hutchinson Lumber Co. and the other 55 mi. long in the Southern end of the San Joaquin Valley under the name of the "Minarets and Western R. R." The former extends from a junction with the Western Pacific R. R. at Bidwell up a fork of the Feather River through very rough country. On part of the line the cost of the grading is reported to have amounted to $140,000 per mile. The main crossing of the Feather River is to be effected by a 120-ft. girder span. The falsework for this bridge is in place and will be used to support the track until the steel is placed. Grading on the entire line is practically completed and about 5 mi. of the track has been laid. An 18-mi. extension of this same line is pending. W. A. Bechtel of San Francisco is the contractor.

The other railroad leaves the San Joaquin & Eastern R. R. at Friant, crosses the San Joaquin River and extends [illegible] for some 55 mi. Of this, 35 mi. is to be operated as a common carrier and 20 m. as a logging railroad. The river crossing is made up of a [illegible] girder span resting [illegible] and a 150-ft. truss. The bridge is under contract to the Merrill Lumber Co. of [illegible], and is to be completed by [illegible]. The entire line is to be finished within a year. The rails for [illegible] ranging from 60 to 75 lb. in weight, have been purchased from a Belgian steel company.

Want More Money for Mississippi

It having become evident that the $45,000,000 authorized for flood control on the lower Mississippi will not be sufficient to bring the entire levee line up to the standard prescribed by the Corps of Engineers, an effort now is being made by the senators and representatives from the Mississippi Valley to secure legislation to authorize an additional sum for that purpose. Due to the increase in the cost of labor and materials after the $45,000,000 was authorized in 1916 the money which was expended has not gone as far as had been estimated. Nevertheless a great deal of work has been done and the weakest point in the whole levee line in the lower Mississippi Valley is stronger than the strongest point in 1912.

Co-operation Asked in Studying Winter Cholera Outbreaks

An inquiry into the nature and causes of so-called "winter cholera" or "intestinal influenza" ascribed to polluted water supplies is planned by the laboratory of the Department of Hygiene and Bacteriology of the University of Chicago. Dr. J. C. Geiger, of the U. S. Public Health Service, has been detailed to the laboratory named to co-operate with Dr. Edwin O. Jordan in the investigation. Owing to the brief course of these outbreaks the earliest possible notice of any such occurrence is needed for this investigation. Consequently Prof. Jordan requests water-works officials and others in a position to know of these outbreaks to wire him a notification as soon as possible at his expense.

Lock-Bar Pipe To Be Fabricated in Pittsburgh District

The East Jersey Pipe Co. has entered into an agreement with the Riter-Conley Co., whereby "Lock-Bar" steel pipe, which has been exclusively controlled by the former company since its introduction into this country in 1905, will hereafter be fabricated in the Pittsburgh district by the Riter-Conley Co. The sale of "Lock-Bar" pipe will continue to be exclusively in the hands of the East Jersey Pipe Co.

Flood Damage Held to Be "Act of God"

On the theory that the flood that swept through the Stuck-Puyallup Valley, between Tacoma and Puyallup, Wash., in December, 1917, was an "act of God" and not attributable to the negligence of man, a jury in the Superior Court in Tacoma recently returned a unanimous verdict in favor of King and Pierce counties in a suit for $60,000 damages brought by Henry Condor as receiver for the Tacoma Meat Co. The receiver asked damages on the ground that the company's loss, when its buildings were swept away, was the result of negligence and carelessness on the part of those engaged on the inter-county improvement project, then being carried forward on the lower Puyallup River. Engineering experts for the two counties were R. H. Thomson, W. H. Nelson, W. J. Roberts.

Am. Soc. C. E. to Discuss Many Phases of Flood Problem

For its spring meeting to be held at the Engineers' Club, Dayton, Ohio, April 5-7, the American Society of Civil Engineers has announced the following program on the general subject of "Flood Problems":

April 5, 10 a. m.—Symposium on flood problems: "Flood Conditions in Canada," by J. G. Sullivan, president, Engineering Institute of Canada; "Relation of Federal Government to National Flood Problems," by Major-Gen. Lansing H. Beach, Chief of Engineers, U. S. Army.

April 5, 2 p. m.—"Flood Problems in China," by John R. Freeman, president, Am. Soc. C. E.; "Methods of Flood Prevention in the Mississippi Valley," by J. A. Ockerson, member, Mississippi River Commission; "Relation of Flood Problems to Power and Irrigation Development in the Rocky Mountain States," by A. P. Davis, director, U. S. Reclamation Service; "Flood Prevention Methods on the Pacific Slope," by C. E. Grunsky, vice-president, Am. Soc. C. E., and "Standing Waves in Rivers," by N. C. Grover, chief hydraulic engineer, U. S. Geological Survey Washington, D. C. These papers will be followed by 10-min. discussions led by J. B. Challies, director, Dominion Water Power Branch, Department of the Interior, Ottawa, Canada; Morris Knowles, consulting engineer, Pittsburgh; Harrison P. Eddy, consulting engineer, Boston; George M. Lehman, engineer Department of Internal Affairs for Pennsylvania, Harrisburg, Pa.

April 5, 8:15 p. m.—"Flood Problems of the Miami Valley and Their Solution," papers by Arthur E. Morgan, former chief engineer, and Charles H. Paul, chief engineer, Miami Conservancy District.

For April 5 and 6 excursions to the Miami Conservancy District's works and elsewhere have been arranged. At a smoker April 6 Col. E. A. Deeds will speak on "Human Phases of the Miami Conservancy Project."

New Plan to Pool Freight Cars and Terminals Opposed

Commenting on the plans recently proposed by the National Association of Owners of Railroad Securities for the formation of a central agency to pool the freight cars of the country, Daniel Willard, president of the B. & O. R.R., has told the Interstate Commerce Commission that the desired ends are now effected through the co-operation of that body and the American Railway Association. In his opinion "nothing could be gained by substituting an experimental agency for one well-tried."

Referring to joint use of terminals and other facilities, Mr. Willard filed a statement which showed that of 128 railway systems operating 229,000 miles of line: 107 reported a total of 1,280 passenger stations used jointly, 95 reported a total of 555 yards used jointly, and 64 reported a total of 554 large bridges used jointly. According to Mr. Willard reports also show that 3,179 separate passenger stations are used jointly by two or more railways, that 394 passenger stations are used jointly by 3 or more railways, that 105 are used by four or more, that 54 are used by 5 or more railways, and that 16,251 miles of track are used jointly.

Philadelphia Engineers Hold Joint Meeting on Zoning

Actuated in part by the hostility to restricting the height of buildings in the central business district of Philadelphia, which led the City Council to strike the central district from the ordinance submitted to it last October by the Philadelphia Zoning Commission, the local sections of the American Society of Civil Engineers and the American Society of Mechanical Engineers, with the Engineers' Club of Philadelphia, the local chapter of the American Institute of Architects, and the Real Estate Board held a joint meeting March 6 on "Zoning and Its Relation to City Development." Addresses were made by Lawson Purdy, who was vice-chairman of the New York Zoning Commission, B. A. Haldeman, formerly city planning engineer with the Philadelphia Bureau of Surveys, now engineer of the Pennsylvania Bureau of Municipalities and City Planning at Harrisburg, and M. B. Medary, Jr., a Philadelphia architect who is a member of the Philadelphia Zoning Commission.

Mr. Purdy sketched the origin, development and beneficial effects of zoning in New York City, laying stress upon repelling the invasion of business districts by manufacturing, and upon the damage caused surrounding property by very tall buildings, such as certain realtors in Philadelphia wish to leave unrestricted.

Mr. Haldeman said that perhaps undue emphasis has been put on zoning as a stabilizer and too little on its being a promoter of orderly growth. He urged that public control by zoning should be provided instead of compelling individuals to fight in the courts one encroachment after another, such as public garages in residence districts.

Mr. Medary showed numerous lantern slides to confute assertions that residence and business property values are not being destroyed because of lack of zoning control in Philadelphia.

Commission Acts to Force Better New York Transit Service

A seat for every passenger during the non-rush hours is included in a "standard of service" that has been set up by the New York Transit Commission. Following an investigation of current conditions, Daniel L. Turner, consulting engineer to the commission, reports actual counts of traffic which disclose that during the peak of the rush hours 13,890 passengers have been carried in cars having 4,000 seats, and that standing has been required during 37 per cent of the time, both day and night. Under the new "standard of service" the period of standing loads would be reduced to about 9 per cent of the total time. The commission has called a hearing on the subject for March 15.

This movement toward better service comes as a result of the recently improved financial condition of the rapid transit companies which is considered by the commission to justify its insistence on a higher standard of service than has prevailed hitherto.

Fire Destroys Montreal City Hall

Fire destroyed the city hall of Montreal, Que., on the night of March 3-4. The building was completed in 1878, after designs by H. M. Perreault.

Kansas and New York Governors Debate St. Lawrence Project

A debate between Governor Allen of Kansas and H. H. Merrick of Chicago, on the one hand, and Governor Miller of New York, on the other, with respect to the merits of the proposed St. Lawrence River Ocean-to-Great-Lakes waterway was the principal feature of the seventeenth convention of the National Rivers and Harbors Congress held in Washington March 1 and 2.

Governor Allen and Mr. Merrick, as proponents of the project, demanded the waterway as a much-needed relief to the transportation difficulties of the country and as a matter of commercial justice to the Middle West, and declared that the improvement would pay for itself out of the water power to be developed. Governor Miller disclaimed any inclination on the part of New York to oppose the project, provided it can be shown to be commercially feasible, and pointed out that the report of the International Joint Commission considers only the engineering feasibility of the project. He urged that before decision is made there should be an impartial investigation into the commercial and financial aspects of the enterprise.

Other speakers at the convention were Ambassador Jusserand of France; J. Hampton Moore, mayor of Philadelphia; Theodore Brent and Millard F. Bowen of Buffalo; John F. Ruge of Florida; A. B. Shepherd of Pittsburgh; Major-Gen. Lansing H. Beach, Chief of Engineers, U. S. Army; Julius Henry Cohen of New York Port Authority; Major E. C. Church of New York, and Arthur McGuirk of the New Orleans Levee District Commission.

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Spring Society Meeting, Dayton, Ohio, April 5-6; Subject, "Flood Problems."

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago; Annual Convention, Chicago, March 14-16.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, Philadelphia, May 15-19.

The New England Water Works Association will hold its regular monthly meeting at the Boston City Club, March 14. The executive committee meeting at 11 a.m. will be followed by a luncheon. Papers on the "Corrosion of the 36-in. Steel Main at Akron, Ohio," and "Investigation of Electrolysis of Steel Force Main at Akron, Ohio," will be read at the afternoon session.

The Pacific Northwest Chapter of the Associated General Contractors of America will hold its annual convention in Portland, Ore., March 10 and 11.

The Vermont Society of Engineers will hold its annual meeting in Burlington, March 10. Standing committees will report as usual. Allen Hazen will

deliver an address on "Water Works" and Judge Moulton will speak on "Some Points of Contract between the Legal and Engineering Professions."

The Western Society of Engineers in conjunction with ten other engineering and technical societies of Chicago, will hold an all-day "mid-winter convocation of engineers" March 22, at which subjects relating to the engineering problems of Chicago will be treated. Some of the subjects to be treated relate to sewage purification, gas and electric utilities, city planning, railroads, urban, water borne and air transportation. The evening session will take the place of the annual mid-winter dinner of the Western Society which for many years has been the greatest engineering event of the year in Chicago. Other meetings scheduled during March are as follows: "Tests of Caissons for Chicago Union Station," by J. D'Esposito, chief engineer, March 6; "Structural Failures," by T. L. Condron, consulting engineer, March 13.

The Indiana Engineering Society held its forty-third annual meeting in Lafayette last month. The following officers were elected for 1922: President, A. A. Potter, dean, engineering schools, Purdue University; vice-president, John L. Elliott, city engineer of Indianapolis.

The Engineer's Society of Western Pennsylvania elected the following officers at its recent annual meeting: President, H. D. Jones; vice-president, Frederick Crabtree; directors, J. C. Hobbs and C. D. Terry.

Personal Notes

H. T. CORY, consulting engineer, U. S. Reclamation Service, has been chosen as the third member of the Board of Review to report on the present and future needs of the water supply system of Denver, Col. Appointment of of the other two members of the board, Dabney H. Maury and H. S. Crocker, was noted in these columns Feb. 16, p. 295.

GEORGE MATTIS has tendered his resignation as city engineer and superintendent of streets of Oakland, Cal., effective March 1. Mr. Mattis was appointed to the office of city engineer in April, 1920.

JAMES A. BROCK, formerly with the Koss Construction Co., Des Moines, Iowa, has been appointed city manager of Pawhuska, Okla.

GEORGE E. JOHNSON, state engineer of Nebraska, secretary of the Board of Public Works, and chairman of the Capitol Commission, has tendered his resignation, effective Jan. 1923. Mr. Johnson has served the state under three different governors, and now desires to accept a more remunerative position with a commercial company.

R. C. BROWN, field engineer, state highway department, S. C., has been appointed acting state highway engineer, succeeding Charles H. Morefield, resigned.

D. C. FENSTERMAKER has been appointed principal assistant engineer of the Chicago, Milwaukee & St. Paul Ry., with offices at Chicago.

ALMA H. CHAMEERS has resigned as city engineer of Logan, Utah, and FRED W. THOMAS has been appointed to fill the vacancy.

Business Notes

JOSEPH S. WEBSTER, New Haven, Conn., has organized a sales force to be known as Joseph S. Webster & Co. to represent the Kingsford Foundry & Machine Works, Oswego, N. Y., in the the New England states on Kingsford-Webster water-tube boiler sales. Offices will be established in New Haven, Providence and Boston.

JOHN M. MARION, late with Dwight P. Robinson & Co., and GODFREY M. WEINSTEIN, formerly with Westinghouse, Church, Kerr & Co., announce the formation of John M. Marion & Co., general contractors and builders.

EDMUND A. CAHITT, recently district manager in the state of Oklahoma for the Concrete Products Co., has joined the J. B. Klein Iron and Foundry Co., where he will handle reinforcing and fire-proofing materials.

F. X. KERN, for several years with the Philadelphia Bureau of Highways, has become associated with the Headley Good Roads Co., Chicago. During the war Mr. Kern was a lieutenant with the 23rd Engineers, U. S. A.

W. A. ALEXANDER has been appointed district engineer in charge of the Helena, Mont., office of the Portland Cement Association.

Obituary

CAPTAIN HORACE G. H. TARR, a familiar figure in the water-works field for the past 50 years, died at his home in Philadelphia, March 2, aged 78 years. At the time of his death he was manager of R. D. Wood & Co., manufacturers of water-works machinery, Philadelphia, Pa. At the close of the Civil War through which he served with the Tenth Connecticut Volunteers, Capt. Tarr entered the employ of the Brooklyn (N. Y.) Water Department as an inspector of cast-iron pipe. A few years later as receiver, he operated the Tom Gaylord plant at Newport, Ky. Later he joined the Worthington Pump Co. as salesman. From 1900 until his death he was with R. D. Wood Co. designing, selling and supervising the erection of water-works machinery.

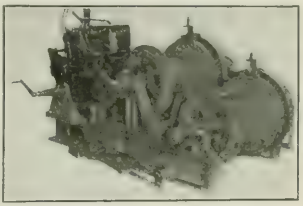
ANDREW MAXWELL, engineer and architect, died in Holland, Man., Feb. 9, aged 77 years. Mr. Maxwell was born in Montreal and was graduated from McGill University in 1865. In 1872 he was engaged by the Government on survey work in connection with the Canadian Pacific Ry. Co. and later was employed by the Hudson Bay Co. in the construction of the first bridge across the Assiniboine River.

ALFRED E. MARTIN, for 30 years superintendent of the Springfield (Mass.) water department, died Feb. 21. He had been superintendent of the water department at Framingham for 17 years prior to his appointment at Springfield. He was engineer in charge of construction of the dam at Ashland for the Boston water-works, now a part of the Metropolitan system. Mr. Martin was formerly president of the New England Water Works Association.

Equipment and Materials

New Gas Engine Hoist

Gas engine hoists ranging from 8 hp. to 110 hp. are now being manufactured by Pawling & Harnischfeger Co., of Milwaukee, Wis. The same hoists are also furnished equipped with

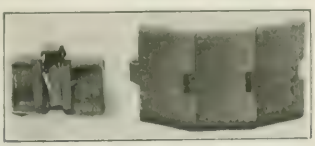


electric motors or for belt drive. On the gasoline hoists the engines are four-cylinder vertical-tractor type, with Bosch magneto, Master carburetors, Stewart vacuum system and air cleaners.

New Paving Mixer With Close-Pitch Crawler Traction

A new full-crawler-traction paving mixer has been placed on the market by the T. L. Smith Co., Milwaukee, Wis. The treads of the new traction are of electric heat-treated steel castings 8 in. wide and with very close-fitting joints. This close pitch of the links excludes more of the dirt and pebbles, which are likely to crowd into the joints and be crushed.

The full-length traction is steered through two all-steel multiple-jaw



clutches. It is furnished on the standard type 14-E and 21-E mixers. It does not wholly replace the half caterpillar and all-wheel types which are quite satisfactory for city or any work where travel is over harder surfaces.

Another feature of these new paving mixers is the new cross-dump bucket, the doors which open crosswise instead of lengthwise. This design, it is stated, discharges more quickly and the concrete can be spread from the bucket as it travels along the boom.

Out-of-the-Ordinary Trade Publications

A well indexed pocket book of 100 pp. for the design and detail of metal lumber joist and steel construction is published by the Berger Manufacturing Co., of Canton, O. For the product to which it relates the book ranks with the well-known structural steel pocket books which have served engineers for years

Business Side of Construction

Facts and Events that Affect Cost and Volume

Production and Materials Stocks in 13 Cities

Output Increased—Stocks Being Replenished to Meet Spring Building Demands—News from Each City

Steel—The production of steel ingots has reached an annual rate of 29,000,000 gross tons as compared with 22,000,000 gross tons one month ago. This compares very favorably with the output rate of 18,000,000 gross tons for December and is about 50 per cent above the yearly production rate for 1921. Mill operations for the entire industry now stand at about 55 per cent of capacity as against an average of slightly under 50 per cent of capacity for the second week in February. Demand appears to be active in steel sheets, with considerable improvement in wrought pipe. Steel rails and materials for the construction or freight cars have been purchased in large quantities by the railroads. Shapes, plates and bars run mostly to numerous small orders rather than large tonnages. Consumers and jobbers steel stocks and mill stocks of tank plates are comparatively low.

Lumber—An average of 371 mills reporting weekly to the National Lumber Manufacturers Association for the month ending February 25, show a total of 683,385,486 ft. cut; 660,939,476 ft. shipped and orders for 671,747,145 ft. b.m. February shows increases over the preceding month of 39,246,335 ft. in production; 62,490,307 ft. in shipments and 51,841,243 ft. in orders. Both production and shipments for the week ending February 25, stood at about 24 per cent and orders at 25.5 per cent below normal.

Brick—Information as of Feb. 1, 1922, received from the Common Brick Manufacturers' Association of America, shows that throughout the northern-central group of states there has been a demand exceeding that of any winter months in the past three or four years. The weather has been unusually favorable for operating some of the plants but current reports show 58 plants closed. Out of this number all but ten are closed for seasonal reasons or for repairs. The accompanying table shows that the quantity of brick on hand has decreased during the past month while orders on the books have increased slightly.

Chicago—Materials stocks in this center are large and delivery facilities very good. Hollow building tile stocks are large compared with this time last year. Business in hollow tile is reported as having fallen off about 25 per cent during February. Lumber, lime, sand, gravel, brick and crushed stone on hand in large quantities; deliveries in few hours. Demand for structural shapes decreased during last month; stocks above normal and immediate deliveries possible. Sewer pipe stocks below normal.

Philadelphia — Sewer pipe dealers have sufficient stock of the smaller sizes on hand to care for present demand; mill deliveries on the larger sizes are now being made. There are about 15 carloads on hand in the city yards. Local refineries well stocked with asphalt, both for domestic and export trade. Wood blocks and paving stone stocks low. Large orders for wood blocks have been placed but deliveries have not been started. Immediate deliveries on sand, gravel and crushed stone from local pits. Cement stocks normal at present but being gradually increased to meet heavy anticipated demand. Lime stocks of local dealers low, about 5,000 bbl. on hand in warehouses; deliveries within two months. Brick yards have been producing for future business but demand is greater than was expected. About 10 carloads of hollow tile in yards, but stocks will be replenished to greater than normal within a few weeks. Lumber yards well stocked and dealers look for heavy orders within short time.

Denver—About 10 carloads of asphalt on hand, within city. Sewer pipe delivered in 24 hr. from local plant. About 6,000,000 common brick and 10,000 bbl. of cement on hand. Twenty four local lumber yards amply supplied for immediate deliveries.

Atlanta—More than 5 carloads of structural shapes; 10 carloads of lime and 20 carloads of cement on hand at present. Plenty of common brick and lumber. Sewer pipe and hollow tile delivered in 2@3 days.

Los Angeles—Supply of brick, sewer pipe and hollow tile sufficient for all orders. Not on market for paving block, yellow pine or spruce but yards well stocked with Douglas fir and hemlock.

Birmingham—Slag, common brick, sewer pipe and cast-iron pipe manufactured locally; supplies unlimited. Small stocks of cement and track supplies. Deliveries in carload lots from cement mills at Leeds, Ala., can be made in 2 days. Reinforcing bars rolled at Bessemer, Ala. Plenty of hollow tile. Large lumber mills nearby and sand shipped in from southern part of state in 1@3 days. Crushed slag used in place of gravel.

Detroit—Local supply of sewer pipe in yards ample for present needs. Heavy dealers stocks of cement with mills close at hand. Immediate deliveries on any quantity. Quick shipments of lime from Ohio mills; 20 carloads in warehouses at present time. Local brick yards supplying large quan-

REPORT ON BRICK FROM 97 YARDS AS OF FEB. 1, 1922

Dist No.	Including States of	No. of Firms Reporting	Plants Closed Down	Burned Brick on Hand	Orders on Books	Price per Thousand at Brickyard	Price per Thousand at Brickyard Jan. 1, 1922
1	N. Y., New England	7	6	5,311,000	2,450,000	$14.00 to $17.00	$14.00 to $18.00
2.	Pa., N. J., Md., D. C., Del.	9	3	28,377,000	22,018,000	12.00 to 16.00	12.00 to 17.00
3	Va., N. C., S. C., Ga., Fla.	10	6	11,060,000	4,615,000	6.00 to 16.00	7.00 to 16.00
4.	Mich., Ohio, W. Va.	10	7	10,320,000	12,404,000	10.00 to 17.00	12.00 to 18.00
5.	Ill., Ind., Wis.	24	7	154,115,000	99,359,000	11.00 to 17.00	11.00 to 17.00
6.	Ky., Tenn., Miss., Ala., Ark., La.	15	13	11,769,000	3,421,000	10.00 to 15.00	9.73 to 15.00
7.	N. and S. Dak., Minn., Neb., Ia., Kan., Mo.	8	8	4,229,000	200,000	11.00 to 17.00	11.00 to 17.00
8.	Okla., Tex., N. M.	7	5	5,388,000	1,287,000	8.00 to 14.00	8.00 to 14.00
9.	Wash., Ore., Mont., Wyo., Ida., Utah., Col.	4	3	1,590,000	381,000	12.00 to 17.00	12.00 to 17.00
10.	Cal., Ariz., Nev.	3	..	5,821,000	5,905,000	14.50 to 15.00	14.50 to 15.00
	Total	97	58	237,980,000	152,040,000		

Minneapolis—Stocks of brick, lumber and hollow tile limited. Lime and brick supplied by local plants; 24 hr. deliveries. Hollow tile deliveries take from 4 to 5 days. Small cement stocks in local warehouses with unlimited supply available at nearby mills.

San Francisco—Plenty of sewer pipe; deliveries 2@3 days. About 10,000 bbl. of cement in local dealers warehouses with mill shipments in 2@4 days. Lime stocks average about 3,000 bbl. with replenishment in progress. Enough brick; deliveries in 2@7 days. Hollow tile sufficient to meet demands; shipments in 2@3 days. About 30,000,000 ft. of Douglas fir on hand; mill shipments 30 to 45 days.

Cincinnati—About 8,000 ft. of sewer pipe; 12,000 bbl. of cement; 13,000,000 common brick and 100,000,000 ft. b.m.

of lumber on hand in warehouses.

New Orleans—Ample stocks of sewer pipe, lime and hollow tile on hand with no demand. Consumption of cement has fallen from 7,000 to 3,000 sacks weekly; sufficient supply on hand. Plenty of brick available to meet all demands. Lumber supply normal with facilities at hand for replenishment.

Montreal—Plenty of sewer pipe, lime and common brick. Cement stocks ample; not much demand. Lumber and hollow tile deliveries in 24 hr.

New York—Winter reserve of Hudson River common brick all sold out. Brick are being shipped in by rail from northern New York and Connecticut; large quantities also received from Staten Island and the Raritan River District. Cement dealers are preparing for a heavy spring demand; plenty now in reserve. Local lime stocks increased by shipments from south. Large tile factories near the city can ship hollow

Middle West Cement Situation Summed Up

Mill Price of $1.30 Net Accepted as Fair by Four Highway Departments—Atlas Company Issues Statement

Four states of the Middle West—Wisconsin, Illinois, Indiana and Michigan—went into the market Feb. 28 asking for simultaneous bids on cement to build a large portion of the 1922 program of concrete highways. The quantity required, 4,088,000 bbl. in Illinois, 1,119,000 bbl. in Michigan, 1,468,000 bbl. in Wisconsin and 211,000 bbl. in Indiana, is approximately one-quarter of the rated capacity of the cement mills in the region. While many bids were identical, the Marquette Cement Manufacturing Co. bid on the lowered base price of $1.30 which it had previously made public; it did not bid in Michigan. There were many restrictions and complications in all of the states, the Marquette Company, for instance, restricting the amount it would furnish to 600,000 bbl. in Wisconsin and 600,000 bbl. in Illinois. In Indiana the Louisville Cement Co. put in two bids for several points of delivery, one for steam-rail delivery, which was the same as the Marquette bid, and a lower price for delivery over the electric interurbans. By this means the Marquette and Louisville companies will each get about half the Indiana quota.

In Michigan there are several smaller mills which took advantage of their advantageous nearby location to put in bids lower than the market at the basing-rate points of the larger mills. Practically all of the companies put in limits as to the amounts they would furnish, either as a total or at least for the maximum during any one month. In general, the large companies, aside from Marquette, held to the published quotations in effect at the present time modified, of course, by the freight differentials from the various basing points.

At a conference Mar. 3, in Chicago, of the executive officers of the highway departments of the four states, they decided to accept only the bids of the Marquette company and the few others that were equal to or lower than the Marquette bids, which in general were based on a net of $1.30 per barrel at the mill at La Salle. The typewritten sheets given newspapers after the conference included these statements:

"At this conference the bids on portland cement, recently received by the various states, were thoroughly discussed. As a result, it was decided by the states that the bids submitted by the Marquette Cement Manufacturing Co., were fair, and that they represented the present economic conditions. It was further decided that the bids of this company would be accepted. The bids of all other companies which were in excess of the Marquette company's bids were rejected, and further negotiations will be undertaken later.

"At this meeting the prices of all other materials entering into road construction were discussed and it was the opinion of the states represented that united effort should be made to insure that all prices for all materials were fair and in accordance with prevalent economic conditions.

"In order that the various highway departments may be fully conversant with each other's problems and conditions, it was decided to hold such conferences at frequent intervals."

Marquette, by the 1920 directory of cement, gypsum and lime manufacturers compiled by *Cement, Mill & Quarry*, has a rated capacity of 6,000 bbl. per day, making a total for a 300-day year of 1,800,000 bbl. The Illinois and Indiana quota of 600,000 bbl. each will therefore absorb two-thirds of Marquette's capacity as rated in the directory. However, it is understood that the yearly capacity has since been increased to approximately 2,400,000 bbl. At any rate, dealer sentiment

CONDITIONS OF MATERIALS STOCKS IN IMPORTANT CENTERS

Stocks on hand in approximate figures, example: (cement, San Francisco, 10,000 bbl.); time required for delivery of carload lots to city job, example: (sewer pipe, Atlanta, 2 to 3 days); and stocks on hand in general terms, example: (common brick, New Orleans, plenty.)

	New York	Denver	Detroit	Minneapolis	Philadelphia	San Francisco	Cincinnati	New Orleans	Atlanta
Sewer pipe	Ample Prompt deliveries	24 hr. del. local plant	Moderate supply		15 cars	Plenty. Del. 2 to 3 days	8,000 ft.	Ample	Sufficient Del. 2 to 3 days
Cement	70,000 bbl. Plenty in reserve	10,000 bbl.	Large nearby mills	4,000 bbl.	Enough	10,000 bbl. Large mill stock	12,000 bbl.]	Sufficient Demand dropped to 3,000 sacks weekly	10 to 20 car
Lime (common)	Moderate stock in city; quick mill shipments		15 to 20 cars Ohio mills	Plenty 24 hr. del.	5,000 bbl. Dealers stocks low. Del. within 2 months from mills	3,000 bbl.		Enough	8 to 10 cars
Lime (hydrated)			15 to 20 cars	Plenty		Fair		No demand	
Common brick	Winter supply Hudson River brick sold out	6,000,000	Ample Local yards	4,000,000	Sufficient	Ample. Del. 2 to 7 days	13,000,000	Plenty	Plenty
Hollow tile	Large plants near city; quick shipments by water		Small; del. take several days	Small; del. 4 or 5 days	10 carloads	Sufficient Del. 2 to 3 days		Ample	Enough Del. 2 to 3 days
Lumber	Can complete del. on 300 M.ft. in 9 or 10 days	Ample supply 74 local yards	10,000 M.ft. Prompt del from Southern mills	44,000 M.ft.	Well stocked	30,000 M.ft. Del 30 to 45 days	100,000 M ft.	Normal Replenished from nearby mills	Large Nearby mills
Asphalt	Large refineries short distance from city	10 carloads			Local refineries well stocked				

partition tile in 500-ton cargoes within lighterage limits in short time.

Lockwood Committee Offers Bills to Aid Housing

Several bills were introduced into the New York legislature last week by members of the Lockwood joint legislative committee on housing as possible means of increasing housing facilities. In general the bills propose the extension of the existing emergency rent laws to April 1, 1924, and the law exempting new construction from taxation; the granting of permission to life insurance companies to use 10 per cent of assets in tenement-house construction; and the revision of banking and insurance laws whereby insurance companies and savings-banks would be compelled to invest a fair share of assets in real-estate mortgages. In addition the committee would establish a state trade and commerce commission invested with supervisory powers over trade-associations and trade-unions.

have been sent out by the company stating that its capacity was sufficient to handle its commitments.

In submitting its bid to the Illinois officials the Atlas Portland Cement Co., through its president, John R. Morron, made the following statement:

"With reference to proposals herewith made for the furnishing of cement for state-highway construction, we are most anxious that the position of this company should be understood, both by the officials of the state and by the general public.

"Since our quotations were last made for the furnishing of cement for highway construction it has been asserted by highway officials that the prices asked by cement manufacturers were not in accord with economic conditions and that manufacturers should and must fix prices which will 'be in harmony with the reduced prices now in effect for all other basic commodities.'

"We do not think this criticism of cement is fair or well founded. As shown by government index figures the price asked for cement has been and is now below the average price of other building materials. Cement never reached anywhere near as high a price as was asked for other building materials; consequently, there could not be so great a drop in price as has occurred with respect to other materials.

"The price herewith quoted to the state is 10 to 15c. per bbl. below the price quoted by us last month, 60c. below our market price of January, 1921 and 90c. below the Atlas peak price of 1920. This, it must be admitted, shows a very substantial reduction.

"No decrease in cost of manufacturing our cement has occurred which warrants the reduction in price now made, and unless a wholly unexpected change in costs or market conditions takes place, our company would be unable to continue to accept orders at these figures.

"Our company is, nevertheless, desirous of meeting to the fullest extent within its power the demand for a lower price. It is willing to make some sacrifice to encourage a great public movement, but in taking this step it desires to point out that in our judgment so low a price as now quoted is not justified on a purely business basis.

"The offer herewith is grudgingly made as an evidence of a desire to meet the demand for lower prices, and in the hope that this action will in some measure forward the state's highway construction program."

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for in Construction News, pp. 97@109, are the following:

A hotel in Chicago, Ill., $15,000,000.

An office building at Philadelphia, Pa., $1,000,000.

A store building at Richmond, Va., $1,000,000.

A bank and office building at High Point, N. C., $1,000,000.

A street improvement project at Clinton, Ia., $350,000.

A road improvement project at Charleston, W. Va., $1,445,000.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual buildings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of March 2; the next, on April 6.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$2.63	$3.25	$4.00	$2.63	$2.91	$3.50	$3.10	$3.25	—$3.75
Structural rivets, 100 lb	3.50	3.80	5.50	3.43	3.90	4.25	4.50	4.00	6.50
Reinforcing bars, ¾ in. and larger, 100 lb	2.53	3.15	3.50	2.53	2.81	3.42½	2.75	3.25	2.75
Steel pipe, black, 2½ to 6 in. lap, discount	61%	68%	45%	—59¾%	61.9–5%	44%	58.8%	53%	35.10
Cast-iron pipe, 6in. and over, ton	47.30@48.30	37.63	48.30	+42.60@44.10	46.00	52.00	48.00	45.00	—55.00
Concreting Material:									
Cement without bags, bbl	2.30	2.39	2.40	—1.94	2.24	2.90	2.73	2.94	—2.40
Gravel, ¼ in., cu.yd	1.75	1.85	2.00	2.00	1.50	2.50	2.25	1.50	1.50
Sand, cu.yd	1.00	—1.15	2.00	2.00	1.00	1.10	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd	1.75@1.85	1.90	2.93	1.60	2.25	3.50	2.25	3.00	—2.00
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	49.00	37.00	34.00	—43.00	38.00	34.75	—29.00	20.00	.....
Lime, finishing, hydrated, ton	15.80@16.80	18.00	25.00	18.00	29.00	24.00	22.00	27.00	—21 00
Lime common, lump, per bbl	2.75@3.48	3.25	2.50	1.40	1.40	2.70	1.75	2.75	11.00
Common brick, delivered, 1,000.	—19.40@20.40	—8.25	11.00	11.00	15.00	—12.00	15.50	14.00	16.00
Hollow building tile, 4x12x12, block	Not used	+.07975	.13	.0821	.0752	.08	....	.10	.20
Hollow partition tile 4x12x12, block	.11120	—.06525	.13	.0857	....	.10	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal	.87	—.94	.93	+.97	1.01	1.14	1.04	.86	+1.05
Common Labor:									
Common labor, union, hour	.60	.35	.....	72½	.....	.50@.55	—.56¼	.50@.60	...
Common labor, non-union, hour	.....	.20	.35	35@.40	.40@.50	.35@.40	.47½@.56	.50	20@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or − sign. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations are delivered except tiles, which are "on trucks." Common lump lime per 180-lb. net; both lump and hydrated quoted f.o.b. cars New York. Sand, gravel and crushed stone are quoted alongside dock. Cement and steel pipe delivered to contractors on job. Gravel ready mixed $2 per cu.yd.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to contractors in yards at San Francisco. Lumber price is for No. 1 fir, common.

Seattle quotes on Douglas fir instead of pine. Common lump lime per 180-lb. net.

Montreal quotes sand, stone, gravel and lump lime per ton. Lime and tile are delivered; cement, sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 97.57 cents). Bag change is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, President

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. Mehren
Editor

Volume 88 — NEW YORK, MARCH 16, 1922 — Number 11

Zoning at Philadelphia

COMMENDABLE in all respects is the action of the Philadelphia engineering and other organizations that joined in calling a recent meeting to consider the local zoning situation. A proposed zoning ordinance has been blocked in the City Council, apparently in large part because of a lack of educational publicity. The Philadelphia Engineers' Club is now exhibiting the zoning maps. This and the joint meeting should help on a project which, to say the least, should not be killed by local apathy at a time when scores of cities are giving warm approval to zoning.

Information on Tides

TIDES are natural phenomena on which the average engineer is little informed beyond the common knowledge of their occurrence and some information on peculiarities at specific localities. Most engineers, for instance, probably believe they are regularly of semi-diurnal recurrence. And yet, as Mr. Rude shows in the informing article on another page, they are of several types with most interesting differences. His clear explanation of the fundamentals of their behavior and the uses to which their study may be put should be read by all engineers who are concerned with marine work and should give a greater appreciation of the work the Coast and Geodetic Survey is doing in tidal investigation and recording.

A Research Opportunity

ANOTHER of the many deficiencies in our stock of engineering data is brought to attention in this issue, in connection with the subject of radio towers. We know little or nothing about wind pressures at some height above ground, and apart from a few measurements of negligible value, are compelled to rely on the common impression that up aloft, where the wind has a free sweep, it blows harder than near the ground, just as a fluid stream moves more rapidly at a distance from the retarding influence of walls. But this is nothing more than an impression, and, especially as we are concerned with maximum rather than with normal velocities, it may be that the same figures hold for ground level and for 1,000 ft. elevation. There is an excellent opportunity for research here. We can get along for a time on arbitrary rules, such as the convenient one proposed by Mr. Fleming. But surely a makeshift rule is no lasting substitute for measured fact.

Re-Study of Wind Pressure

IF RESEARCH in the field of wind pressures on towers is entered upon, it should by all means have combined with it a general re-study of wind effects on engineering structures. The existing data are incomplete, unco-ordinated, and old. There is a mass of anemometer readings in our Weather Bureau records largely undigested, but no one has yet succeeded in translating them satisfactorily into terms of pressure on engineering structures. An anemometer measures the integrated wind movement at a particular point close above the roof of a particular building; this tells of the movement of a single air filament, regardless of pulsation, of change in direction, or of lateral extent. We conclude from such records and from scattered pressure tests that probably the greatest horizontal pressure to be expected in ordinary inland locations is about 30 lb. per square foot on a fixed flat object, large or small —a fairly definite conclusion resting on a surprisingly uncertain foundation. On the basis of conclusions of this kind we daily spend great sums of money in providing against wind pressure. A moderate expenditure for re-investigation of the subject, from the engineer's not the meterologist's, standpoint, would enable us to tell whether these sums are spent properly and economically. Such a research investment promises to pay substantial dividends.

Showing Up an Industrial "Spook"

PERPETUAL motion appears to be just about as elusive in commercial affairs as we have found it to be in matters physical. Consider the bugaboo of German competition. So long as the rôle of Germany in foreign markets was to sell, her cheap money was all in her favor. But now, we are told, she has practically exhausted the stocks of raw materials that were bought abroad before the recent decline of the mark. Now she must enter the world's market place as a buyer, and that cheap money doesn't look so good. It appears, too, that even Germany cannot emerge from a World War stronger and more efficient industrially. No less an authority than Dr. Siemens, head of Siemens-Halske, has told his stockholders, according to a New York *Times* dispatch that under equal conditions German industry could no longer compete in world markets. Her loss of productivity, Dr. Siemens says, "is momentarily concealed by the difference between the purchasing power of the mark at home and abroad." So much twaddle has been circulated concerning this superhuman competition which is to overwhelm us, that it might be worth while for American business men to stop right now, stoop and hook their fingers securely in their shoe-straps and try to lift themselves to their desktops. Then, when they have satisfied themselves that it can't be done, they may take heart and "carry on."

Curing Pavement With Chemicals

ILLINOIS' successful experience last season with calcium chloride for curing concrete pavements is of direct interest to highway contractors. As related in the last issue, a sprinkling of granular chloride amounting to less than 4 lb. per square yard makes it

unnecessary to use water, in excess of that contained in the concrete, for tempering and hardening. One of the objections to wet-batch haulage as a construction method has been that about as much pipe-line work and pumping equipment are required merely to supply water to cure the slab as are necessary when dry batches are hauled and the concrete is mixed on the grade. The new method of curing eliminates this objection. It also does away with sprinkling, ponding or earth carpeting, with subsequent cleaning of the cured slab, when the mixing is done on the grade. Finally the curing process is shortened and the contractor does not have to guard his finished work so long against damage from trespassers and he can put it in service sooner for hauling in supplies and materials if his method of operation makes this use desirable. Altogether the new process promises to simplify the work of pavement construction, besides, it appears likely, producing a structurally improved pavement. Its cost is astonishingly small. One objection only—that a heavy rain will wash away the curing application—leaves any doubt of the usefulness of the process according to the statement of experience.

French Coefficient Not Important

PAST persistence in clinging to high wearing qualities for the coarse aggregate for concrete roads appears to have been largely a waste of energy. At the convention of the Associated General Contractors a resolution was passed by the highway contracting section urging engineers to raise the percentage of permissible wear so as to make available a greater number of aggregates and thus frequently eliminate the expense of importing stone merely to satisfy French coefficient values based on macadam road practice. Gradually too a number of state highway commissions have been cautiously permitting higher and higher percentages of wear, and placing French coefficients in the background, when writing specifications. Finally there comes from the structural materials research laboratory at Lewis Institute a report sponsored by Prof. D. A. Abrams, as is noted briefly in this issue, that percentage of wear has little significance when applied to aggregates for concrete roads. Any reduction in the requirements for aggregates which will make a greater number of pits and quarries available to the concrete road builder is bound to reduce costs. Will it reduce quality? The swing of thought seems to be toward a general opinion among highway engineers that it will not. Probably before this opinion is allowed to crystallize it will be well to learn more from the investigations now under way of the effect on impact stresses of small surface irregularities, such as are produced by moderate wear. Tentatively, however, a reduction of the wear requirements of aggregates for concrete roads is sound procedure if it enlarges opportunities for wayside materials supplies or increases the number of commercial producers who can supply the work.

Increase in Motor Vehicles

PRELIMINARY figures just issued by the U. S. Bureau of Public Roads indicate that the motor-vehicle registration in the United States for the year 1921 was approximately 10,325,000, based upon returns from all but three states, for which an estimate of last year's registration was made. The 1920 figures, as reported in *Engineering News-Record*, April 21, 1921, p. 683, showed a total of 9,211,295 vehicles. The 1921 total, therefore, represents an increase of 12 per cent over the number of vehicles reported for 1920. For highway engineers this result is significant, for it comes at the end of a period during which all reports indicated that the motor-vehicle industry had experienced a decided slump. Yet in spite of this depression there were placed upon the country's highways in 1921 a million more motor vehicles than were operated during the previous year. A comparison of the total revenue from the registration fees—$125,000,000 in 1921 as against $102,034,106 in 1920—is worth noting. The increase of almost $23,000,000 represents a gain of 23 per cent as against a gain of 12 per cent in the number of vehicles. This comparison indicates clearly the trend in motor vehicle legislation toward higher license fees for both automobiles and motor trucks. During the past year the opinion has sometimes been expressed that, so far as motor vehicles were concerned, the country had about reached its saturation point. The figures just issued by the U. S. Bureau of Public Roads disprove this belief. They demonstrate again the necessity for continuing policies of highway development and a steady supply of funds for carrying out the federal aid highway system.

Curves and Train Resistance Tests

SINCE railway curves constitute an appreciable part of track mileage their maintenance in proper condition for traffic is a matter of economic and practical importance. Curves have an important influence on the loading and smooth riding of trains and the wear of equipment. They are also the cause of much additional expense in wear of material and maintenance of track as compared with similar expense on straight line. A recent review of curve practice on a number of railway systems, started on p. 446, shows enough variation in practice to suggest the desirability of investigation as to the sufficiency of the principles on which present practice is based.

Formulas and rules now employed in problems where train speed and train resistance are functions are based mainly upon tests and investigations made many years ago. To what extent these formulas and rules are applicable to or should be modified for present conditions is a question. For instance, formulas for determining the superelevation of rails on curves are found in many cases to give excessive figures, even allowing for the fact that they serve only as a guide in practical application. In general, therefore, the elevation is determined on the basis of custom, experience and observation rather than upon scientific analysis or calculation.

Similarly, the locomotive constitutes no factor in the above formulas. But the long and heavy locomotives of today are decidedly a factor in the practical adjustment of both elevation and gage on curves in order to secure safe and easy riding track which is economical in maintenance. Compensation of grades for curvature is another problem whose solution is based largely on old records.

New tests and investigations of train resistance in its various aspects appear to be desirable. The work of the late A. M. Wellington is classic and is the basis of much present practice, but it seems to require so much modification under present conditions as to indicate a field for further investigation. Herein lies an opportunity for research.

Two District Water-Supply Projects

RARELY within two weeks does an engineering journal have an opportunity to present the outstanding features of two such important water-supply reports as the recent ones on the water-supply needs and possibilities of the Massachusetts and New Jersey Metropolitan Districts. The Massachusetts report, abstracted in the issue of March 2, p. 360, outlines a project for adding 500 m.g.d. to the present available supply of Boston and associated municipalities in order to meet the needs of the next 50 years. The New Jersey report, as shown elsewhere in this issue, places the needs of Newark, Jersey City, Hoboken, Paterson, and various other municipalities in six counties at 820 m.g.d. 50 years hence, or some 550 m.g.s. in excess of the safe yield of the present sources of supply. The Massachusetts project has possibilities of extension that are outlined rather vaguely, although sufficiently in view of governing conditions. The New Jersey report presents four separate projects from which a choice may be made to meet the needs of the next 50 years, and outlines possible combinations and extensions, including an extension to the Delaware River, that would yield three times the estimated needs of fifty years hence, or nearly ten times the amount of water consumed by the New Jersey Metropolitan District in 1920.

The Massachusetts report proposes a single storage reservoir of 410 billion gallons capacity. The largest storage reservoir in any one of the four New Jersey projects has a capacity of 328 billion gallons, but this reservoir would be supplemented by others to be added from time to time. One of the New Jersey storage projects would solve the Passaic Valley flood problem, and a second one (and the one which seems most likely of the four to be adopted) would contribute materially to its solution.

The Massachusetts report contemplates no filtration for the immediate present, either of existing or the proposed additional supply, although looking forward ultimately and indefinitely to the filtration of water from all surface sources. The New Jersey report includes estimates for filtration of all the water to be taken from additional sources of supply. This particular difference is due in part to different local governing physical conditions and in part to the well-known Massachusetts tradition in favor of sources of water supply that do not require filtration.

A marked contrast between the Massachusetts and the New Jersey projects is that the former proposes to use the higher stream flows only (run-off in excess of 1.2 sec.-ft. per square mile, or about 775,000 gal. per square mile per year) while the New Jersey projects contemplate taking as much as is feasible of the entire run-off without encroaching upon existing water rights and the need for maintaining a minimum dry weather flow for purposes of stream sanitation. This difference also in the Massachusetts and New Jersey [illegible] considerable part explainable by local conditions.

Another remarkable difference in local conditions deserves mention. In Massachusetts a metropolitan district authority has been in existence twenty-five years. It supplies water, by wholesale, to the various municipalities in the district, all or practically all of which own and operate their own water-works. In New Jersey such a metropolitan water [illegible] report suggests does not exist. True, there are several joint systems of water supply in the New Jersey Metropolitan District, but the most notable of these are under private ownership. The East Jersey Water Co. and its associated companies supply a number of municipalities, either wholesale or to individual consumers. The Hackensack Water Co. supplies Hoboken by wholesale and some fifty other municipalities, direct. There are four or five other companies that supply together something like thirty municipalities in the New Jersey district. Newark and Jersey City own and operate their own supplies, but these were developed by and purchased from the East Jersey Water Co. many years ago.

Although, as has just been stated, a New Jersey Metropolitan District would have to be created, it should be noted that there is in existence a North Jersey District Water Supply Commission and a corresponding district taking in all the northern counties of the state. This commission has power to acquire or construct water-works for the supply of such municipalities as may, either singly or collectively, contract with it for that purpose. The New Jersey report, however, suggests an entirely new commission, a state board with power to issue state bonds. This (the report does not bring out) would require additional legislation and besides that it would be necessary to have a state-wide referendum, owing to a constitutional prohibition of state bond issues in excess of $100,000 unless approved by the voters of the whole state.

The New Jersey report suggests as a model to be followed the Massachusetts Metropolitan Water District plan. This resulted from a report made in 1895 by the Massachusetts State Board of Health. Eleven years earlier, or in 1884, the New Jersey Water Supply Commission, created in 1882, recommended a joint water-supply plan under which ten cities and towns, including Jersey City and Newark, would have been provided with a joint water supply from the Pequannock River—later developed by the East Jersey Water Co. for Newark. How this plan came to naught is too long a story to be told here, but the story, together with many other interesting details, may be found in a lengthy editorial review entitled "Water Supply of Northeastern New Jersey and the Jersey City Bid," covering in some of its ramifications a period of more than a century, published in *Engineering News*, Apr. 25, 1895. It may be added that " the Jersey City bid" that forms a part of the title quoted was one of a half dozen or so in as many years made in the long struggle over a new water supply for Jersey City which finally resulted in the present gravity system from the Boonton reservoir on the Rockaway River—a struggle which in some of its phases and later developments has continued for about thirty years, and which is only one of many water conflicts in this territory, some of which are still being fought.

These conflicts have nothing to do with the physical aspects of the projects outlined in the New Jersey report, but they do raise some serious questions in connection with the final solution of the water-supply problem of northeastern New Jersey. The entire problem will never be solved until it is handled in a broad public-spirited way, with co-operation on the part of the state, the several municipalities, and the various private interests concerned. Mr. Hazen's admirable report presents such remarkable and desirable possibilities that it should stimulate this essential co-operation.

Huge Water Storage Projects for New Jersey District

Any One of Four Plans by Allen Hazen Would Give Supply for Several Decades—Combinations of Reservoirs and Delaware River Flow Would Yield Three Times 1970 Needs

TWO and one-half billion gallons of water daily, or three times the need of the 5,600,000 estimated population to be supplied in 1970 by the 33 water-works systems now operating in the six counties on the west side of the Hudson River, could readily be provided for wholesale delivery to the several works by a New Jersey Metropolitan Water Board of three capable men empowered to take over existing sources of supply, enlarge them to their full capacity and supplement them with new developments, according to a report by Hazen, Whipple & Fuller, civil engineers, New York City, to the State Department of Conservation and Development of New Jersey. Of the 2,500 m.g.d. mentioned, 1,661 m.g.d. would come from three large storage systems on the Passaic and Raritan rivers and smaller streams to the north and west combined with the Hackensack and a number of minor sources, and 839 m.g.d. would be pumped from the Delaware River "in winter, so as completely to fill reservoirs" in the Passaic and Raritan storage systems "holding 635 billion gallons." Included in the 1,661 m.g.d. are over 300 m.g.d. already developed or being developed, chiefly from the Passaic and its tributaries. The entire 2,500 m.g.d. "is more than ten times the present rate of output" of the 33 water-works systems, which is 244 m.g.d. for a population of 2,070,000.

All the 2,500 m.g.d. except 4 m.g.d. would be filtered. Each of the three large proposed storage reservoirs is near the district to be supplied, the most remote (the Raritan) requiring an aqueduct only 32 miles long, while the aqueduct from the upper Passaic or Long Hill system would be only 19 miles long, terminating in Jersey City, but passing under Newark en route. Each Passaic reservoir would deliver water to considerable low service areas by gravity, but the Raritan water would be under only 80-ft. head at tidewater. Besides the three storage systems already named, estimates were made for a large reservoir on the Wading and Mullica Rivers, in South Jersey, but while this would yield 316 m.g.d., the water would have to be lifted 200 ft. through 12 miles of steel mains, then conveyed 72 miles additional through a 13-ft. aqueduct, and at the Newark terminal the delivery head would be only 80 ft. above tidewater, also for the Raritan aqueduct.

Two Passaic Projects Lead—Since the estimated need of the New Jersey Metropolitan District up to 1970 is for only 820 m.g.d. and since either one of the Passaic projects when combined with the safe future yields from existing sources outside these projects would come within less than 100 m.g.d. of that amount, and since the Passaic projects are so far superior to the Raritan and Mullica projects, little further consideration will be given here to the two last named or to pumping water from the Delaware River. As will be shown further on, the upper Passaic or Long Hill reservoir system, including the supplementary reservoirs to the westward, is superior to the lower Passaic or Passaic Great Reservoir project from a water-works viewpoint solely, but the latter would serve not only for water-supply purposes, but would also solve the very serious Passaic flood problems and eliminate a large mosquito breeding area. Moreover, the Long Hill system, combined with existing and proposed developments in the area tributary to the Passaic Great Reservoir, would supply 859 m.g.d., which with the 101 m.g.d. of existing sources of supply outside the Passaic gathering grounds would give 960 m.g.d., as against the 820 m.g.d. needed in 1970.

The principal communities in the New Jersey Metro-

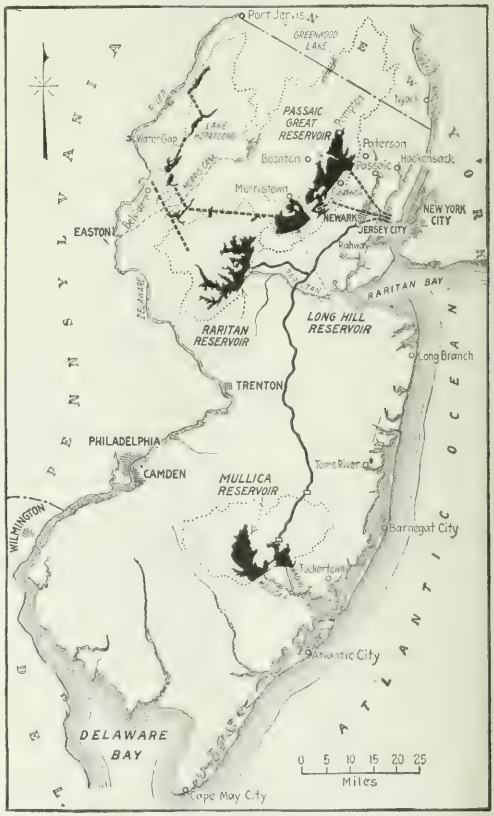


FIG. 1. FOUR POSSIBLE ADDITIONAL WATER-SUPPLIES FOR NEW JERSEY METROPOLITAN DISTRICT

Any one of these, combined with existing sources, would serve the district for decades to come without recourse to one of the Delaware River plans.

politan District are Newark, Jersey City, Bayonne, Hoboken, Paterson, Passaic, Montclair, the Oranges, Elizabeth and Plainfield. The East Jersey Water Co. and allied companies supply a considerable number of places either directly or wholesale from the Little Falls filter plant on the Passaic River and the Hackensack Water Co. sells water at wholesale to Hoboken and at retail to some fifty other cities and towns. Newark and Jersey City have their own supplies. Plainfield, Elizabeth and a number of other places in the south

part of the district depend upon four or five companies for water.

Water Consumption and Industrial Supplies—Of 283,777 services in the district, 205,361 or 72 per cent are metered. The per capita consumption in 1920 was 118 gal. For 12 systems having altogether 94 per cent of their taps metered the per capita water consumption in 1920 was 89 against 154 for 21 systems having but 49 per cent of metered taps. The population in the heavily metered group was 1,139,753 against 930,729 in the other group. The population supplied by public owned works was slightly under and that privately supplied a little above 1,000,000. The public works had 66 per cent of their taps metered and a consumption of 139 gal. per capita compared with 77 per cent and 99 gal. for the private works. Complete metering, Mr. Hazen says, might reduce the per capita rate from 118 to 100 gal. He assumes that the per capita consumption will still be 118 gal. in 1930, and that it will rise to 123 in 1940 and will reach 147 in 1970. Meanwhile he assumes that the supply of water for industrial purposes contributed by the industries themselves will fall from the present 19 gal. to 11 gal. per head of total population; or the present total requirement of 137 gal. per capita will be 158 gal. in 1970, of which the proposed district will supply but 147 gal.

Leaving industrially owned water supplies out of account, Mr. Hazen estimates that the present water consumption is divided as follows: domestic and public uses, 38 per cent; industrial, including supplies to railways and steamships, 32; waste due to leaky pipes and plumbing and unmetered services, 30 per cent.

Population increase from 1920 to 1970 in the six counties of the New Jersey Metropolitan District is estimated by Mr. Hazen as 1.95 per cent annually. The actual annual increases in the decade 1910-20 was 2.45, while in the four decades from 1870-1910 it was 3.4 per cent.

Existing Sources—The chief existing source of water supply in the New Jersey Metropolitan District is the Passaic River and tributaries, which have been developed to a safe yield of 164 m.g.d., and the Hackensack, which might yield 41 m.g.d. in 1970. The 164 m.g.d. yield on the Passaic and the Hackensack is thus provided: 57 m.g.d. by storage on the Pequannock tributary for Newark, another 57 m.g.d. by storage on the Rockaway for Jersey City, and 50 m.g.d., without storage, from the main Passaic at the pumping and filtration plant of the East Jersey and allied companies at Little Falls. Besides this 164 m.g.d. already provided, storage up to some 50 m.g.d. (of a possible 70 m.g.d. or more) is being developed on the Wanaque, for Newark, by the North Jersey District Water Supply Commission, and Bayonne has an application for storage rights on the Ramapo, the most eastern tributary of the Passaic, while there are opportunities for more storage on some of these tributaries. Of the headwaters, there remain practically untouched the Ramapo, already mentioned, and the main stem of the Passaic, which offers an opportunity for a reservoir site that would conserve all the run-off above the dam as well as store the yield of many streams farther away. The undeveloped flow of the upper main Passaic and all the tributaries mentioned now passes the East Jersey plant at Little Falls. The catchment area above this point is 761.2 miles, but the safe yield now available, after allowing for the sanitary and other needs down the river, is only the 50 m.g.d. already mentioned. A dam just above Little Falls would provide a storage reservoir of immense area and large volume, extending back almost to the possible reservoir on the main river, already mentioned. Either one of these reservoirs combined with the Passaic catchment areas for which storage has already been or is being provided, and with the Hackensack River and other sources, would supply more water than would be needed for more than half a century to come.

Maps and Tabular Data—Before taking up the two Passaic storage reservoir proposals in brief detail, it may be stated that the location of the four storage system possibilities reported on by Mr. Hazen is shown on the accompanying sketch map of the State of New Jersey and that various comparative data for the four systems are given in three tables reprinted here from Mr. Hazen's report. Table I gives the length of the various proposed main dams at the flow line, and for each reservoir its maximum and average depth, water surface area, water elevation at flow line and low water, and capacity to the bottom and also for the portion of the reservoir available. Table II compares the cost of the four reservoir and associated aqueduct systems, by construction and other elements, by totals and in unit cost per million gallon daily capacity. Table III is a cost estimate for the Long Hill system arranged progressively in order of development, beginning with the main reservoir, filters and conduit, and then continuing step by step to include additional reservoirs and tunnels to the westward, this latter installment bringing the total cost up to $122,909,000, and finally extending by means of pumps, filters and tunnels to take in 131 m.g.d. from

TABLE I. COMPARISONS OF FOUR STORAGE SYSTEMS

Name	Length of Main Dam at Flow Line, Ft.	Depth of Water Feet Max.	Depth of Water Feet Ave.	Area of Water Surface, Sq. Miles	Elevation Flow Line	Elevation Low Water	Capacity in Billion Gallons To Bottom	Capacity in Billion Gallons Available
Flat Brook	1,160	120	49	3 90	480	445	40	24
Paulinskill	600	105	23	3 80	460	433	18	13
Beaver Brook	1,430	85	26	4 70	440	413	26	18
Pequest	1,100	60	28	1 70	435	405	10	8
Musconetcong	1,400	70	22	2 90	420	390	13	10
So. Br. Raritan	610	30	9	0 60	505	475	1	1
No. Br. Raritan	1,500	100	38	0 52	335	310	4	2
Long Hill Res....	850	105	64	24 50	320	280	328	182
Passaic at Little Falls....	7,700	42	22	61 50	200	180	290	220
Raritan	12,360	90	29	38 50	140	120	295	157
Mollies and Wading Rivers	33,400	30	12	53 80	40	25	140	106

TABLE II. RELATIVE COST OF FOUR PROJECTS
All in Millions of Dollars Except Cost Line

	Passaic Great Reservoir	Long Hill System	Raritan	Mollies and Wading Rivers
Land and damages	39	24	21	3
Dams and reservoirs	10	15	12	11
Aqueducts	0	0	21	44
Collecting tunnels		20		
Pressure conduit or pipe line	14	23	5	4
Filters	11	10	10	8
Pumping machinery	4	2	7	13
Pumping station		3	3	3
Engineering, administration and contingencies	16	22	16	17
Total cost of works	93	149	95	103
Cost of land acquired, pumping equipment	8	0	15	22
Total cost	101	150	110	125
Capacity m.g.d....	450*	750	400	300
Cost per gallon daily capacity	$223 000	$171 000	$275 000	$417 000

*The capacity of the Passaic Great Reservoir is limited by smaller developments and not counting a flow of 80 m.g.d. assumed to be maintained [illegible]

FIG. 1. THE LONG HILL RESERVOIRS AND AQUEDUCTS

The Long Hill reservoir alone would have an area of 21 square miles and store 3.28 billion gallons of water. Its dam, 4,850 ft. long, would be 57 ft. high above the ground surface and 70 ft. above the bottom of the valley. Two impounding basins would be formed by the following dams: the 57-ft. dam and dam across Passaic River at the north end of the basin [illegible]

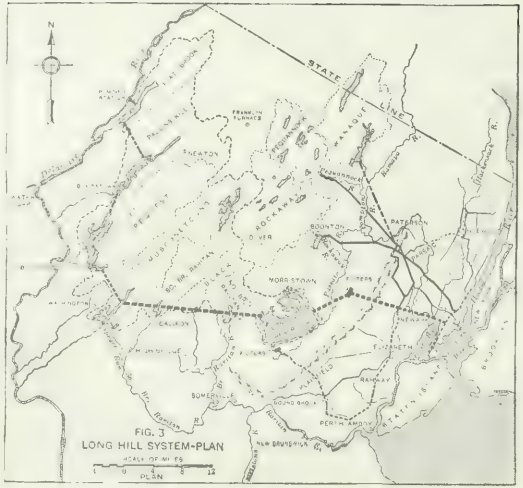


FIG. 3
LONG HILL SYSTEM-PLAN

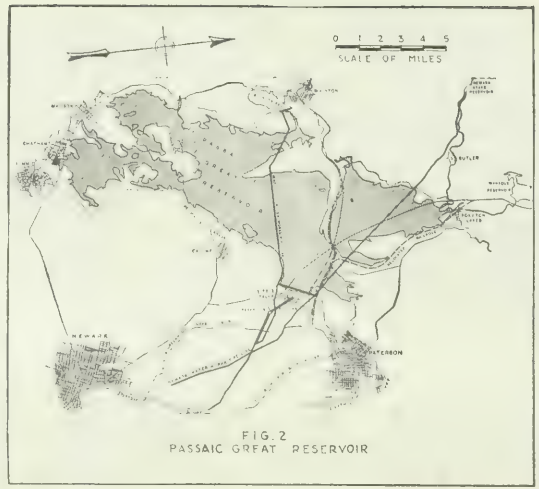


FIG. 2
PASSAIC GREAT RESERVOIR

FIG. 2. PASSAIC GREAT RESERVOIR AND PRESENT CONDUITS

This reservoir would have an area of 61.5 sq. miles, and store 290 billion gallons of water. It would solve not only the water-supply but also the Passaic flood problem. It would submerge the Newark pipe lines from the Pequannock and the Jersey City conduit from the Rockaway and many miles of railroad and highway

FIG 4. EXISTING AND PROPOSED CONDUITS IN NEW JERSEY METROPOLITAN WATER DISTRICT

A 19-mile pressure tunnel and various pipe lines would connect the Long Hill Reservoir with the existing pipe lines of the 33 municipal and private water-works systems in the district.

(BELOW) FIG. 3A. PROFILE OF LONG HILL SYSTEM

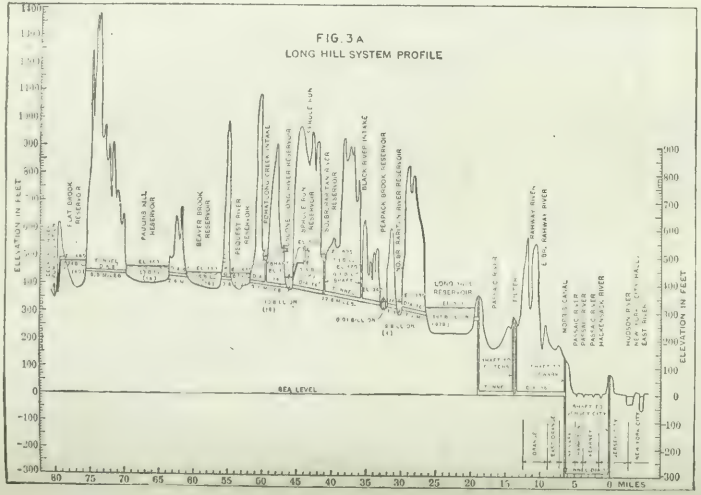


FIG. 3A
LONG HILL SYSTEM PROFILE

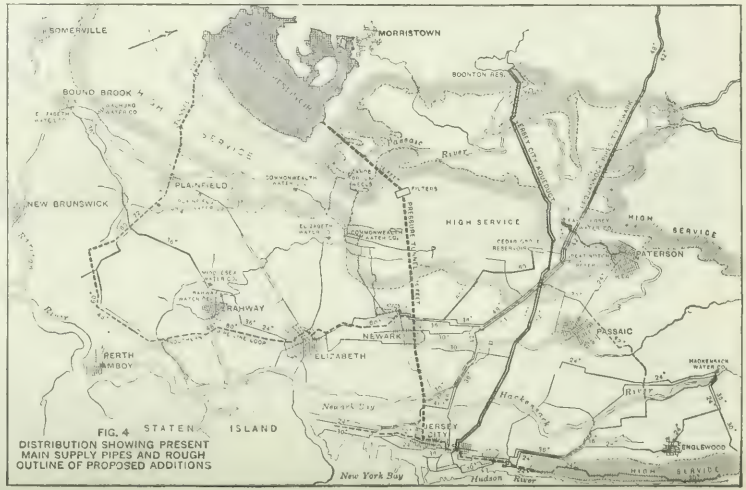


FIG. 4
DISTRIBUTION SHOWING PRESENT MAIN SUPPLY PIPES AND ROUGH OUTLINE OF PROPOSED ADDITIONS

the Delaware River, bringing the total supply developed to this point up to 750 m.g.d. and the total cost to $129,571,000, and making a corresponding unit cost of $172,000 for each million gallons daily supplied. In addition to the sketch map of the entire state already mentioned, Fig. 2 is a map of the Great Passaic Reservoir from the proposed dam, just above Little Falls; Fig. 3 shows the Long Hill reservoir on the upper Passaic above Millington, together with the tributary reservoirs further

TABLE III. SUCCESSIVE DEVELOPMENT COSTS, LONG HILL RESERVOIR AND DELAWARE RIVER PUMPING PROJECT

Long Hill Reservoir	$16,045,000	
Southern loop, extending to Newark with filters	7,410,000	
42 m.g.d. @ $558,000		$23,455,000
Filters for North Branch and Black River division	$3,600,000	
Reservoir and tunnel	12,402,000	
109 m.g.d. @ $357,000		38,857,000
Pressure tunnel to Newark and Jersey City	$27,338,000	
Filters for So. Branch Division	1,560,000	
Reservoir and tunnel	7,085,000	
168 m.g.d. @ $446,000		75,040,000
Filters for Musconetcong division	$3,900,000	
Reservoir and tunnel	10,939,000	
300 m.g.d. @ $306,000		89,879,000
Filters for Pequest division	$3,240,000	
Reservoir and tunnel	8,262,000	
417 m.g.d. @ $243,000		101,382,000
Filters for Beaver and Paulinskill division	$4,116,000	
Reservoirs and tunnels	9,981,000	
558 m.g.d. @ $207,000		115,479,000
Filters for Flat Brook division	$1,680,000	
Reservoir and tunnel	5,750,000	
619 m.g.d. @ $199,000		122,909,000
Filters for Delaware division	$3,800,000	
Tunnel and pumps	2,862,000	
750 m.g.d. @ $172,000		129,571,000

It is assumed that the southern loop, or a part of it, will be first built, and that the first water will be distributed through it; and that the pressure tunnel to Newark and Jersey City will not be built until somewhat later. In the interval it may be that there will sometimes be more water available at Long Hill Reservoir than can be distributed through the southern loop. This will depend upon how large that loop is made and what extensions of it there may be before the pressure tunnel is built. In this interval, if the Little Falls facilities permitted, water could be released from the Long Hill Reservoir to flow down through natural channels to the Little Falls plant and be utilized in that way.

This is another interesting matter. The yield of its own catchment area is so small that by itself years would be required to fill Long Hill Reservoir. With some of the feeders diverted to it the filling time would be reduced.

west and north, and Fig. 4 shows the main aqueducts and pipe lines already in use in connection with existing supplies, as well as those proposed by Mr. Hazen for conveying water from the proposed Long Hill storage system to the present 33 water-works systems in the New Jersey Metropolitan District.

Passaic Great Reservoir—A dam 7,700 ft. long at the flow line, built across the Passaic River above Little Falls would store 290 billion gallons of water, of which 220 would be available above the proposed low water flow line of 180 ft. above tidewater, the available draft of water being only 20 ft. This reservoir would afford an equalized yield of 757 m.g.d., of which 80 m.g.d. would be allowed to flow down the stream for industrial purposes and river sanitation, leaving 667 m.g.d. available for public water supply. In addition, the Passaic Great Reservoir would prevent floods on the lower Passaic, one of which in 1903 caused immense damage and led to the recommendation of a reservoir on this very same site for flood control, but with a lower flow line than is now proposed. This reservoir would also flood large areas of meadow which now create a great nuisance through mosquito breeding.

Two drawbacks to the Passaic Great Reservoir are the necessity of providing the entire storage at once, involving high unit cost while the consumption is relatively low, and also the number of buildings existing on portions of the 61.5 miles that would be covered by the reservoir. Dwellings of all kinds that would be flooded total 2,150, but many of these are below the level of the 1903 flood. The reservoir would also flood four water-works plants, including the stations for pumping from wells for the supply of East Orange and the Commonwealth Water Co. The water power at Pompton Lake would be submerged and also the Du Pont powder works at Wayne. It is estimated that the buildings and industries that would be submerged by the Passaic Great Reservoir are equivalent to what would be "found in an average city of 10,000 or 12,000 inhabitants." Both the Delaware, Lackawanna & Western R.R. and the Greenwood Lake Division of the Erie R.R. cross the reservoir, besides many important highways, all of which would require more or less relocation. It would also be necessary to build a trunk sewer to divert the sewage of several small towns to a point below Little Falls.

It may be noted in passing that if the Passaic Great Reservoir were not built there would still be made available by existing and proposed storage on some of the Passaic tributaries a considerable total volume of water which in no way would affect the yield from what may be termed the rival Passaic storage system (Long Hill) to be described next. It may also be noted that if the Passaic Great Reservoir were not built and the Long Hill reservoir was constructed, then the storage now being developed on the Wanaque could be sent down the stream beds of the Wanaque, Pompton and Passaic Rivers and be utilized by means of the pumping and filter plant at Little Falls.

Long Hill Reservoir—Alternative to the Passaic Great Falls Reservoir is the Long Hill Reservoir, supplemented by northern streams, and eventually by pumping from the Delaware River if found desirable. The Long Hill reservoir would be formed by a dam near Millington, on trap rock, 110 ft. high and 850 ft. long at the flow line, compared with the dam 7,700 ft. long to form the Passaic Great Reservoir. The Long Hill reservoir would have an area of 24 sq.mi., compared with the 61.5 sq.mi. of the Passaic Great Reservoir, but owing to its greater depth (see Table I) the Long Hill reservoir would store 328 billion gallons to the bottom, of which 182 would be available at the proposed low water flow line of 280 ft. above tide level, or a full 100 ft. higher than the low water flow line of the Passaic Great Reservoir at Little Falls. The elevation and capacities of the various reservoirs supplementary to the Long Hill are shown in Table I in the line above the figures there given for the Long Hill reservoir. The safe yield from the Long Hill reservoir system is placed at 619 m.g.d.—without any pumping from the Delaware River. This amount plus what can be obtained from the Passaic and its tributaries entirely below this reservoir and from various other sources available, would be more than is needed to supply the New Jersey Metropolitan District for fifty years to come.

Water-supply rights of the Morris Canal in Lake Hopatcong, in Greenwood Lake, and other bodies of water in the Passaic catchment area would not be interfered with under the development scheme proposed by Mr. Hazen. Should this canal be abandoned [as has been proposed for years past is provided for in a bill that passed the New Jersey Legislature last week] and these rights become available for municipal water supply there would be some addition to the yield from the Passaic projects.

In making estimates for the yields of the various catchment areas considered, Mr. Hazen allowed a correction factor not only for the percentage of water surface in each area but also for the average elevation of these areas. Allowances were also made for the amounts of "ground storage yield" to the reservoir, ranging from 60 days to nothing in terms of net yield. [See Mr.

Hazen's paper, Trans. Am. Soc. C. E., vol. 77, p. 1539, or "American Civil Engineer's Pocket Book for Definition of 'Ground Storage Yield.'"]

Population on Catchment Areas—On the Long Hill catchment area of 645.5 sq.mi., including that of the supplementary reservoirs, the total population in 1920 was 39,544, or 61 per square mile. In 1910 the population per square mile was 67 and in 1900 it was 61, or the same as in 1920. On the Passaic Great Reservoir catchment area of 761.2 sq.mi. above Little Falls the total population in 1920 was 116,303, or 153 per square mile. In 1910 the population per square mile above Little Falls was 133 and in 1900 it was 114. The proposal to divert sewage of certain towns below the Little Falls dam has already been mentioned. The Raritan catchment area had a population of about 70 per square mile in 1920, which was about the same as in both 1910 and 1900. The Mullica and Wading River combined catchment areas had a population of only 29 per square mile in 1920.

The catchment area of the existing Pequannock supply for the city of Newark had a population of only 16 per square mile in 1920 compared with 17 in 1910 and 18 in 1900. [The city of Newark has been gradually acquiring this catchment area until it now owns a very large percentage of it.] In the Rockaway catchment area of the Jersey City water supply the population per square mile was 210 in 1920, 179 in 1910, and 190 in 1900. The Wanaque catchment area above the dam now being built for Newark had a population per sq.mi. of 25 in 1920, 20 in 1910, and 16 in 1900. The existing Hackensack River catchment area had a population of 325 per sq.mi. in 1920, compared with 260 in 1910 and 156 in 1900.

The total number of dwelling houses that would be submerged not only by the Long Hill reservoir but also by all of the reservoirs tributary to it is 781. Comparatively few industries would be submerged. The houses and industries that would be flooded, Mr. Hazen states, would correspond roughly to a community of 4,000 population. Sewage from the portion of Morristown that would naturally drain into this reservoir basin is already diverted outside the catchment area.

Water Distribution—The Long Hill reservoir system would give "gravity service to much the largest part of the district," but areas above El.200 in Montclair, the Oranges, and elsewhere would be in high service pumping districts (see shaded areas on Fig. 4). The water from the Long Hill as well as from the Passaic Great and other proposed reservoirs would be filtered. At the Long Hill reservoir it is proposed to put the filters at such an elevation that they would deliver water to the pressure tunnel mentioned further on at a head of 280 ft. above tidewater. The upper 20 to 30 ft. of the total 40 ft. storage which it is assumed would be utilized from the Long Hill reservoir would flow to these filters by gravity. The water in these upper levels would be sufficient for many years to come. When it was necessary to install booster pumps, they would take water out from below the 280-ft. flow-line elevation.

A pressure tunnel only 19 miles long would convey water from the Long Hill reservoir to Jersey City, passing beneath Newark and connecting with the distribution system of that city en route and connecting at Jersey City with supply mains running south to Bayonne and north to the Hackensack water system at Hoboken. The southern loop pipe line would extend from the tunnel in Newark to Elizabeth and Rahway. This could be extended, if desired, "all the way around through Plainfield, as a belt line, and give an independent connection with the Long Hill reservoir," serving a region where large additional quantities of water are likely to be required.

The present Pequannock supply owned and used by Newark is "available by gravity at a higher elevation than any other part of the proposed supply." Mr. Hazen suggests that by pooling all the sources of supply "it would be good business to use Pequannock water for the high service only, thus avoiding pumping." The Jersey City reservoir at Boonton on the Rockaway and the proposed Wanaque reservoirs "are slightly lower than the proposed Long Hill reservoir, but the differences are not enough to be troublesome," since booster pumps could be used "on any of the supply lines where the head was otherwise deficient." Water from the Little Falls plant would go to the same distribution system by pumping. Most of the water supplied to this district, Mr. Hazen states, now passes through Great Notch at "a point about four miles south of Paterson which might be well called 'Grand Junction,' for so many of the present main supply lines pass through it."

If the Passaic Great Reservoir instead of the Long Hill reservoir were the main source of supply, additional filters and pumping plant could be built at Little Falls; or a tunnel could be driven "from the reservoir to some convenient point of distribution on the eastern slope where filters and pumping stations could be located." Mr. Hazen adds that "such a tunnel might take the water from the southern end of the reservoir."

Dual System of Water Supply—In view of the large volumes of water used for industrial purposes in the New Jersey Metropolitan District, Mr. Hazen asks: "Why not have two grades of water like two grades of milk? Grade A water to be used for the primary systems for all domestic purposes, and Grade B water to be used for industrial purposes." The Grade B water could be chlorinated so heavily that "there would be little valid ground for objection to it for sanitary reasons." The Grade B water could also be "supplied at lower pressure and at a lower price" than the Grade A water, thus aiding industry and affording "a market for waters that are not suitable for domestic requirements."

Costs—Comparative costs for the four projects are given in some detail in Table II while Table III gives costs of successive stages of the Long Hill Reservoir scheme, with pumping from the Delaware River.

Suggested Program—The engineering problem of providing water for the New Jersey metropolitan district can be readily handled, Mr. Hazen says, and the financial problems are also easy of solution by means of a proper system of charging for the water delivered wholesale to the different communities and companies. The real problem lies in the "diversity of ownership in 33 separate systems of water supply now in the district," which Mr. Hazen says, makes it "almost impossible to hope for an adequate solution by voluntary co-operation." In view of this and also the fact that the necessary operations will extend through a long term of years and that action must be taken and money spent long in advance of the need for some of the sources of water supply that will be required eventually, Mr. Hazen suggests the creation of a water board with power to acquire existing and additional sources of supply, and to

build water-supply works, to sell water at wholesale and to issue bonds to pay for the works. A board of three members would be large enough. These should be men who can handle "large enterprises efficiently and economically" and who would be "in a position to decide all questions on their merits and without political or other obligations to anyone."

Such a board once created would immediately "take over some of the larger supply works [but not the distribution systems] now in service," including perhaps those of Newark, Jersey City, the East Jersey Water Co., including in the latter the present Little Falls pumping and filtration plant. The board would also take the dam now being built at Newark on the Wanaque by the North Jersey District Water Supply Commission. When this dam is completed to its full height, water from it could be delivered down existing streams and taken out at the Little Falls plant, which would then have to be enlarged.

Acknowledgment of co-operation is given by Mr. Hazen to the Department of Conservation and Development of New Jersey, with special mention of Alfred Gaskill, director, Dr. Henry B. Kummel, geologist, and H. T. Critchlow, hydraulic engineer. Co-operation was also given by engineers and others connected with many of the 33 water-works systems now operating in the New Jersey Metropolitan District. Much time was devoted to the collection of field data and various studies by Malcolm Pirnie of the staff of Hazen, Fuller & Whipple.

Engineering as a Human Activity

Extracts from a paper by Prof. H. E. Riggs, of the University of Michigan, before the Michigan Engineering Society, on some of the non-technical sides of engineering. Jobs and how to get them; fees and how to maintain them; scalawags and how to treat them are always interesting topics.—EDITOR.

AS I look back over a professional practice of more than 30 years, I am impressed by a few facts which you older men can verify and you younger ones must never forget. The friendships formed during those years are very largely among engineers, not mere acquaintances, but the warmest of close personal friendships. The large majority of the work that has come to me and by far the largest part of my total income, has come directly or indirectly through other engineers. These two facts lead me to say to you that we cannot get along without one another, that our profession is so big and covers such an infinite multitude of specialized lines of work that no one man can possibly fit himself for more than a limited service and that he is constantly coming into contact with problems that demand the attention of other engineers than himself.

The man who takes this view, who sees that he can afford to be helpful and not selfish, who realizes that on a big job there is credit enough for all, and who says "we did a big piece of work and if it had not been for the splendid work of these other men it would not have been possible," is the really big man and soon or late the world will see his bigness.

Twenty or more years ago John W. Alvord read a paper before the Illinois Engineering Society entitled "The Theory and Practice of Getting a Job." Hunt it up and read it. It entitles Mr. Alvord to a place among the great American humorists. It also proves him a philosopher.

As I recall it, he states the theory as the beautiful dream of the day when gray haired corporation presidents will wait in your outer office until it is your pleasure to see them and will then beg you to accept the commission of designing their work and spending their millions.

The practice is a different matter. You hear of a job of designing a pavement in the next county seat and you hie you there by the first train. You find that you are fourth or fifth man, and that a prominent engineer from Chicago, of national reputation, happened to be passing through and dropped off for a chat with his college classmate, the banker, and, hearing of the job, agreed to take it for the banker's sake.

The question is what to do? You want a job. You need one for the money there is in it. Will you knock him, cut prices, use improper influence, get sore, or will you do your best to put the competition on a high plane by putting your price up where it belongs and letting the other fellow take the work at a losing figure if he wants to?

My own observation is that the world is full of jobs, and if you will devote yourself to doing your job, when you get it, a little better than anyone else ever did an engineering job in that town, if you will watch the trouble on the job and see to it that no criticism is made that is not followed to the end, you will make friends on the job who will land the next one for you.

It is absolutely impossible to please everybody. Don't try. Do the job in such a way that you are sure you are right, have reasons for all you do, use the best diplomacy of which you are capable in satisfying the owner that you are right. Be honest, be fearless and you will find job after job coming to you. Use your friends. If you are worth while it will be a pleasure to them to help you.

Don't cut prices. If you have been working for $200 per month for some other fellow and have gone in for yourself, on your first job, don't ask $100 per day. Take $15 or $20. The expert fees will come with the gray hair and the experience.

It has always seemed better to me to let the other fellow, who insists on taking work at less than cost, get the job. Remember that while he has it, he will not be after another, and your chances of getting the new one at a right price is so much the better.

Some of us lack diplomacy. We may be good engineers but our psychology is poor. We cannot convince the man with the money that we do know enough to take charge of his work. If after several experiences we find this to be the fact, we had best work for some fellow who has the God-given gift of convincing the world that he can be trusted to do anything.

I would say to you young men, with all the earnestness there is in me, stick together, work together. What benefits one benefits all. Engineering is an infinitely better profession than when Frank Rogers, Clarence Hubbell and myself were in your places. Make the same kind of friendships that we made. Keep sweet. Do the things that you know are right and honest. The big thing is that the field of engineering does have rich rewards for the man who loves it, and who does his work as the work which the Master sent him to do in making the world a better place.

If you are going to be happy in your work, avoid small town gossip. Fight in the open if you have to fight. If gossip is right, and your friend is no longer your friend, better know it and govern yourself accordingly.

There are now, always have been and always will be, men in every profession who do not belong there. Some are untrained and ignorant. They have acquired a certain amount of practical skill in some branch of work and have undertaken to claim membership in the profession. Some are dishonest and a disgrace to the profession. You ask what shall we do with these? Be sure their ways will find them out. When it becomes clear where they belong, when no doubt remains, then the profession should be purged of these men. A few years ago Prof. J. B. Davis, one of the founders of this society and one of the greatest teachers and greatest men in the profession, said in a discussion of this subject: "When a man comes across a rattlesnake in the path it is his duty to kill it."

The new registration law is hoped to help conditions and the fact that many states have adopted such laws will tend to place engineering upon a higher plane, but after all the laws are in full operation, we will still need to drop back upon ethics, we will still have to use the Golden Rule, we will still have to watch ourselves and we will still have to kill rattlesnakes.

Thin Concrete Lining Successful In Irrigation Canals

On 64 Miles of Canal Saves in Maintenance and Permits Less Seepage Than Earth Construction

By R. C. E. Weber

Project Manager, U. S. Reclamation Service, Orland, Cal.

CANAL lining, 1½ in. thick, placed on 64 miles of the main distribution system of the Orland Project of the U. S. Reclamation Service, at a cost of 39c. per square yard has effected a saving of 60 per cent in maintenance costs over earth sections and has reduced seepage losses to less than one-third of those in clay.

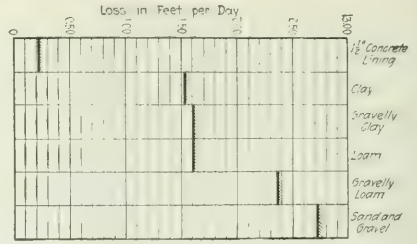
The first concrete lining was placed during the fall of 1911 following the first season of operation. The work performed at that time consisted of lining several high fills in the High Line canal together with laterals



DISTRIBUTION OF LABOR IN LINING CREW

located in a rich, loam soil, in which vegetation grew so luxuriantly as to require cleaning several times during the operating season. The results of the first lining placed were so satisfactory that the work has been carried on each year until at the present time 64 of the total 146 miles of the project distributary channels are lined with concrete. The original plan of the project contemplated and provided for about 30 miles of lined canals and laterals, but the increasing cost of maintenance from year to year together with the heavy distribution losses made necessary the adoption of a more comprehensive plan for concrete lining. Accordingly, in 1917 the project land owners entered into a supplemental agreement with the Secretary of the Interior whereby the land owners acquiesced to an estimated increased cost of $220,000 for lining approximately 70 miles of canals and laterals.

Comparative costs for maintaining concrete-lined



SEEPAGE AND EVAPORATION LOSSES FROM CANALS

channels and earth sections have been kept with the following result: The average cost per mile for concrete-lined section was found to be $19.50. It was $53.70 per mile for earth section. A saving of $34.20 per mile, or 64 per cent, therefore is effected in maintenance costs by the use of lining. In addition to this marked reduction in maintenance cost, there is the reduction of distribution losses and the increased operating safety.

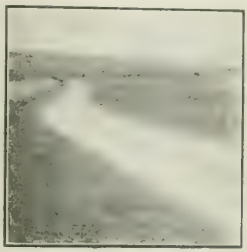
Seepage and evaporation losses in concrete-lined sections and in earth sections of various general soil types are available covering the series of irrigating seasons extending from 1911 to 1920. These losses are in terms of depth in feet per 24 hours over wetted perimeter and are graphically represented by the accompanying diagram. The maximum loss of 2.79 ft. occurs in the sand and gravelly earth section, which by means of concrete lining may be reduced to a loss as low as 0.28 ft.

On account of the fact that the major portion of the project is under irrigation it is not practicable to carry on extensive lining operations during the irrigation season, and the time for lining is necessarily confined to a period of six months, extending from Oct. 1 to April 1.

Approximately 75 per cent of the lining placed on the project has been machine mixed, the remainder having been mixed by hand. Because of the frequent moves in connection with the lining of laterals, mixers of from 3- to 4-cu.ft. capacity are best adapted to the work. Line and grade stakes for bottom of floor and top of lining are provided at intervals of 15 ft. The section is prepared for lining by means of mattocks, picks and square-point shovels, a force of 15 to 25 men (depending on the nature and hardness of the soil encountered) being necessary to keep in advance of the concrete force. The concrete force consists of three men charging hopper with gravel, cement and water, one mixer operator, one man at the chute conveying concrete from the mixer on the bank to the wheelbarrows in the canal, three to seven wheelers (depending on the distance) transporting concrete in end-dump wheelbarrows from the chute to placers, two men placing concrete on slopes and floor and two men finishing. To eliminate wheeling the concrete into the canal section, a metal-lined chute is provided to convey the concrete from the discharge spout of the mixer to wheelbarrows placed directly in the canal section. The maximum length of wheelbarrow haul is 300 ft., mixer set-ups being at 600 ft. intervals. Slopes when dry are thoroughly sprinkled in advance of the concrete and the lining is kept wet for three days following placing. The usual practice is to work downstream, bringing water, controlled by small earth dams, down over the lining the day following placing.

In order to place the lining on the side slopes it is necessary to use a comparatively dry mix of concrete. The same consistency is used for the floor, as it is difficult to transport a wet mixture in wheelbarrows. Water as required is sprinkled over the floor after the concrete is spread, just ahead of the finishing operation. Finishing on the side slopes is first accomplished roughly by means of the reverse side of a square-point shovel and the final operation with a finishing trowel: On the floor shovels are also used but most of the finishing is done by means of a special trowel of heavier construction than that used on the side slopes.

Expansion joints, provided on the side slopes only, at intervals of 6 ft., are made as follows: After the surface has been given a final finishing, the concrete is cut through by means of a pointing trowel guided by a straight edge and the joint thus made is smoothed by a sidewalk jointer. The mixture of concrete used for lining is 1:7 and the average thickness of the lining is 1½ in. Lining of this thickness placed in 1911 and in use since that date is in excellent condition, demonstrating the durability of this thickness of lining in this locality where mild winters prevail with a minimum temperature of 25 deg. F. above zero. Run-of-bank gravel from local creeks is used for aggregate. Gravel with rock not exceeding 1 in. in size is found in its natural state which requires neither washing nor screening for a satisfactory quality of concrete.



COMPLETED LINING ON 22-SEC.-FT. CANAL

Costs.—Since 1911 there has been placed a total of 622,000 sq.yd. of 1½-in. lining on the Orland Project at an average cost of 39.1c. per square yard. This cost was incurred over a period when wages for ordinary labor varied from a minimum of $2.40 to a maximum of $4 per day, and when other items of cost varied in about the same proportion. For the purpose of giving a detail of the various items entering into the cost and also to indicate how costs are returning to normal the following tabular analysis is given of cost per square yard of lining placed during the year 1920 and during the fall construction period of 1921:

Items	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

The average labor costs per day for the year 1920 were as follows: Laborers, $4 and $3.[illegible]; [illegible], $5; finishers, $6; teamsters with two horses, $7; and teamsters with four horses, $10.25. The average haul for gravel was 3 miles and for cement 3 miles. The cost of cement at the project warehouse was $3.20 per barrel. The 116,599 sq.yd. lining was placed on 10.75 miles of canals and laterals. The capacity of the sections lined varied from 15 to 225 sec.-ft. The bottom widths were from 3 to 14 ft., vertical height from 2 to 4.5 ft. and side slopes 1½ to 1 and 2 to 1. For the fall period of 1921 the following prices prevailed: Laborers, $3 and $3.25; placers, $4; teamsters with two horses, $5.50; teamsters with four horses, $8 and finishers, $4.25. The average haul for gravel was 4 miles and for cement 3 miles. Cement at the project warehouse cost $2.90 per barrel. Five and four-tenths miles of laterals with capacities varying from 15 to 35 sec.-ft. were lined, on which 45,618 sq.yd. of lining were placed. The sections lined varied from 3 to 5 ft. in bottom width, 1.5 to 3.5 ft. in vertical height and had side slopes of 1½ to 1.

Most of the concrete lining was placed when A. N. Burch was project manager and the writer, engineer in charge of construction. All of it has been carried out by day labor under the direction of Reclamation Service engineers.

Water From Missouri River Advised To Increase St. Louis Supply

A PROJECT for an additional water supply for St. Louis, Mo., to be drawn from the Missouri River at a point eight miles above St. Charles, Mo., was outlined by Edward E. Wall, water commissioner of St. Louis, in a paper read before the Associated Engineering Societies of that city on Feb. 1. The project includes a shore intake, low- and high-service pumps, a purification plant, distribution reservoir and supply mains leading from the reservoir to the southern and western parts of the city, leaving the northern part to be served from the present Mississippi plant at the Chain of Rocks. The cost of the new works, sufficient, with the proposed enlargements to the existing works, to supply the city and outlying territory until 1960 is placed at $22,000,000, but for the immediate future an outlay of only $12,000,000 is proposed. Ordinances for the acquirement of land at the new site and for a $12,000,000 bond election have been drawn by Mr. Wall. The proposed date of the election is Aug. 1.

In contrast with the Chain of Rocks intake, which for local reasons is about a half mile from shore, in rather shallow water, and gives rise to ice and other troubles, the new intake at Howard Point would be on the convex side of a long curve, where the river hugs the shore. Dikes have been planned which would make the river scour out and maintain a deep channel.

It is estimated that by 1926 the new plant would be delivering an average of about 30 m.g.d. Additions would be made as needed until in 1942 the new works would be supplying 80 to 90 m.g.d. and in 1960 an average of 120 m.g.d., giving a total average daily supply from this plant and the present one at Chain of Rocks of 240 m.g.d., or water for the 1,500,000 estimated population of St. Louis County at that time.

The $12,000,000 estimated cost of the plant built up to 1942 is distributed as follows: Land, dikes and bank protections, intake, buildings, pumping works and accessories, $3,711,000; three 50-m.g.d. low-service and four 30-m.g.d. high service pumps and boiler plant, $1,417,000; 72-in. steel main, $1,589,000; 100 m.g.d. reservoir, $1,130,000 pipe lines connecting with distribution system, $[illegible], to be cost for contingencies, $1,160,000; total, $12,110,000

Wind Pressures at High Elevations and Their Application to Radio Towers

A Review of Practice and Theory—Observations Showing That Wind Velocity Increases with Height —More Experiments Needed—The Gradient Wind—Recommended Loads and Stresses for Design of High Towers

By R. Fleming
American Bridge Co., New York

IT HAS long been known that wind velocity, and consequently wind pressure, increases with the height above ground. Yet it is customary to design steel frames of buildings for uniform wind pressure throughout. The paragraphs in the New York building code calling for a wind load of 30 lb. per sq.ft. and in the Chicago code of 20 lb. are intended for wind loads at all elevations. While this is not logical, the errors in building design that may result are not serious. High buildings in cities are somewhat sheltered by surrounding buildings and the lower portions may be subjected to little or no wind load. Moreover, the wind load is not the dominant load, but its effect on the members of the structure is usually exceeded by that of the vertical loads.

Building Codes that Consider Height

While most building codes call for uniform wind pressure regardless of height, there are exceptions. In London, where the skyscraper is unknown, buildings are designed to resist a horizontal pressure of not less than 30 lb. per sq.ft. on the upper two-thirds of the surface exposed to the wind. In Philadelphia, for high buildings erected in built-up districts, wind pressure is figured at not less than 25 lb. per sq.ft. at the tenth story, 2½ lb. less on each succeeding lower story, and 2½ lb. additional on each succeeding upper story to a maximum of 35 lb. at the fourteenth story and above. In Boston, where buildings are restricted to heights not exceeding 125 ft., the revised code (1919) calls for a wind pressure of 10 lb. per sq.ft. for vertical surfaces 40 ft. in height, 15 lb. for portions from 40 to 80 ft., and 20 lb. for portions more than 80 ft. above the ground.

Prof. Henry Adams in his book, "The Mechanics of Building Construction," London, 1912, under "Finding Stresses in Roof Trusses," writes, "The author's formula for wind pressure gives a value increasing with the height of the ground and decreasing with the width to be taken. It is: $\log p = 1.125 + 0.32\ h - 0.12 \log w$ where p = ultimate wind pressure in lb. per sq.ft. necessary to be allowed for against a plane surface normal to the wind, h = height of center of gravity of surface considered above the ground level in feet, w = width in feet of part taken as one surface." The same formula is given in a previous book by Adams, "Theory and Practice of Designing," under "Steel-Framed Sheds."

Evidently Adams had mainly in mind roofs and roof trusses. If his formula is applied to the side surfaces of buildings the value of h in the formula is one-half the height of the building. If the wind pressure on the sides is carried to the ends by horizontal bracing w is increased and p is thereby reduced. The limitations of the Adams formula may be inferred from the following values: For $h = 50$ and $w = 20$, $p = 32.6$; $h = 50$ and $w = 100$, $p = 26.8$; $h = 100$ and $w = 20$, $p = 40.6$; $h = 100$ and $w = 100$, $p = 33.5$; $h = 100$ and $w = 200$, $p = 30.8$.

Eiffel Tower—In tower design the wind is a far more important factor than in the design of buildings. What wind load shall be assumed, is one of the first questions asked regarding a proposed tower. In the design of that king of towers, the 1,000-ft. Eiffel Tower of Paris, two assumptions were made: A horizontal wind pressure of 300 kg. per square meter (61.4 lb. per sq.ft.) of surface, and a pressure varying from 200 kg. at the base to 400 kg. per square meter (40.9 to 81.9 lb. per sq.ft.) at the top. The committee appointed to examine the design, in its report approving the project, said: "These limits are notably more than the pressures of winds observed in our climate." It is related of Eiffel that when asked what would happen if his proposed tower should topple over he replied that it was calculated to withstand a pressure of 61.4 lb. per sq.ft. counting the lattice work as full surface, and that-in such a wind little would be left standing except the tower.

U. S. Navy Practice—With wireless towers the cost is materially affected by the wind loading assumed. In towers of the U. S. Navy type a wind pressure of 30 lb. per sq.ft. of vertical surface has been commonly (though not always) assumed. This loading was used in designing the triangular towers of the San Diego, Pearl Harbor, Cavite and other high-powered stations. Several of these towers are 600 ft. high.

It may be stated here that "Wind, 30 pounds per square foot," as inscribed on the name plate of the Guam towers, does not furnish complete information. In a self-supporting tower have the members on the leeward side been considered protected to any extent by those on the windward side? In proportioning the several parts has the surface-area of one side, of two sides or some intermediate value been assumed as exposed to the wind?

Specifications for Monroe Towers

The specifications (1918) of the U. S. Navy Department for 20 radial brick towers, each 500 ft. high, at Monroe, N. C., called for a wind pressure on the vertical projection of 40 lb. per sq.ft. for the first 100 ft. from the top, 35 lb. for the next 100 ft., etc., and 20 lb. for the lower 100 ft. Further, a pressure of 40 lb. was to be considered acting on the spreader trusses. Specifications for alternate 820-ft. triangular steel towers called for a wind pressure of 30 lb. per sq.ft. on 1½ times the exposed area of one face.

Radio Corporations—The "Radio Central" Station at Port Jefferson, L. I., when fully completed with its 72 towers will be the largest and most powerful radio station in the world. The twelve 400-ft. square towers now in use were designed for a wind pressure of 30 lb. per sq.ft. of vertical surface acting on twice the projected area of one face for the upper 300 ft. and on 1½ times the projected area of one face for the lower part.

The specifications (1919) of the Marconi Wireless Telegraph Co., Ltd., (London) for towers 800 ft. nigh require the design to provide for, "a wind pressure of 30 lb. per sq.ft. over the whole of the exposed surface in the direction of the wind on the front framing and 30 lb. ditto on the back framing."

The wooden lattice masts, 714 ft. high, of the radio station of the Italian navy at Rome (San Palo) built in 1917 during the stress of war, were designed for a wind pressure of 61.5 lb. per sq.ft. (C. F. Elwell, *Proceedings of the Institute of Radio Engineers*, June, 1920, p. 194.)

The great French station at Croix d'Hins, 14 miles southwest of Bordeaux, known as the "Lafayette Radio Station," was designed to meet the exigencies of war. Happily the armistice came and the station was finished in times of peace. The eight triangular steel towers, 820 ft. high, fabricated by the Pittsburgh-Des Moines Steel Co., of Pittsburgh, were designed by the Bureau of Yards and Docks of the U. S. Navy. Wind pressure was assumed at 30 lb. per sq.ft. on an area 1½ times the exposed surface of one face. (Lieut. Copeland, *United States Naval Institute Proceedings*, Dec. 1920, p. 1905.)

The circular concrete wireless tower at Tokyo is the tallest masonry structure on record, being 660 ft. high above ground level. "The wind pressure on a plane area was taken at 60 lb. per sq.ft. at the ground level and 126 lb. per sq.ft. at the top, changing uniformly between these two extremes, while the coefficient of reduction for the projected area was taken at two-thirds." (Prof. Shibata, *Engineering News-Record*, Aug. 4, 1921, p. 204.)

Wind Loading Data not Always Given

It is to be regretted that the *Zeitschrift des Vereins deutscher Ingenieure* (Nov. 20 and 27, 1920), in its 24 columns on the great German station at Nauen, does not give complete information regarding the wind loading assumed in the design of the 260-meter (853-ft.) masts. It is stated that 350 kg. per square meter (71.7 lb. per sq.ft.) perpendicular to the vertical surface was used at the summit, but nothing is said about loading at the base. A lack of information about wind loading is quite common in descriptive articles, even in those in technical papers. *Le Genie Civil*, Dec. 11, 1920, in a 10-page article on the Lafayette station says nothing about wind. *Engineering*, May 3, 1889, devotes 8 of its large pages to the Eiffel tower, but the reader must look elsewhere for information on the important matter of wind loading assumed in the design.

Activity in Wireless—We seem to be on the eve of worldwide wireless. In current electrical papers may be found items, as "Belgium is to begin the building of a wireless station, having eight steel antenna towers, each 850 ft. high"; "A new high power station at St. Assise, France, will be one of the most powerful in the world. It is intended to erect sixteen towers somewhat higher than those of the American-built station at Bordeaux." "The report of the Imperial Wireless Committee recommends the construction of a chain of wireless stations about 2,000 miles apart"; "Brazil plans Radio Expansion." The 1,000-ft. towers [illegible] practicability.

The choice between increased cost of power with lower towers and increased cost of higher towers with lessened cost of power is made by the radio engineer. For his benefit it may be said that the weight of steel in self-supporting steel towers varies nearly as the square of the height. For instance, if the 400 ft. towers of the Radio Central requiring 130 tons of steel each had been built 800 ft. high the weight of steel would have been about 450 tons each.

From the variations of wind loading cited it may be inferred that the assumption of wind pressure on high towers has been largely a matter of guess. As far as known, no disastrous failures have occurred from past assumptions, but the time has come when the relation of wind pressure to height should be more accurately determined. Different formulas have been advanced, but they are based on rather narrow ranges of experiments and are thus limited in application to structural design.

Variation of Pressure With Height—Thomas Stevenson, in "Report on Simultaneous Observations of the Force of Wind at Different Heights above the Ground" (*Journal of the Scottish Meteorological Society*, March, 1880, p. 348) from a series of observations on winds varying from 2 to 44 m.p.h. concludes that for *small heights* the velocity V at any point H above the ground, from the known velocity v at a height h (h being above 15 ft.) may be expressed by the formula

$$V = v \sqrt{\frac{H + 72}{h + 72}}$$

His observations were made at stations 276 ft. to 1617 ft. above sea level and did not include heights more than 50 ft. above the ground. Later, in writing on the same subject (*Proceedings of the Institution of Civil Engineers*, Vol. 69, 1882, p. 120) he thinks the formula "should be applicable to lofty engineering structures such as lighthouse towers, chimneys, and high-level bridges." Since wind pressure varies as the square of the velocity $P/p = V^2/v^2$, or by the Stevenson formula,

$$P = p \frac{H + 72}{h + 72}$$

where P and p represent pressures per sq.ft. at H and h respectively. It is seen at a glance that this formula does not apply to high towers. For if $p = 25$ and $h = 50$, P is equal to 178.7 when $H = 800$, and 219.6 when $H = 1{,}000$. Stevenson also writes, "when it is wanted to ascertain the velocity for *great heights* above the sea level, the approximately correct formula, which is believed to be sufficiently correct for practical purposes, is $V = v \sqrt{\frac{H}{h}}$." Evidently H and h are elevations above the sea level. This formula in terms of pressure becomes $P = p \frac{h}{H}$.

Archibald's Exponential Formula—E. Douglas Archibald presented a paper, "On some Results of Observations with Kite-wire-suspended Anemometers up to 1,300 ft. above Ground, or 1,800 ft. above Sea Level, in 1883-5," at the Aberdeen meeting (1885) of the British Association for the Advancement of Science. The paper is an enlargement of one he presented at the Montreal meeting the previous year. It is published more fully in *Nature* (Vol. 33, Apr. 22, 1886, p. 593) than in the Association Reports. Prof. Archibald endeavored to determine values for the exponent x in the empirical formula $\frac{V}{v} = \left(\frac{H}{h}\right)^x$ where V, v, H and h are the velocities recorded at and

heights of the instruments. He divided his 42 observations into 6 groups and made the following table:

TABLE I. OBSERVATIONS BY ARCHIBALD

Group	Number of observations	Mean height of upper instrument above ground, ft.	Mean height of lower instrument, ft.	Mean height of bird, ft.	Mean velocity of bird, ft. per min.	Mean Upper and Lower Velocities ft. per min. Upper	Lower	Mean value of x
1	7	250	102	176	1,395	1,617	1,174	0.372
2	3	322	128	225	1,955	2,232	1,679	0.307
3	8	407	179	293	1,545	1,705	1,385	0.275
4	5	549	252	400	1,940	2,107	1,773	0.237
5	9	795	481	638	2,074	2,192	1,957	0.250
6	10	1,095	767	931	2,166	2,236	2,096	0.194

The conclusion the author draws from his table is that the velocity of the wind *always* increases from the surface of the ground up to 1,800 ft. above sea level, and that the ratio of the increase steadily diminishes up to that height. "The only exception to the steady decrease in the value of x occurs in Group 5, and this is evidently due to the inclusion in that group of an abnormally large value of x (0.576), corresponding to an abnormally small velocity of 789 ft. per min., which is little more than a third of the mean velocity of the stratum corresponding to that group." The author is to be commended for including in his table *all* observations. Investigators have sometimes thrown out those that did not conform to a proposed equation or theory.

Other Observations—Dr. W. N. Shaw, later Sir Napier Shaw, published in 1909 ("Report of the Advisory Committee for Aëronautics for the year 1909-10") his formula, $V = \frac{H + a}{a} v$, in which V is the supposed velocity at height H above ground; v the anemometer velocity at the ground, and a is the height above sea level. The formula is supposed to apply until the "gradient velocity" is reached. It was tried by Shaw as far as proportionality to height is concerned for places at altitudes of 377 ft., 492 ft., 541 ft., and 1,100 ft. above sea level, and he writes, "It seems likely to prove very effective." It is certainly not applicable to places near sea level, though Shaw writes, "At a well-exposed sea-coast station, a may be very small, so that the limiting or gradient velocity is soon reached."

W. H. Dines, who has given much study to the wind, says, "Judging from the result of 5 years' constant kite flying, it appeared that the velocity at 1,000 ft. elevation (at inland stations such as Bushy) was quite double that at the surface, but there was certainly no regular rule with which the increase occurred." (*Proceedings of the Institution of Civil Engineers*, Vol. 171, 1907-8, p. 215.)

The *Bulletin of the Mount Weather Observatory* (Vol. 2, June 1910, p. 357), quotes wind velocities taken at three observatories. At the top of the Eiffel Tower the average velocity for winter winds was 22 m.p.h., while at a distance about 68 ft. from the ground they averaged 5.4 miles. For the year they averaged 19.5 miles at the upper and 4.8 miles at the lower level. The records of the Prussian Aëronautical Observatory at Lindenburg (altitude of station above sea level, 122 meters = 400 ft.) show a velocity of 20.6 m.p.h. at an altitude above sea level of 500 meters (1,640 ft.) when the surface velocity was 11 miles. The velocities at 1,000 and 2,000 meters were 21.3 and 21.7 m.p.h. At the Blue Hill (Mass.) Observatory (altitude of station, 195 meters = 640 ft.) a velocity of 19.5 m.p.h. was recorded at an altitude of 500 meters when the surface velocity was 9.4 miles. At 1,000 meters altitude the velocity was 20.4, and at 1,500 meters altitude 23.7 m.p.h.

Wing's Conclusions—S. P. Wing (Civil Engineer, C. F. Elwell, Ltd.), in *The Electrician* (London), July 1, 1921, presents an article, "Wind Pressures and the Design of Radio and High Transmission Towers," which from the standpoint of the structural engineer is the most valuable presentation of the subject yet published. During 1915 he made observations at the wireless station at Ballybunion, Ireland, from anemometers placed on top of the 492-ft. mast, a 300-ft. mast, and points 40 and 15 ft. above the ground level. During the 40 observations the wind velocity varied from 0 to 37 m.p.h., and at different times came from nearly every point of the compass.

The general conclusions drawn by him are: (1) At a locality whose elevation is close to sea level the wind velocity increases considerably with increase in elevation above ground, and does not reach the limit of its increase at 500 ft.; (2) the increase is limited by the gradient wind and probably does not exceed by 15 per cent the increase reached at 500 ft.; (3) the extreme variation in wind velocity at 750 ft. is between 140 to 170 per cent of the ground velocity; and (4) an approximation to the actual pressures within a probable error of not more than 15 per cent is given by the equation

$$P = (0.00126\,h + 1.16)P_g$$

in which P = pressure in lb. per sq.ft. at point h ft. above ground, and P_g = pressure per sq.ft. at ground level. This equation is assumed to apply to high velocities (those of the order of 100 miles an hour) as well as those measured.

Mr. Wing places a modest value upon his experiments. "The results are too scattered," he says, "to prove anything definitely." Yet it is true, as he thinks, that the results "are useful in showing the limits of the increase in pressure with height and the need for allowing positively for this increase in the design of tall structures."

Table II shows values obtained for P in the Wing equation:

TABLE II

Wing Formula: $P = (0.00126h + 1.16)\,P_g$

h	P	P (P_g=20)	P (P_g=25)
100	1.286 P_g	25.72	32.15
200	1.412 P_g	28.24	35.30
300	1.538 P_g	30.76	38.45
400	1.664 P_g	33.28	41.60
500	1.790 P_g	35.80	44.75
600	1.916 P_g	38.32	47.90
700	2.042 P_g	40.84	51.05
800	2.168 P_g	43.36	54.20
900	2.294 P_g	45.88	57.35
1,000.....	2.420 P_g	48.40	60.50

Kempe, "The Engineers' Year Book," 1921, gives a formula for wind velocity based on the varying densities of the air as observed by a mercurial barometer. It is,

$$V = 1347.4\sqrt{\frac{H - h}{h}}\,(1 + 0.00208\,t)$$

where V = velocity in ft. per second, H and h = densities of the air in inches of mercury and t = temperature in degrees Fahrenheit.

Gradient Wind—The predictions of the Weather Bureau regarding the winds are made by mapping barometric heights observed simultaneously at different places after they have been reduced to what they presumably would have been if the stations were all at

a certain common level, that is, if all stations were at sea level. From the differences in pressure thus shown, the strength and course of the winds during the next 24 hours may be closely predicted. In meteorological circles winds are compared by their relation to the "gradient wind," which is "a theoretical wind based on the calculation of differences of pressure and is supposed to exist at some unknown distance above the earth's surface, where the effect of the earth's friction and local conditions are not felt. This wind is generally considered to be near the limiting velocity of all earth winds. This being the case, if, at a given place, we know the ratio which the ground winds bear to the gradient wind, then an estimate of the maximum gradient wind would give us an estimate of the maximum ground wind." (Wing.) Incidentally, the engineer could profitably acquaint himself with certain meteorological terms and methods. Humphrey's "Physics of the Air" will prove to be of great value in this direction. The four chapters "Atmospheric Circulation" are of unusual interest.

High Pressure Assumptions—It will be seen from the foregoing that data of wind pressure at high elevations are meager. Practically nothing is recorded regarding velocities a few hundred feet above ground level when a wind of 60 or 70 miles is blowing at the surface. An instance of present vagaries on the subject is shown by two sentences quoted from "Wireless Telegraphy," one of the D. U. Technical Series, bearing date 1921: "The stresses set up in the mast by the wind during storms are very considerable, and a large factor of safety must be allowed in their design. This is usually based upon a wind pressure of 500 kg. per square meter and a factor of three is allowed." Now, 500 kg. per square meter is equivalent to 102.4 lb. per sq.ft., an excessive pressure for wind.

Observed Velocity at 570-Ft. Level

Prof. Omori, in determining the oscillations of the 570-ft. Sagoneski chimney, encountered at the top a gale of 78 m.p.h. In his report he writes that the velocity at the top was undoubtedly greater than at the bottom and "it is no exaggeration to assume in time of storms the wind velocity at the top will be twice that at the base." The structural engineer would like to know the velocity at the top of the chimney when it is 78 miles at the base.

New Observations Needed—What is needed are observations taken simultaneously at the top and bottom of some of the existing radio towers during high winds at the lower level. It would seem that some of the 135 U. S. Government shore stations could be utilized for such a purpose. Possibly an extensometer could be used to determine stresses in a lower section of column during a high wind. Kite anemometers can be used only in moderate winds, and results obtained by them are therefore limited in application.

Wind velocities vary greatly with locations. The present writer has been impressed by this in designing sugar mills. Asking an engineer from Peru what winds a proposed mill in that country would have to resist, he was told that the wind was never "strong enough to blow off your hat." From far Formosa, where there are large sugar mills, a steel erector writes, "Up to the time I left that island all such steel buildings were calculated for a wind velocity of 150 m.p.h. This factor was decided upon after the roof had been taken off a large molasses storage tank when the Japanese wind gage in that district registered 135 m.p.h., at which rate the instrument was destroyed and therefore put out of commission."

Local Variations—At Mobile, Ala., along the Gulf coast, the highest velocities recorded in the year 1916 were 107 and 115 m.p.h., while at Anniston, in the interior of the state, 250 miles distant, the highest velocity recorded during the same year was 32 m.p.h. The highest velocity recorded in New York City for the period 1884-1921 was 96 m.p.h. This was from the present station on the Whitehall Building, Battery Place, at an elevation of 453.9 ft. above ground level. At Chicago the highest velocity recorded 1872-1913 was 84 m.p.h., in the storm of Feb. 12, 1894. This was from the former station on the Auditorium tower, 274 ft. above ground level. During this storm the wind averaged nearly 70 m.p.h. for 10 consecutive hours. (The New York and Chicago velocities for a period of 1 min. were both greater than those given). A point of interest in the Chicago observations is that while the average hourly velocity for 15 years (February 1890-June 1905) at the station on the Auditorium tower was 17.2 miles, at the station on the Federal Building (310 ft. above ground level) the average hourly velocity for 5 years (July 1905-December 1910) was 14.3 miles, or 2.9 miles less than at the previous location, 36 ft. lower. For the six months July-December 1905, registers were maintained at both buildings, and the average movement at the Federal Building was only 90 per cent of that at the Auditorium tower. This is explained by the fact that up to the time the station was moved the Auditorium tower was a comparatively isolated structure and there was a free approach to the anemometer from all sides. On the other hand the dome of the Federal Building, although rising above the former exposure, is in a way hemmed in by surrounding buildings of nearly the same height and the wind is influenced by these obstructions. ("The Weather and Climate of Chicago." Cox and Armington, 1914.)

Maximum Velocity and Pressure—It may be said here that, although average velocities have their use, the structural engineer needs the maximum velocity. He cannot design a structure for an average velocity of 30 or 40 m.p.h. when once in six months it may have to withstand a velocity of 60 or 80 miles.

Comparison of Formulae

The velocities heretofore mentioned are recorded velocities, but according to the reduction formula used by the U. S. Weather Bureau a recorded velocity (V) of 100 m.p.h. indicates an actual velocity (V_a) of 76.1 m.p.h. The pressure formula used by the Bureau, $P = 0.004\,V_a^2$, thus gives for a wind of 100 m.p.h. a pressure of 23.2 lb. per sq.ft. Many British engineers use $P = 0.003\,V^2$, which for a wind of 100 m.p.h. indicates a pressure of 30 lb. per sq.ft. As the actual velocities of occasional gusts may be near those recorded by the ordinary cup anemometer, and as the coefficient 0.004 is more than that given by many authorities, the writer believes that the assumption of 30 lb. per sq.ft. wind pressure is sufficient for towers up to 300 ft. in height unless located where winds are phenomenally severe.

Exposed Area—An important question arising in all network construction is, how much is the leeward side or face protected by the windward side. In bridges, where the trusses are but a few feet apart and the

members are of considerable size, wind currents in passing through the windward truss may be deflected and lessened in force. In radio towers, where the truss systems are widely separated and the members are of small size, it is improbable that there is any appreciable difference in wind pressure on two opposite parallel sides.

In addition to the assumptions of wind pressure and area of surface exposed to the wind, a third factor in the design of towers is the working stresses used in proportioning members. Because wind loads are intermittent and seldom reach their maximum, it seems reasonable to allow working stresses greater than those used for dead loads.

Recommended Practice—The writer recommends that radio towers be designed to withstand a wind pressure of 30 lb. per sq.ft. up to 300 ft. height. For the upper parts of *towers more than 300 ft. high* he would add 2½ lb. for every 100 ft. additional height, so that the upper 60 ft. of a 660-ft. tower, for example, would have a pressure of 40 lb. per sq.ft. (If spreader or cross-arm trusses are used the wind load on them should be assumed the same as on the upper section of tower.) For self-supporting triangular towers he would consider the area of exposed surface as 1½ times and for square or rectangular towers two times the vertical projection of one face. Working stresses of 20,000 lb. per sq.in. in tension and $20{,}000 - 90\frac{l}{r}$ in compression are recommended for combined loading.

The recommendations made are tentative. They differ slightly from some former recommendations. As previously mentioned, more information is needed on the ratio of *high* wind velocities at the ground level to velocities of points several hundred feet above. It is also desirable, but not always practicable, to have wind data regarding the particular location of a proposed tower.

Treatment of Car Sills and Decks

By Forrest S. Shinn
Tie Treating Department, Chicago, Burlington & Quincy Ry. Co.

Abstract of paper before American Wood Preservers' Association.

SINCE 1911 the Burlington railroad has treated 1,300,000 ft. of car sills and 1,800,000 ft. of car decking. We are not in a position as yet to know just what results will be obtained from this treatment, as none of the lumber has been taken out for any cause except on account of being broken; however, in view of the fact that we are taking out yearly a large amount of untreated flooring on account of rot we feel that the money spent for treatment has brought good returns. We have not made any tests on this material, comparing the strength of the treated lumber with the untreated, but from close observation have come to the conclusion that treatment very materially increases the hardness and makes it much more resistant to wear. Many untreated planks in cars built in 1911 and 1912 have been worn so thin that they have had to be replaced.

No floors or sills for open-top coal cars or flat cars have been treated but, while this flooring is not subject to conditions that will produce rot as quickly as in stock cars, I believe that from an economic viewpoint we would be warranted in treating it. I have seen hundreds of these cars where the flooring showed signs of rot to a very considerable extent and it is a very common sight to see where the sapwood along the edges of the planks has sluffed off, leaving the top of the plank in the shape of a halfmoon. This very materially weakens the floor, finally causing it to break.

Tidal Characteristics and Their Importance to Engineers

What Tides Are, How They Vary and How They Are Studied and Reported by the Coast and Geodetic Survey

By G. T. Rude
Chief, Division of Tides and Currents, U. S. Coast and Geodetic Survey, Washington, D. C.

TIDAL work in general had its origin in the necessity for reducing soundings, in hydrographic surveys, for the rise and fall of the tides. Since then the needs of the engineer and mariner have resulted in the extension of the work until it covers the following fields: Prediction of tides and the preparation of annual tide tables in advance; determination of datum planes; study of mean sea level and its relation to crustal movements; development of instruments for observing and predicting tides, and the study of tidal phenomena in general.

Tide tables containing the predictions, in advance, of the state of the tide at the different ports of the world,

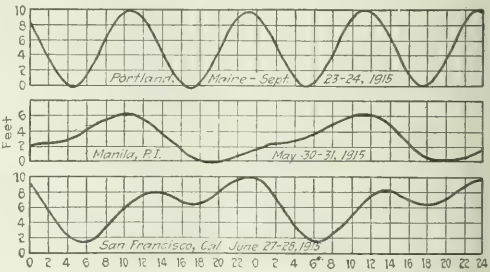


FIG. 1 THREE TYPES OF TIDE, DAILY, SEMI-DAILY AND MIXED

while of use to engineers and others, were primarily evolved for the use of the mariner, in order to furnish him in advance the state in which the tides would be at some future time, for his guidance in entering or leaving port. This information as finally evolved is contained in a conveniently arranged tide table, and consists of the time and height of each successive high and low water referred to some datum plane, usually that of the chart of the vicinity, for a year in advance.

The oldest recorded tide table appears to be the one in the library of the British Museum. It is a manuscript table written about the thirteenth century, and gives the time of high water at London Bridge, with reference to the moon's age and not for the calendar day. The British Admiralty published the first modern table in 1833. The issue of tide tables by the United States began in 1853 with a condensed table for eight stations in the United States. These tables have increased in size and scope so that they now appear annually in advance as a volume of about five hundred pages, covering the entire maritime world, with full predictions for each day of the year at eighty-one principal ports and tidal differences for more than thirty-five hundred subsidiary ports.

Prior to 1882 the tides for the United States were predicted by means of tables and graphs. Beginning with that year the predictions were made by the Coast and Geodetic Survey on the Ferrel Tide Predicting Machine (see Appendix No. 10, Coast and Geodetic

Survey Report for 1883) designed by William Ferrel of the Survey. This machine is about 2 x 3 ft. in size and is essentially a maxima and minima machine. Its small size as compared with other predicting machines was made possible by the fact that the constant representing the large or lunar component was placed directly on the face of the machine and the gearing had to take account of the differential only between this and the effects of the constants representing the smaller components. In 1910, a new machine, (see Special Publication, No. 32, Coast and Geodetic Survey, and *Engineering News*, July 20, 1911, p. 69), designed and constructed in the office of the Survey, was put in operation. It shows on its face the time and height of each successive high and low water, and at the same time draws a tide curve.

For the purposes of predictions the tide is assumed to be composed of many elementary tides, each due to the motion of moon or sun, or to their relative positions. This machine will take account of thirty-seven elementary tides. The effects of each constant representing the different components or simple waves are combined by means of a fine, flexible chain, which passes over each constant's pulley, transmitting the resultant motion to dials and pointers on the face of the machine where the time and height of each successive tide is directly indicated. It handles with equal facility the various types of tides, which are briefly explained later.

In the predictions of tides the observations obtained at a station for a year or more are subjected to the harmonic analysis which resolves the tide into its constituent waves or harmonic constants. The amplitudes and phases as secured from this analysis for each constant are set on the cranks and dials of the machine so as to sum up into the tide of nature. It is, of course, out of the question to predict the tides for all ports. To secure the state of tide at places where no full predictions are made, it is customary to refer such places to some port for which predictions have been made as a standard port. This has led to a study of the different types of tides in order that subsidiary ports may be referred to a standard port having a similar type of tide.

While there are a number of different types and forms of tides, they may be conveniently and accurately classed as three distinct types with their different forms. The main classification may be made into the semi-daily, the daily and the mixed. In Fig. 1, there are represented reproductions of the automatic tide gage records at Portland, Me., Manila, and San Francisco, illustrating these simplest types of tide—the semi-daily at Portland, the daily at Manila and the mixed at San Francisco.

In the simple form of the semi-daily, there are two high and two low waters every day; also the morning and afternoon tides are very much alike. In the simple form of the daily we have only one high and one low water a day. The third, mixed type, is caused by a combination of the two preceding types. In this we have two high and two low waters a day, but these two tides differ both as to form and height. This type is illustrated by the tide at San Francisco.

Even the simplest types vary somewhat with the moon's declination. Fig. 2, which represents reproductions of the tidal marigrams at Portland, Maine, and at Manila, P. I., illustrates the variations from this cause.

The upper curve for Portland is an equatorial form; that is, the moon's declination is nearing a minimum. The lower for Portland is the declinational form when the moon's declination is large. At this port which ordinarily has the simple semi-daily tide the curve at certain times approaches somewhat the mixed type. The curves for Manila also illustrate the case of a port which ordinarily has a daily type changed for a few days during a lunar month to a semi-daily tide when the moon is nearest the equator and the semi-daily forces are exerting the predominating influence. In the same way the tide of a port which ordinarily has a mixed type changes for a few days during the month to a

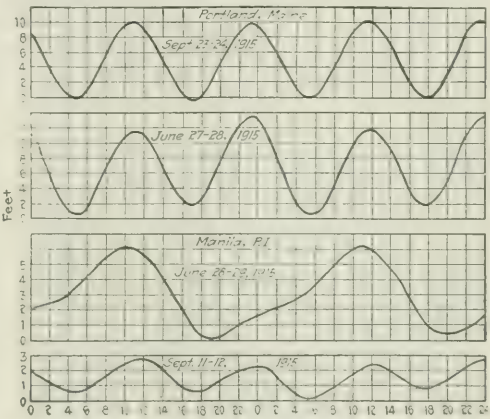


FIG. 2. VARIATION IN TIDAL CURVES DUE TO CHANGING DECLINATION OF MOON

semi-daily form when the moon has its minimum declination.

The tidal curves in Fig. 3 are reproductions of the marigrams of Seattle and Honolulu, illustrating two different forms of the mixed type.

The one at Seattle shows very little variation in the high waters but considerable difference in the lows; while the one at Honolulu shows very little difference in the height of the lows but with a marked accentuation in the difference in the height of the highs.

Briefly, this difference in form is due to the different ways in which the daily and semi-daily waves combine—they may have the same phases and different amplitudes; the same amplitudes and different phases, or both different amplitudes and different phases. It is evident, therefore, that they may combine in various ways giving rise to many different forms.

One type which has not been covered by the preceding may be called the "River Type of Tide." It is evident that fresh water run off in a river will affect the tidal wave causing the tidal curve to be steep and of a short period for the flood and more inclined and of longer period for the ebb.

There are, of course, many variations of forms, which it is impossible to cover, except as a separate subject. The types shown, however, are the principal ones.

This question of types and many other problems have required study and solution by mathematicians before tide predictions could be presented to the engineer and mariner in their present accurate state.

One of the important phases of tidal work of great

value in particular to the engineer is the determination and establishment of tidal planes of reference. The subject of datum planes would furnish material for a paper in itself. It will therefore be touched on briefly here, bringing out only the essential features of the subject and the relation of tidal planes to the work of the engineer and to the needs of the mariner.

Formerly, surveyors and engineers made use of arbitrary or local datum planes. This practice has frequently made it impossible to compare the results of recent with previous surveys. To eliminate the confusion arising from this procedure the Coast and Geodetic Survey has been establishing and furnishing datum planes based on tidal definition for all the coasts of the United States. On the Atlantic coast long series of observations are being obtained at Portland, Boston, New York City, Breakwater Harbor, at the entrance to the Delaware, Philadelphia, Baltimore and Fernandina; on the Gulf coast, at Key West, Cedar Keys and Galves-

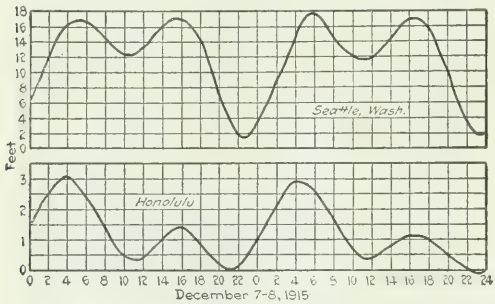


FIG. 3. DIFFERENT FORMS OF MIXED TYPE OF TIDE

ton, and on the Pacific, at San Diego, San Francisco, Seattle and Ketchikan. The observations are all connected with permanent bench marks for the use of engineers locally, or for the initial elevations or "tie in" points for precise level nets.

The great advantage of a tidal datum plane lies not only in its simplicity of definition, but also in the certainty with which it may be re-established at some future time, even if all bench mark connections be destroyed. For the purposes of the mariner a low water plane is obviously the most satisfactory, and for this reason on hydrographic charts the plane of mean low water has been adopted for the whole of the Atlantic coast. On the Pacific coast, because of the diurnal inequality of the tides, the plane of mean lower low water is in use; that is, all the soundings shown on charts of the Coast and Geodetic Survey have been reduced, no matter what the stage of the tide when taken, to mean low water on the Atlantic coast and mean lower low water on the Pacific coast and Alaska, with the exception of Wrangle Narrows, where an arbitrary plane 3 ft. lower has been adopted.

For other engineering purposes, planes such as that of high water or higher high water are at times adopted, but in general the most satisfactory plane is that of mean sea level, since it is the most easily determined and also that the other planes may be derived from it by a knowledge of the range of the tide and of its diurnal inequality.

It is evident that the planes of mean low water, mean high water and others are all local, since they depend on the range of the tide at any given place; that is, the

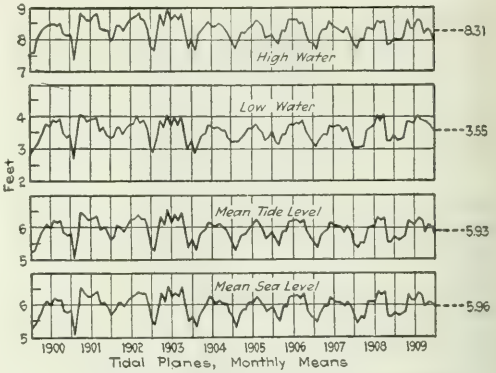


FIG. 4. VARIOUS TIDAL PLANES AS DETERMINED BY MONTHLY MEANS

planes of mean low water, etc., for the different places along the coast would, if visualized, be a wavy plane, while mean sea level may be considered as an equipotential plane forming one continuous unbroken surface. This then may be considered as the plane in which the waters of the ocean would come to rest if all disturbing influences of tide, current and wind were removed.

For practical purposes a tidal plane, determined from a series of observations covering a period of a month may be considered as being fairly well determined. Such planes, however, determined at different times may differ considerably because of long period tides and seasonal changes, and for that reason it is necessary to have long continued observations such as are being made by the Coast and Geodetic Survey at its principal tidal stations on the coasts of the United States.

The diagrammatic representation of various datum planes, as determined by monthly means (Fig. 4) brings out the fact that the determination of accurate planes of reference is not an altogether simple matter. The curves represent the planes of various tide levels by monthly means, from 1900 through 1909, at Port Hamilton, N. Y. The means of these observations show variations from month to month of as large as a foot and a half. The seasonal variations of the different planes are also very evident, being much higher in summer than in the winter months, the variations in this respect being uniform, however, for each year throughout the period. The planes of mean sea level and mean tide level (Fig. 4) are for practical purposes about the same, mean sea level being the average of all the hourly heights of the tide and mean tide level the average of the high and low waters. This difference, of course, is a minimum on a regular tidal curve and a maximum on an irregular curve. Studies of the Pacific coast tides show similar seasonal variations in the planes, except that the higher stages occur in the winter months, due to prevailing winds and rainy season.

While the difference in mean sea level as secured by means for one month, may differ as much as a foot or more from that secured for another month, the mean from a period of one year as compared with that for another year, may differ as much as a quarter of a foot, so that for a very accurate determination even a year is not sufficient.

The plane of mean sea level is a most important one, since the changes in this plane as related to fixed bench

marks on shore measure the relative changes in the emergence or subsidence of the land mass. Now, if observations extending over a year determined accurately mean sea level, the difference in this plane as between two years would measure the rate of change in this relative elevation. But it is not quite so simple; for mean sea level is subject to a long period variation upon which further study is required.

The principal tidal stations of the Coast and Geodetic Survey are so placed as to be representative of the region and to furnish tidal control for these regions. In addition to serving this purpose the records from the gages at these stations furnish the data for tidal studies, one of the most important of which is mean sea level and its changes. Continuous observations covering a number of years bring out the changes in mean sea level, thus furnishing data for a quantitative determination of relative changes in elevation of land and water.

Tidal Observations and Reductions

It is not the purpose of this paper to enter into the details of the methods used in securing and reducing tidal observations. The improvements introduced in recent years have had two aims—increase in accuracy of determination with the view to the use of results for scientific and technical, as well as for practical purposes; and decrease in the time necessary for computation. The former is being sought by improvements in the staff used for comparison with the tidal marigram by the securing of an absolutely fixed zero of staff, and frequent inspections of tidal stations connecting by spirit levels all bench marks with the tide gages at frequent intervals. In the matter of computations, improved forms tending to shorten labor and, wherever possible, the employment of graphic means of securing desired results have been devised.

The methods employed in reducing tidal observations may be grouped under two heads: Harmonic and Non-harmonic. By the harmonic method the tide wave is decomposed analytically into a number of constituent simple harmonic waves, the periods of which have astronomical definitions, while the amplitudes and phases are derived from observations. The results of the harmonic analysis are made use of by the United States in its predictions of tides. The non-harnomic is essentially a statistical method, by which the tides are tabulated for any desired argument.

The finished products of the tidal work for the use of the engineer and mariner appear in several forms: In the tide tables which foretell the state of the tide for any future time; in publications on tidal bench marks, which definitely fixes for the engineer the various datum planes over all the coasts of the United States, and in other publications devoted to a detailed study of the tides and tidal phenomena of the various ports of the country.

Newark Municipal Ownership Vote Invalid

The Supreme Court of New Jersey has declared invalid the referendum vote in Newark, N. J., in November, 1920, for a municipal light, heat and power plant. The ground for the decision is that the question on the ballot did not make clear whether the voters favored a heating, a lighting or a power plant or two of them or all three. The court gave no opinion on the constitutionality of a referendum on municipal ownership under the State home rule act of 1917.

Comparative Road-Building Costs

The cost of road construction today, according to an address before the Boston Society of Civil Engineers by Arthur W. Dean, chief engineer, division of highways, Massachusetts, averages about six times greater than that of thirty years ago. Several conditions have led to this increase. In the old days of horse-drawn vehicles, a road surface 15 ft. wide was considered adequate on all suburban roads, and in many cases a surface 12 ft. wide was sufficient. The same roads today need surfaces at least 18 ft. wide, and in many instances 24 ft. The minimum width constructed anywhere today is 15 ft. On main through lines of travel where the number of vehicles per day is sometimes as high as 3,000, the width, according to Mr. Dean, should be at least 20 ft., with a sufficient width of suitable shoulder to make an aggregate available width in emergencies of 26 ft.

On the road between Worcester and Springfield, Mass., a large amount of reconstruction has been carried on during the present year, and the width, in this case, of hardened surface has been made 20 ft. with the foundation carried out 3 ft. on each side to permit future further widening without great expense.

Another reason for the increased cost, Mr. Dean pointed out, is the necessity for improved permanent surfaces, and still another is the necessity for more adequate foundation. Where in 1895 a waterbound macadam might be built for approximately $6,000 per mile, a cement concrete or other equally strong surface and suitable foundation cost in 1921 about $40,000 per mile. In 1921 a fair average cost of a bituminous macadam surface 18 ft. wide, consisting of 4½-in. base course and a 2½-in. penetrated upper course, exclusive of all expense except the construction of pavement above the foundation was about $3 per square yard. The cost of reinforced cement-concrete surface as compared with the above is about $3.05 per square yard. Costs of construction gradually decreased during the year 1921, and the outlook, as seen by Mr. Dean, is that with this decrease in cost and with the increased use of machinery the expense of road construction in 1922 will probably be less than it has been for several years.

Thumbnail Review of 1921 Railroad Finances

Financial results of operation during 1921 of the 201 Class One railroads in the United States, as reported to the Interstate Commerce Commission, are announced by the Association of Railway Executives as follows: Net operating income was $615,625,619, which was at the annual rate of return of 3.31 per cent on their tentative valuation. This net income hardly more than covered their interest charges and rentals alone, these items amounting to $603,000,000 in 1920 and somewhat greater than that in 1921. Fifty-four railroads, consisting of 26,022 miles of track, had operating deficits in 1921, these deficits totaling $29,114,000. In 1921, operating revenues totaled to $5,569,888,000, a decrease of 10.6 per cent compared with the total in 1920. Operating expenses for the year amounted to $4,602,425,000, which was a decrease of 21.1 per cent compared with the year before. Tabulations showed that $2,019,985,000 were spent for maintenance, 23.1 per cent less than in 1920.

Railway Curves: Superelevation and Maintenance—I

Editorial Review Shows Variations in Practice and Opinion—Influence of Modern Locomotives —Relations of Curvature to Gage and Grades—Checking and Marking

By E. E. R. Tratman
Associate Editor, *Engineering News-Record*

IN RAILWAY PRACTICE, curves have not only an important relation to location but a still more important relation to operation and maintenance, since they introduce complications regarding train resistance, load, speed and safety, while they are also the direct cause of increased cost and work in track maintenance. Much improvement has been effected during recent years in reducing the amount of curvature and eliminating specially sharp curves, but this work has applied largely to excessive or extreme conditions and has not reduced the problems of curve maintenance and operation to any great extent.

Curves in railway track affect the economy and comfort of train service and the economy of track maintenance to a large degree. Further, they represent a goodly proportion of railway mileage. Curve problems and curve work have always had a special attraction for the engineer and the accompanying article presents a comparative review of the practice of some 28 railways in regard to various curve details.

It has been estimated that under ordinary traffic conditions the operating cost is increased by $1 per degree of curvature per daily train per year, and that each 12 deg. of curvature per mile adds 1 per cent to the labor cost of maintenance. These prewar figures would be too low at the present time, but they serve to indicate the financial relation of curvature to operating and maintenance. Wear and maintenance expense are assumed generally to increase directly with the central angle of curve, but investigations noted in the "Proceedings" of the American Railway Engineering Association for 1919 (p. 754) indicate that they increase as the square of the curve.

As compared with tangent track there is greater wear and displacement of rails, fastenings, ties and ballast, due to the lateral pressures exerted by the wheels, so that track material has a shorter life and maintenance work is required more frequently. Further, there is the problem of keeping curves in such condition that fast passenger trains will ride easily around them and slow freight trains will not be subject to excessive curve resistance.

Various aspects of railway curves in relation to train operation and track maintenance are dealt with in the present article, with a review of variations in practice as illustrated by information from a number of railways.

Curve elevation, or the superelevation of the outer rail on curves, is introduced to counteract the centrifugal force of trains, to relieve the rails of wear and lateral pressure, and to give a safe and easy riding movement of trains passing through the curve. But as centrifugal force varies with the speed, and trains of various speeds traverse the curve, the adjustment of superelevation to suit both high and low speeds must be a matter of compromise. Practice in the superelevaton of track curves is based largely on old time theories and tests, modified by experience under modern conditions, so that in many cases it is little more than "rule of thumb."

Since the amount of elevation for any specific conditions of speed and curve may be determined by calculation, the matter is apt to be regarded as a definite mathematical problem capable of being solved by established formulas. In fact, recent inquiry as to whether present practice is satisfactory brought some replies to the effect that established formulas are as applicable now as at any previous time, since they are based upon scientific principles which do not change. One reply stated specifically that the rules are entirely efficient and satisfactory for present locomotives and present train speeds because: "the superelevation is governed by the correct mathematical formulas and it is the speed which governs the superelevation."

Theoretically this is true, but the problem is affected by many practical conditions and by the existence of varying conditions at any one point, so that mathematical solution at best can be no more than a guide or indication. That this is the case is evidenced by the variety in practice as to superelevation, by the changes made from time to time in an attempt to obtain better results, and by numerous examples of unsatisfactory experience.

Speed is one of the governing factors in the calculation of superelevation. But no curve is operated under conditions of a single rate of speed, since fast passenger trains, local passenger trains, tonnage freight and slow drag freight trains may all operate on the same track, and perhaps in both directions on that track. There is no rule or principle or line of scientific reasoning by which the most economical and suitable superelevation can be computed when diversity of traffic and variable speed enter into consideration.

In direct opposition to the views quoted above endorsing the sufficiency of mathematical solution of the problem is the following statement by the engineer of a large road: "Speed of trains being the principal factor in determining the proper superelevation it is impossible to arrange the track to meet all conditions of traffic. For this reason we do not adopt any universal practice on a theoretical basis, but treat the matter in a practical way based on experience in order to secure the best results under the varying local conditions."

Multiple tracks which provide for separation of fast and slow trains and of passenger and freight traffic will simplify the conditions. But such trackage exists on only a small proportion of the railway system, and even there the variable conditions are merely reduced and not eliminated.

Where passenger traffic is the more important, a high speed factor may be used, but even so, the elevation

must be limited to an amount which will not injuriously affect freight trains. Further, the location of the curve may enter into consideration. Thus, even on a double track high-speed line, the actual speed on a curve near the top of a long grade or near a station will be considerably lower than on a curve located along level ground or on a descending grade. A derailment due to elevation too low for the speeds allowed was noted in *Engineering News-Record,* Feb. 26, 1920, p. 433.

From these brief statements as to actual physical and operating conditions, it is evident that the selection of superelevation for any particular curve must be necessarily a compromise, and that judgment based on observation and experience is fully as important as the mathematical calculation which may support this judgment. One of the great difficulties for men in charge of track and maintenace of way is the selection of a compromise figure which will give reasonably satisfactory results under extreme or opposite conditions.

Length of engine wheelbase is not a factor in the mathematical calculation, but it has proved to be a troublesome factor introduced in some cases by new equipment. Although most of the engineers whose opinion was asked have replied briefly to the effect that the rules are satisfactory in regard to modern equipment, two cited difficulties arising from the use of new and large locomotives, as noted later. It seems probable that further and more detailed inquiry would result in showing that similar difficulties have been experienced on many individual divisions or engine districts. Further, with heavier locomotives the wear and maintenance will be increased.

That superelevation tends to be in excess of the amount needed is indicated by several replies, some engineers advocating marked reductions from present practice. Another practical condition noted is the tendency of speed to increase with superelevation. In other words, on a curve elevated for a certain speed, enginemen who find that their trains ride easily are apt to increase the regular speed. Higher speed being noted by the track officials, increased superelevation is introduced. Slow orders or speed restrictions may be issued but it is useless to burden the engineman with many such orders, and it is obvious that these are not and cannot be obeyed with any exactitude in train service by night and day, in clear weather and in storm.

Lack of Modern Tests

In relation to this matter of the sufficiency of present rules for curve elevation, inquiry was made as to recent studies of their efficiency under modern conditions of equipment and traffic. The most definite replies were to this effect: There has been no intelligent or thorough study or analysis of the present situation, and there are no recent reliable data on the subject.

No recent tests or investigations are noted by any railway, but reference is made to textbook formulas and to the routine observations as to the riding qualities and rail wear of curves. Nor do any roads contemplate changes in their practice, according to the replies to a specific inquiry on this point.

Lack of uniformity in opinion and practice is shown clearly by a study of the curve elevation rules and tables used by a number of railways, all these lines operating both fast and slow trains. From this comparison it is apparent that for the same given conditions of speed and curvature there are variations of from 50 to 100 per cent in the superelevations specified.

Of twenty-four railroads, nineteen issue tables giving the superelevation for different combinations of curve and speed; one uses a diagram, several give formulas and two use a system of ordinates. Only two state that they follow the recommended practice of the American Railway Engineering Association but others practically conform to it. Where a table is issued it is almost invariably for general application, but at least one road has a series of tables adapted to the conditions of different divisions or portions thereof.

Examples of the variations in practice, as shown by several tables, are given below:

A. *Range in Curvature.*—As a rule the list of curves begins with 1 deg. and increases by 1 deg. increments, but in some cases it begins with 0.5 deg. In several tables there are half-degree interpolations for the flatter curves and in a few cases these interpolations vary by quarter-degrees. Two roads carry the table only to 8 deg., three carry it to 12 deg., four to 15 deg., five to 20 deg., and one each to 25 and 30 deg.

B. *Range in Speed*—The speeds listed in the superelevation tables show a wider difference than the curvature, the number of speeds given ranging from five to thirteen. Usually they begin with 10 or 15 m.p.h., sometimes 20 or 30 m.p.h. on large trunk lines, and continue by increments of 5 or 10 m.p.h. to a maximum of 60, 75 or 80 m.p.h. In one case the limit is 100 m.p.h., but this is on the diagram mentioned above and is merely an arbitrary limit for plotting the diagram, since this is not specially a high-speed road.

C. *Range in Increase of Elevation*—Of sixteen railroads, six increase the elevation by increments of ⅛-in., six by ¼-in. and four by ½-in. In the first case the tables are lengthy, since there is a change with nearly every increase of curvature, but where the larger increments are used the same superelevation applies to groups of curves. In view of the extreme variation of actual speeds at any one curve, it is a question whether the ⅛-in. variation is necessary or useful. Further, doubt has been expressed as to whether such close measurement or refinement is maintained in actual practice. On the other hand it is included in the recommendations of the American Railway Engineering Association.

D. *Range in Maximum Elevation*—In maximum superelevation prescribed, the range is from 6 to 9¾ in. A number of roads use 6 in. for 25 m.p.h. on 15 deg. curves to 60 m.p.h. on curves of 3 or 4 deg. Two roads use 7 in. for 45 m.p.h. on 5 deg. and 55 m.p.h. on 4 deg. curves. Four roads use 8 in. for 40 m.p.h. on 8 deg., 50 m.p.h. on 5 deg. and 70 m.p.h. on 2½ deg. Two roads specify 9 in. for 40 m.p.h. on 8 deg. and 80 m.p.h. on 2 deg. Finally, one specifies 9¾ in. as its maximum, this being for 75 m.p.h. on 3 deg. curves. The American Railway Engineering Association gives 9½ in. for 60 m.p.h. on 4 deg. curves, but recommends that "ordinarily an elevation of 8 in. should not be exceeded."

With all allowance for difference of speeds, loads, grades and operating conditions on different railways, these wide variations in maximum limit of superelevation appear to indicate divergent opinions rather than scientific deduction or operating necessity. Some roads specify that where speeds are such as to require elevations (as determined by rule) in excess of the prescribed maximum, the speeds must be reduced. It is of interest to note here that several engineers consider present elevations are excessive, but this applies to the ordinary

run of cases rather than to those which require the maximum elevation.

Summary of Variations—To illustrate more clearly the extreme range of practice in regard to superelevation under similar conditions, the accompanying table has been prepared from the tables issued by fifteen railroads. This table shows the range of elevations

TABLE OF VARIATIONS IN CURVE SUPERELEVATIONS

Speed, Miles per Hr.	1 Deg. In	3 Deg. In	5 Deg. In	10 Deg. In	15 Deg. In
20	½ and ¾ (2)	¾ to 1 (4)	1 to 1½ (4)	2 to 3 (5)	3 to 4½ (6)
30	¾ to 1 (5)	1½ to 2 (4)	2 to 3½ (4)	4½ to 6¼ (6)	
40	1 to 1½ (4)	2½ to 3½ (6)	4 to 5½ (5)	6 to 8½ (2)	.....
50	1 to 2 (6)	4 to 5½ (5)	6 to 8½ (4)	.....	.....
60	2 to 2½ (3)	6 to 7½ (4)	.....	.....	.....

prescribed by different roads for the same combinations of speed and curvature. The figures in parentheses indicate the number of different elevations for each combination.

For example, for a speed of 40 m.p.h. on a 5 deg. curve, there are no less than five amounts of superelevation prescribed, ranging from a minimum of 4 in. to a maximum of 5¾ in. These several amounts are 4, 5⅛, 5½ and 5¾ in. For 30 m.p.h. on 10 deg. curves, these fifteen railroads have six different elevations, ranging from 4½ in. to 6¼ in. Further, for such easy conditions as 30 m.p.h. on a 1 deg. curve, there are five different elevations ranging from ¾ to 1 in. As noted above, it is probable that on different curves for which a theoretical elevation of 3½ in. is prescribed, the actual elevations on individual curves will be more nearly 3 in. or 3¼ in. For side tracks, maximum elevations of 1 in. and 2 in. are specified.

The string and ordinate system of determining superelevation is prescribed by two roads, according to the following rule: "Superelevation of outer rail on curves shall be the length, in inches, of the middle ordinate of a string or chord equal in length to the distance, in feet, traversed in one second by the average express train." The elevation must not exceed 8 in. in one case and 7½ in. in the other. Other roads also specify this method for cases where the degree of curve is not known, the chord lengths prescribed in two cases being as follows:

32 ft. for 20 m.p.h.	64 ft. for 40 m.p.h.
40 ft. for 25 m.p.h.	72 ft. for 45 m.p.h.
48 ft. for 30 m.p.h.	80 ft. for 50 m.p.h.
56 ft. for 35 m.p.h.	

Here again there is diversity of practice. One road specifies the middle ordinate of a 60-ft. chord or twice the middle ordinate of a chord of 43 ft. 8¾ in. Another varies the rule according to class of track, as follows: (1) Main passenger tracks, curves under 2 deg. to have an elevation twice the middle ordinate of a 62-ft. chord or string, adding 2 in. to this amount for curves of 2 deg. and over; (2) main freight tracks, three-fourths of the ordinate as above; (3) combination tracks, the full length of middle ordinate.

Four formulas for determining superelevation on curves are given by different railways. In each of these as given below, E = the elevation in inches.

1. $$E = \frac{S^3 \times D}{1450},$$

S is speed in miles per hour, D is degree of curve and 1,450 is a constant.

2. $E = 0.00066\ DV^2$, where D is degree of curve and V is speed in miles per hour. Three roads use this, and it is recommended by the American Railway Engineering Association for ordinary practice.

3. The same as No. 2 but with 0.0007 as the figure.

4. $$E = \frac{GV^2}{32{\cdot}2\,R}$$

Here G is distance between centers of rails, V is speed in feet per second, and R is radius of curve in feet.

On curves having spiral easements or transition curves at the ends, the superelevation is made gradually on the spiral, so as to reach full elevation at the main curve. In some cases it is provided, however, that where the length of spiral is insufficient for this, the superelevation may be divided equally upon the tangent and spiral, or simply extended as far as necessary on the tangent.

For compound curves, other than spirals, it is usual to prescribe full elevation on the entire length of the main curve or curve of greatest degree, and then to reduce the elevation gradually to the amount required for the curve of less degree. While one road says simply that this reduction is to be made "gradually," others specify rates of ½ in. in 30 ft., ½ in. in 33 ft. and 1 in. in 40, 60 or 67 ft. If a spiral is used in connecting the two parts of a compound curve, the reduction must be made on the spiral. Such spirals are required by some roads when the change in rate of curve exceeds 1 deg. or 2 deg. In one case, the length of this spiral is required to be such as to increase the superelevation at the rate of 1½ in. per second for the speed for which the curve is elevated.

Runout of Superelevation

For simple curves, without transitions or spiraled ends, the practice on twenty-two railroads is to give full elevation for the entire length of the curve, and to run it out to normal elevation on the tangent. Two roads provide for only half the elevation at *PC* and *PT.*, the runout being divided equally upon the curve and tangent with a rate of 1 in. in 60 ft. In general, the rate of runout is ½ in. per 33 ft. or per rail length, but some roads vary this from ½ in. to 1 in., according to speeds. Other specified rates are 1 in. in 40, 50, 60 and 75 ft. Still others are as follows:

A. Runout varies as degree of curve and cube of speed; 100 ft. for 50 m.p.h. and 1 deg. curve.

B. Runout 50 ft. long for 1 in. elevation and increasing by 50 ft. to 300 ft. for the maximum 6-in. elevation.

C. Up to 3 in. elevation the runout is ½ in. per 30 ft.; for higher elevations the length is not to exceed 360 ft.

D. Rate of runout equals 1½ in. per foot per second, taking the velocity in feet per second for which the curve is elevated.

Runout for spiraled curves has been noted above under the heading "Spiral and Compound Curves."

A difficulty which, as a rule, must be overcome arbitrarily and to suit local conditions, is that of providing runout for superelevation of reverse curves or of curves separated only by short tangents. Reverse curves in main track are prohibited by some roads. To eliminate the condition of short tangents, one road has made a point of substituting one long curve for two short curves or of separating the curves so as to provide each with suitable spirals and corresponding runouts.

In one case the rule is to divide the short tangent into two parts, in proportion to the degrees of the curves which it connects, the longer portion being adjacent to

the sharper curve. At this dividing point the track is level transversely and the runout is made in each direction, extending onto the curves as far as may be necessary. The rate of runout varies from ½ in. in 30 or 33 ft. to 1 in. in 30, 40 or 50 ft. For reverse curves, having no intermediate tangent, the runout is made in both directions from the point of reverse. Some roads reply simply that such conditions are matters for local study, or that superelevation is reduced in order that a proper runout can be secured. Two rules mentioned are as follows:

A. Between curves provide a stretch of level track equal to the length of the longest passenger car. A modification of this rule provides a fixed length of 30 ft.

B. When both curves are in the same direction, maintain the superelevation on the short tangent.

Selection of Superelevation

For individual curves the superelevation is prescribed usually by the engineer of maintenance of way, division engineer or roadmaster, due regard being given to the speed of trains, the adjacent profile and alignment and the local operating conditions. The necessary instructions are then given to the section foreman, who sometimes is provided with a list of all curves on his section, showing their degree and superelevation.

The difficulty of thus selecting the elevation which will best suit the particular curve is indicated by the fact that several railways issue instructions to the effect that if there are indications of excessive or insufficient elevation, the necessary adjustment in elevation of rail or speed of train will be recommended by the roadmaster or engineer. Instructions as to changes in elevation made necessary by alterations in train schedules or speeds are issued by the engineers. In many cases a record of the approved superelevation on all main track curves is kept by the engineering department.

(To be concluded)

Interstate Water Supply Certification

Of the 3,102 sources of water supply of interstate carriers (railway and steamship) on records of the United States Public Health Service for certification, 1,309 or 42 per cent were certified as satisfactory by the Service during the year ending June 30, 1921; 339 or 11 per cent were certified provisionally; 143 or 5 per cent were classed as polluted; and no rating was made for 1,311 or 42 per cent. The reason for leaving so many sources unrated, according to the 1920-21 report of the Surgeon-General of the Public Health Service, was "lack of personnel and appropriations in the Public Health Service and the various state health departments." This control rests primarily with state health departments, where such exist and are qualified for the work, the Public Health Service marking the state reports as favorable or unfavorable. The country is divided into nine sanitary districts, each in charge of a sanitary engineer of the Public Health Service. The certification extends to any carrier line which, in connection with one other carrier makes it possible for a person to travel "without unnecessary delay from one state to another." Of the 3,102 sources of supply already mentioned, the ownership of 1,950 is municipal, 413 private and 739 railroad.

Local Pit Road-Graveling Costs and Performance

Outfit Described—Performance Recorded in Terms of Delays and Output—Costs Include Overhead and Camp Expenses

By J. A. Prior
Highway Engineer, Red Wing, Minn

A ROAD-GRAVELING outfit was operated last year in Goodhue County, Minnesota, under conditions which give the cost and performance records a representative value not often presented by such figures. In 1921 the county had two jobs of road graveling aggregating 24.5 miles. A total of 31,394 cu.yd. of gravel from five pits was loaded. Of this volume, 22,749 cu.yd. from four pits were screened and pebbles over ¾ in. were crushed. The remaining 8,645 cu.yd. was pit run. The



MAIN EQUIPMENT OF PORTABLE GRAVEL PLANT

operating season was from April 15 to Dec. 31, and during this period the plant was moved four times, two moves of 6.5 miles each, one move of 9 miles and one move of 30 miles.

A camp was established at each location of the plant. Its equipment was one 24-man cook car, a 32-man bunk car, a water wagon and a Ford service car. To take the gravel from the pit to the screens and crusher there were one double-drum 40-hp. hoist, with mast and cable, a 20-cu.yd. bin and slide, a 1-cu.yd. drag bucket and a 500-gal. water wagon. The screening and crushing equipment comprised a ¾-in. shaking grizzly, a 9 x 13-in. jaw crusher, a bucket elevator, and a 40-60 gas tractor. Power for the grizzly was taken from the upper shaft of the elevator. The screen and crusher had a capacity of 30 cu.yd. an hour, with gravel running 25 per cent over size. At the pits worked the oversize stones varied from 25 to 35 per cent. The hauling was done with eight 3½-cu.yd. army trucks with 3-cu.yd. dump bodies and hoists. There were also a 500-gal. gasoline tank on wheels and a supply car containing truck and repair parts having an inventory value of $2,998. A field shop was provided with a welding outfit, hand wall-drill, forge, engine stand and hand tools, inventoried at $1,031.

In explanation of the costs given in Table I, it may be stated that the camp is self supporting as to food, service and upkeep. Interest and depreciation are charged under overhead as rent of camp equipment at $2 per day. They are apportioned, as are all joint expenses, as follows: loading, 40 per cent; hauling, 40 per cent; and screening and crushing, 20 per cent. The county carries its own accident insurance, settling with

TABLE I—FORCE ACCOUNT COST OF GRAVELING ROADS IN GOODHUE COUNTY, MINNESOTA, FROM LOCAL PITS WITH A PORTABLE PLANT

	Amount	Per Cu.Yd
Loading:		
Labor, engineer, fireman, foreman, etc	$1,498.23	$0.108
Oil and grease	75.85	0.002
Coal, 148 tons	1,501.04	
Hauling by trucks @ $2.50 per hour	357.75	
	1,858.79	0.058
Water, labor, team	587.15	
Gas and oil	88.02	
Repairing, pump and engine	48.80	
	723.97	0.024
Moving	2,250.68	0.072
Repairing, hoist engine:	149.33	
Bin and slide	380.44	
Mast, cable and sheaves	122.35	
Miscellaneous	114.67	
	766.79	0.025
Depreciation, hoist engine	670.00	
Bin	134.00	
Bucket	67.00	
Mast, cable and sheaves	134.00	
	$1,005.00	0.033
Overhead, superintendence	508.79	
Timekeeper	692.10	
Rent of camp equipment	242.25	
Rent of camp grounds	38.80	
Rent of shop and supply cars	26.30	
Insurance	28.00	
	$1,536.24	0.048
Total loading	$11,615.55	$0.370
Screening and crushing	$944.77	$0.042
Gas	320.98	0.014
Oil and grease	1,549.38	0.068
Labor	562.67	0.024
Moving	735.00	
Depreciation tractor	210.00	
Screen	1,050.00	
Rock crusher, elevator	$1,995.00	$0.088
Overhead, superintendence	254.40	
Timekeeper	346.06	
Rent camp equipment	121.14	
Rent of camp grounds	19.40	
Rent of shop and supply cars	26.30	
	$795.30	$0.035
Repairing, tractor	$331.09	
Screen	116.71	
Rock crusher and elevator	197.13	
	$644.93	$0.028
Total screening and crushing	$6,813.03	$0.299
Hauling:		
Gas	$3,609.58	$0.049
Oil	922.21	0.012
Grease	214.00	0.004
Labor, drivers	4,579.50	0.059
Truck parts	2,369.25	0.033
Truck supplies	355.95	0.006
Repair labor	1,138.05	0.015
Depreciation @ $0.10 per mile	4,870.00	0.066
Overhead superintendence	1,326.76	
Mechanic	1,497.35	
Timekeeper	692.10	
Rent of camp equipment	242.25	
Rent of camp grounds	38.80	
Rent of shop and supply car	228.17	
Insurance	14.00	0.041
Total hauling	$21,087.97	$0.285

the claimant under the Workmans' Compensation Act of Minnesota. The amount paid out has not exceeded $100 in any of the last five years. The insurance for 1921 was $70 as against $1,322 which would have been the premium on the total county pay roll for liability insurance. The cost under "timekeeper" includes his wages and the upkeep, depreciation and operating cost of a car.

The cubic yard-mile consumption was:

Gas	0.2317 gal.
Oil	0.0553 qt.
Grease	0.0171 lb.
Driver's time	0.1110 hr.

Loading, screening and hauling performance was:

Loading and Screening, Performance Records

	Hr.	P.C.
Time working	1,337	61.6
Time delayed for weather	414	19.1
Time delayed for repairs	48	2.2
Time delayed for moving	371	17.1
Total time, 217 10-hr days	2,170	100.0

Monthly Average Outputs		Cubic Yards per Day	
April	130	Sept.	210
May	297	Oct.	200
June	250	Nov.	238
July	230	Loading only	
Aug.	220	Dec.	326

Average for working time, 234 cu. yd. per 10 hr

Hauling Performance Records

	Truck Hours	P.C.
Time working	8,274	47.8
Time delayed for weather	3,178	18.3
Time delayed for repairs	2,884	16.5
Time delayed no driver	66	0.3
Time delayed for moving	2,601	15.3
Time delayed for gravel	357	1.8
Total time, 217 days	17,360	100.0

Monthly Average Output per Truck per 10 Hours, Cubic Yard-Miles

April	66.6	Sept.	95.6
May	87.3	Oct.	96.8
June	78.8	Nov.	100.8
July	88.9	Dec.	90.2
Aug.	92.3		

Season's average, 90.3 cu.yd.-mi. per 10 hours
Season's average length of haul, 2.5 miles

German Sewage-Works for Houses and Public Buildings

By Karl Haller
Doctor of Engineering, Langenau in Württemberg, Germany

In Germany, and especially in Württemberg, the official regulations and measures for the protection and furtherance of public health are stringent. This applies especially to water supply and sewage disposal. For public buildings, such as concert and lecture halls, theaters, schools and hospitals, sewage treatment plants are always required. In towns, which have a flushing system, the sewage tanks are arranged for flushing with water. How this is done is quite simple. Small buildings, run on business lines, will be shown here by means of a few examples.

For connecting the sewage pipes from houses to the municipal sewer system in the town of Ulm, the so-called "Ulm tank" (Fig. 1) has been developed. For building such tanks for water closets, the municipal police issues the following regulations:

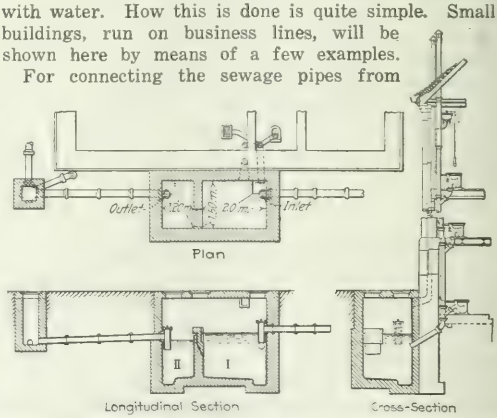


FIG. 1 TANK BETWEEN HOUSES AND SEWERS AT ULM

1. The size of tank [compartment] I is to be calculated so that for each inhabitant of the house 120 liters are allowed; minimum size, 2 cu.m. For tank [compartment] II half of the numbers for tank I are taken.

2. Normal depth of water is 1.20 to 1.50 m.

3. The water level in tank I is 20 cm. lower than in tank II.

4. Ventilation must be carried above the roof.

5. The width of overflow from tank I to II must be at least 50 cm.

6. The depth of immersion for supply pipes and effluent pipes as well as for overflow baffles is 30 cm. below the water level.

7. The tanks must be completely watertight, and must have sumps for emptying, and tightly fitting covers.

Fig. 2 shows a biological sewage purification plant [settling tank and percolating filter] for a lecture hall at Stuttgart. The building has space for 1,375 people, for whom there are provided 24 water closets, 4 urinals, and 22 m. of urinal wall. The daily flow therefrom is calculated as follows: 120 liters (29.7 gal.) each, for 5 persons in the janitor's building, 60 liters each for 70 persons in the janitor's staff and 6 liters each for the audience of 1,300, making a total of 1,260 liters (333 gal.) a day.

To clarify this quantity of sewage, tanks and a filter of the dimensions and capacity shown in the accompanying table were provided.

The sewage flows over a weir 0.80 m. wide to a digestion tank. An immersed baffle board, reaching to a depth of 30 cm. and extending 20 cm. above the water level, retains the floating scum. The digestion tank effluent passes to the percolating filter through main

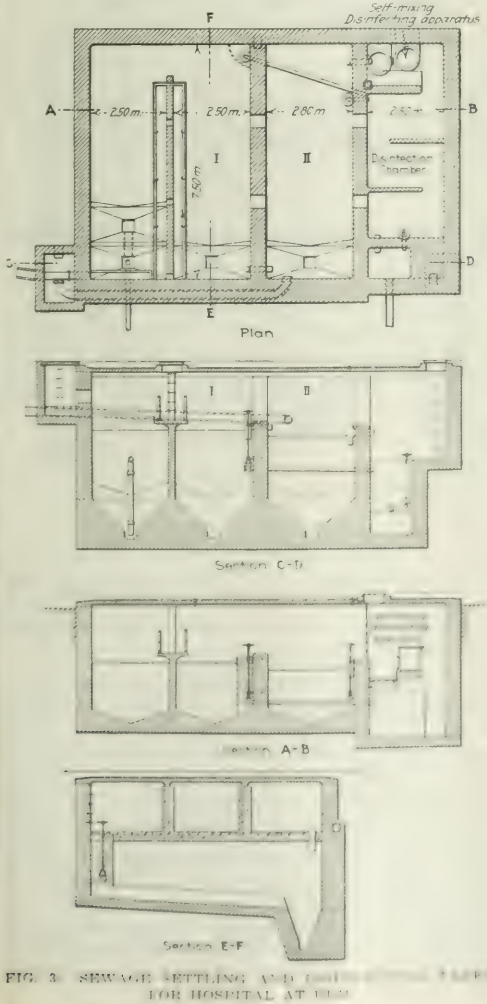


FIG. 3. SEWAGE SETTLING AND [illegible] FOR HOSPITAL AT ULM

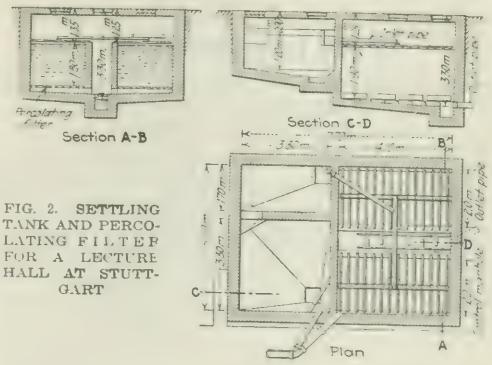


FIG. 2. SETTLING TANK AND PERCOLATING FILTER FOR A LECTURE HALL AT STUTTGART

and branch gutters. The main gutters are of channel iron, 14 cm. in width, 6 cm. in height, supported on pipe at intervals of 30 cm. and having their upper edge so adjusted as to give uniform discharge of the sewage along their whole length. The percolating gutters are

ELEMENTS OF SEWAGE-WORKS FOR STUTTGART LECTURE HALL

	Dimensions in Meters				
	Length	Width	Surface	Effective Height	Effective Capacity Cu.M.
Collecting tank	2.30	2.50	1.00	1.20	12.00
Digesting tank	3.30	1.70	5.61	1.20	6.73
Percolating filter	1.10	1.00	16.40	1.50	24.60

of L iron, into whose upper edges notches are filed at intervals of 5 cm. in such a way that percolation takes place uniformly along the whole length. The gutters are protected from rusting by a coat of paint.

The percolating filter, 1.50 m. deep, consists of slag and is provided below with a space for ventilating which can be washed out from a hydrant in the controlling manhole. In this manhole a disinfectant may be introduced if need be. The tanks and the percolation filter are provided with ventilation pipes.

Another plant, that of the hospital at Ulm built during the world war, is shown by Fig. 3. In view of the great danger of infection from hospital sewage, a constantly operating disinfecting device was necessary at this plant. In order to be able to put the digestion tanks out of commission alternately for cleaning or repairing, a circulating line to tank II is provided and equipped with a slide valve. The incoming sewage flows over an overfall into tank I, then runs slowly round the baffle wall, and then, after sedimentation of the floating scum, goes to tank II over a weir 0.2 m. long. After further clarification it runs through an exit, also 0.2 m. in width, at the opposite end of tank II, to the disinfecting apparatus in the disinfection chamber. The upper mixing tank is operated automatically. After four years of operation the plant has given entire satisfaction.

Definition of Ethics

Ethics may be defined as an expression of undivided principles of action for the guidance of the members of a group or profession in their relations with other members of the group, so as to insure as far as possible equity and justice to all.—Prof. H. E. Riggs before Michigan Engineering Society.

Concrete Dam 22 Feet High Built With Traveling Form

Timber Frame Spanning Site and Riding on Rails on Foundation Carries Steel Spillway Form by Adjustable Rods

IN CONSTRUCTING the concrete spillway in the earth dam for the new water supply of Danville, Ill., a steel form was suspended within and braced from a timber traveler, as shown in the sketch herewith. This spillway, 22½ ft. high above the foundation course, and 470 ft. long, was built in sections 18 ft. long, each section requiring about 250 cu.yd. of concrete.

The concreting of the spillway was divided into three stages. Alternate sections of the downstream apron were placed first and then alternate sections of the 6-ft. foundation course, this latter being 30 ft. wide and extending 2 ft. beyond the upstream face of the dam. Two longitudinal ribs on this base form a key with the body of the dam and a channel or recess forms a seat for the toe of the curved downstream face. The third stage was the pouring of the 18-ft. sections of the spillway. Vertical recesses 6 x 36 in. are provided to key the sections together. Two recesses in the top of the spillway (Fig. 2) will permit the hinged steel frames of the flashboards to be lowered during high water.

The steel form, 20 ft. long, is built up of plates and angles, each plate 1 x 5 ft. having a hole and cover piece so that tie rods may be placed in any desired number and position. More rods were used than are shown on the drawing. A wooden bulkhead at one end was held in place by 1-in. tie rods screwed into malleable iron sleeves attached to rods in the adjacent concreted section of spillway. Similar sleeves were used also on the 1-in. transverse tie rods between the front and back faces of the form. These sleeves were placed just inside the form, so that the short rods could be unscrewed and the holes filled with concrete or mortar. The tie rods pass through waling timbers on the outside of the form.

To carry this steel form, a traveler 30 ft. high and 32 ft. wide was built. Each side sill was carried by four 9-in. double-flanged wheels riding on a rail. These rails were spiked to timber stringers laid on the concrete base course, as shown. Suspension rods and brace rods with adjusting ratchets hold the form in position, the concrete toe being secured also by a waling timber fitted to anchor bolts embedded in the concrete base.

This steel form was designed by the Blaw-Knox Co., Pittsburgh, Pa., for L. N. Cope & Son, Decatur, Ill., the contractors for the dam. The consulting engineers are Pearse, Greeley & Hansen, Chicago, with J. Albert Holmes as chief engineer in charge of the construction work.

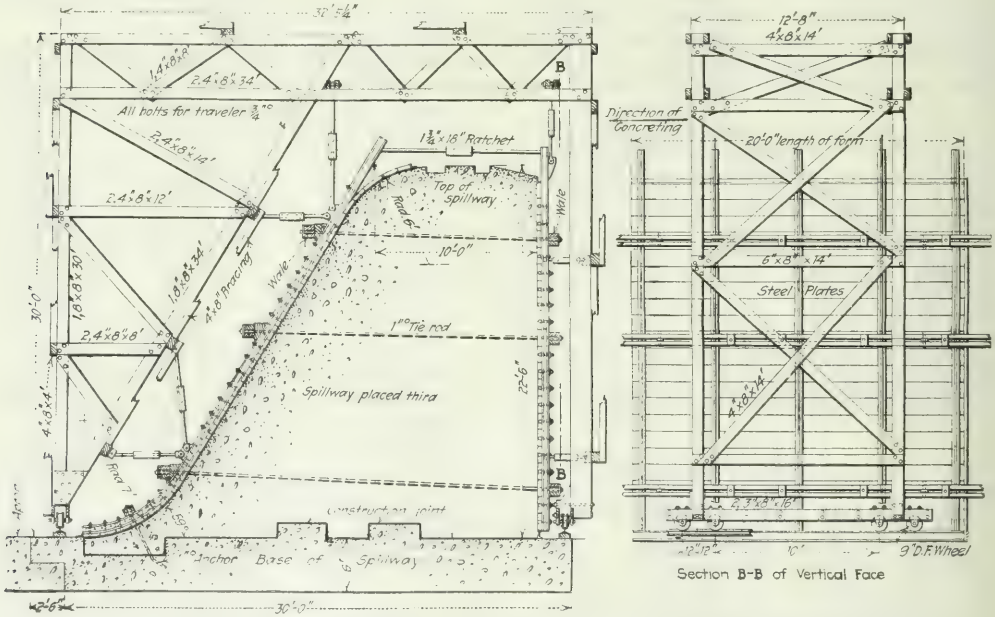


FIG 1 DOWNSTREAM SIDE OF TRAVELING FORM FOR CONCRETE DAM

A Detail of Road Foundations on Clay

In a discussion before a recent meeting of the Boston Society of Civil Engineers John R. Rablin, chief engineer, park division, Metropolitan District Commission of Massachusetts cited the following experience with road foundations: "We have found, where we have a clay subgrade, that if we lay crushed stone or a coarse gravel over it, before laying our macadam, in a few years, if we have occasion to excavate, most of the stone seems to have disappeared and the clay to have come to the surface or mixed with the stone. This action is probably due to frost and moisture. We have also found that by covering the clay with a layer of fine sand before putting on the coarse gravel or stone, it will prevent that to a large extent."

Ontario "Hydro" Condemned As Wasteful and Expensive

W. S. Murray Investigates Leading Government Owned Power System for the National Electric Light Association

AS a result of an investigation made for the National Electric Light Association and taking over six months' intensive work, W. S. Murray, electrical engineer of the firm of Murray & Flood, New York City, concludes that the Hydro-Electric Power Commission of Ontario, the leading example of a government owned utility on the continent, is inefficient, expensive and wasteful, and that notwithstanding all the claims made for it, service from private utilities in the United States and in Canada is cheaper. These conclusions are set forth at length in a 225-pp. book entitled "Government Owned and Controlled Compared with Privately Owned and Regulated Electric Utilities in Canada and the United States," which has just been published by the National Electric Light Association.

The report gives a brief history of the commission, outlines the development of the powers which have been given it, contrasts its operation with that of a private utility under government regulation in the United States, discusses the effect of the remission of taxes on the Ontario development, investigates fairly thoroughly the expense of the new Queenston-Chippawa development and the recently completed Nipigon development, outlines the peculiar rate method of the commission, and finally makes an elaborate comparison of the cost to consumer of power and domestic electricity in Ontario, in Quebec (where there is a large degree of government control but little government ownership), and in the private companies of the United States. The main conclusions of the report are given in the box which accompanies this abstract. The detailed information below is taken from the report.

The Hydro-Electric Power Commission of Ontario is a growth from a league of seven municipalities formed in 1907 to control the delivery of Niagara power to these municipalities. It has now become a commission acting variously as a public service commission, an engineering company, an electric utility company, a holding company, a construction company, a banker, a manufacturer, a supply dealer, and an underwriter's inspection bureau. It has exclusive jurisdiction as to all matters conferred upon it and nothing done by the commission within its jurisdiction is open to question or review in any action or proceeding or by any court. No suit can be brought against the commission without fiat from the attorney general, and to date no such fiat has ever been granted. Its investments now total nearly $200,000,000, the bonded indebtedness of which is guaranteed by the Province of Ontario. This amount in 1920 represented 70 per cent of the debt of the province itself. The commission, however, is independent of the government of Ontario, except that two of the three members may be and one of them shall be a member of the government. The chairman, Sir Adam Beck, however, has held his office through a succession of governments since the formation of the commission.

All property held by the government electric utilities in Ontario is tax free with the exception of that appli-

Abstract of W. S. Murray's Conclusions on Ontario "Hydro"

AFTER a careful analysis of the governmentally owned, controlled and operated electric utility structure as represented in the Hydro-Electric Power Commission of Ontario, I am of the opinion, first, that the principles of its application can find no place in the United States; second, that to attempt the substitution of its principles of control and operation within the States would not only be to strike a blow at economic structures the present existence of which is far better equipped to protect the public interests in their conjunctive relation with the public service commissions of the states regulating their rates, but it would also be to strike an equal blow at the shareholders of the electric utilities which are now serving the American public; and, third, that the Hydro-Electric Power Commission owes its being only to the fact that a public service commission on the order of those operating in that States was not in existence in the Province of Ontario at the time of its creation.

I support the above statement in the following conclusions:

Power as applied in Ontario from the governmentally owned and controlled system in associate relationship with the Hydro-Electric Power Commission to be superior in kind to that supplied by the privately owned electric utilities of the United States must be more adequate, more reliable and cheaper. The facts show, however, that the electric utilities of the States hold more power in reserve and sell more energy per capita served; that by that token they can claim a greater reliability of supply and that the supply is cheaper to the consumer.

At the end of the fiscal year 1920, out of the total power-plant capacity operated by the Hydro-Electric Power Commission only 23 per cent was constructed by the Hydro-Electric Power Commission. The remainder represents plant capacity constructed at the initiative and risk of private investors, and in acquiring ownership of it such intangibles as franchise rights, good will and other intangibles were included in the purchase. This intangible cost, therefore, is represented in power "at cost."

The building of new power-plant facilities under the auspices of governmental ownership, as shown in the cases of Nipigon and Chippawa, both in respect to policy and cost, is not to the economic interest of the people.

The advocates of government or municipal ownership of electric utilities claim reduction in the cost of power in virtue of (a) elimination of taxes, (b) elimination of dividends, (c) elimination of high-salaried executives, (d) more economical wage and higher efficiency in labor scale.

With regard to (a), taxes are not eliminated. Just as much money in taxes is paid. The difference is in their distribution. In the case of private ownership, only the users of service pay the tax bill, while in the case of government-owned utilities all the people pay the bill.

With regard to (b), (c) and (d), notwithstanding dividends, high-salaried executives and the wage and labor claim, the answer is that, when the total operations are summed up, the people receive the power at less cost through private ownership under regulation.

The Hydro-Electric Power Commission is the judge of its own acts. A commission cannot fairly be the judge of its own (and others') rights in contentions.

The American companies in the Niagara district are supplemented by steam power far more than those on the Canadian side, and yet on the American side power is being furnished at less cost to the people.

The commissions of the States fully realize that protection to the people lies in protection to the electric utilities from which they are receiving power. The authority delegated to them to regulate rates, and the constitutionality of the law standing behind any action on their part or on the part of the electric utilities, provides a structure constructively balanced to do justice to all parties.

rable to land, so that the effect of taxes on the apparent cost of power in Ontario is insignificant. With all of his computations, however, Mr. Murray has compared the cost of the government power with private power with the tax charge deducted from the latter. It is obvious that the taxes cannot be eliminated but are merely distributed to people in general rather than to the users of current.

The rate structure adopted by the commission is different from that used anywhere else. Each of the separate systems in the network has a power center. In the vicinity of that center the cost of power is a minimum. At the point farthest from the center, measured in transmission distance, the cost is maximum. Several systems overlap zones and power sold to a municipality from one system may be at a price more than 500 per cent higher than that sold to a municipality within the same zone but receiving power from another system. The commission uses an interim wholesale rate, which is an estimated rate to municipalities. At the end of a year a municipality is credited or debited, depending upon whether actual cost has been lower or higher. In every city, however, the individual consumer rate, that is the rate which the ordinary citizen has to pay for his house service, is low, though the power rates charged to the large user as a rule are higher than in comparable regions in Quebec or the United States. In the 1920 annual report of the commission the interim wholesale rates for 169 municipalities are given, while the actual wholesale rates paid can be computed for 174 municipalities. The highest interim wholesale rate that was quoted in this report was between $80 and $90 per horsepower year, while the highest actual wholesale rate paid per horsepower was between $150 and $160 per horsepower year. Altogether there were nine municipalities which paid a rate higher than the maximum interim rate quoted.

Public vs. Private Operation

The report has many pages of statistics comparing government owned and privately owned utilities. In Ontario the province owned in 1920 approximately one-half of its electric utilities, and of the total utility income two-thirds was derived from those governmentally owned, while in Quebec the government owned utilities representing but 4 per cent of the investment in that class of property receive about 5 per cent of the total revenue therefrom. The report shows that the cost of power to the entire people of the Province of Quebec and to the American Niagara district is less than to the people of Ontario. In respect to economic operation, as between governmentally owned and privately owned electric utilities in Ontario and Quebec, it is shown that the operating ratios between the privately owned and the governmentally owned companies indicate a much lower per cent for the former.

In the Niagara district of Canada it is shown that the government owned electric utilities furnish power at 9.25 mills per kilowatt-hour generated, the private electric utilities at 7.6 mills, and the weighted average of the two supplies is 8.78 mills. In the United States, for comparable zones supplied by Niagara Falls power, the average price of power to the consumer is 7.65 mills per kilowatt-hour generated. In the Province of Quebec, the average cost to consumer is 6.6 mills. The average cost of power, that is revenue per kilowatt-hour generated, for the American Niagara power district is about 17 per cent less than that for the total operations of the Hydro-Electric Power Commission and the municipal commissions for wholesale power delivered in the Canadian Niagara district, and it is about 13 per cent less than for all electric utilities in that district.

Comparing the average cost of retail power to the people residing within municipalities served by the Hydro-Electric Power Commission of the Niagara district, it is found that the average cost of power to the people in the American district is less by 4.45 mills per kilowatt-hour, or 40 per cent, and furthermore that the American district has a capacity per thousand of population 65 per cent in excess of that in Canada.

Other figures are given to show that the operating costs in "Hydro" are not as low per unit as in the privately owned plants.

A final chapter gives some cost figures on both Chippawa and the Nipigon developments. For the former, the largest hydro-electric power development in the world, it is stated that some confusion exists on its probable maximum output, which is variously estimated from 495,000 to 650,000 hp. Estimates and costs on this work have gone up steadily since it was projected in 1917. A number of reasons, mainly the effect of war increases and certain added expenses due to an effort to make increased speed last summer, are responsible for this. Mr. Murray shows that whereas the commission formerly purchased 100,000 hp. from the Ontario Power Co. at somewhat more than $9 per horsepower per year, the cost of power to the municipalities of Ontario from the Queenston-Chippawa development, *based on the diversion of water in accordance with existing international treaties*, will be $28.05 per horsepower year plus $9.40 for transmission from Niagara Falls to the municipalities, or $37.45 in all. With unlimited diversion of water the cost for power when the Queenston-Chippawa plant is constructed to a capacity of 275,000 hp. will be about $21.30. However, Mr. Murray shows that when the Queenston-Chippawa development is ultimately completed and is handling a load of 600,000 hp. based on the use of 20,000 sec.-ft., provided there is sufficient water available so that none of the capacities of the other power plants on the Canadian side need be closed, the cost will be $12.60 per horsepower year.

Abrasion Tests of Aggregates Disagree

Tests indicate that the type and per cent of wear of the aggregate has little influence on the compressive strength or wear of the concrete for pavements. In a recent series of investigations, by Prof. D. A. Abrams at Lewis Institute, of the abrasive resistance and concrete making properties of about 150 different samples of coarse aggregate, four methods of testing, for wear, the A. S. T. M., the Mattimore, the Rea and the Abrams, were compared. The A. S. T. M. method gave the lowest per cent in each instance. The Mattimore method gave about double the value by the A. S. T. M. method and the Rea method about double that by the Mattimore method. The Abrams method gave values which averaged about the same as the Mattimore method. The different methods did not give the same rating to the different types of coarse aggregate. The values for gravel by the A. S. T. M. method were absurdly low. It is difficult, states Professor Abrams, to draw any conclusions from these tests, except to suggest a grave doubt as to whether any of the tests has any significance when applied to aggregates for concrete roads.

ENGINEERING LITERATURE

An Unsatisfactory Compilation

REVIEWED BY F. W. SCHEIDENHELM
Consulting Engineer, New York City

HYDROELECTRICAL ENGINEERING. A Book for Hydraulic and Electrical Engineers, Students and Others Interested in the Development of Hydroelectric Power Systems by Richard Muller, Electrical Engineer. Formerly Consulting Engineer for the Government of Ecuador, S. A. New York, London, Leipzig and Paris: G. E. Stechert & Co. Cloth; 7 x 10 in.; pp. 431; 395 illustrations in the text; half-tone frontispiece and diagram on folding plate; 74 tables. $6 net.

The good in this book lies essentially in the matter which is made available from Continental sources and in a few detailed discussions giving evidently the results of the author's own work. It is regrettable that the author has not made more effective use of his apparent familiarity with the German and French and probably also the Italian languages, for the engineering profession would benefit greatly from a mere compendium of practice in the field of hydro-electrical engineering throughout the world, provided only that such a compendium were reasonably complete in scope, well-balanced and above all up-to-date. To these characteristics the compilation before us can not lay claim.

Briefly, the volume takes up hydrology, canals, pressure pipes, dams, turbines and other machinery, transmission lines, water-power economics, various existing developments and water-power legislation.

A foreign "accent" is evident in the diction and the text is replete with loose phraseology, inconsistencies and plain errors. Such faults could be overlooked if the essentials of a good compilation were present, if the further search and study of the reader were aided by suitable references to sources and if, conversely, those sources were given proper credit by reference.

Completeness of treatment of the subject would require much more extensive discussion of the storage of water against the needs of the peak load or of the dry season. A discussion of dams which purports to be broad should not omit mention and illustration of the multiple-arch type. The automatic and semi-automatic types of hydro-electric plants are too important, both in their present use and their still greater prospects for the future, to warrant their omission. The vertical-shaft type of generator, not mentioned in the section on Alternating Current Generators, is now the predominating type where reaction wheels are used, thanks to the perfecting of the vertical thrust bearing. The treatment of the latter, too, is inadequate.

The lack of balance is illustrated by the fact that about 50 pages are devoted to the subject of Pressure Conduits (including 9 pages of abstract from a French article analyzing elaborately a self-supporting penstock bridge), whereas to the subject of dams there are devoted only about 40 pages and to a chapter combining the Investigation of Water Power Projects and Economics there are devoted only about 20 pages. Yet in the preface the author assures us that he particularly had in mind, among other things, the needs of engineers reporting on the "commercial success" of hydro-electric developments. That no consistent program has been followed is evident from the casual occurrence of "problems" in Chapters III and VIII, and the fact that the discussion of operating methods is limited practically to the comparatively unimportant rotary-converter.

To show that the book is not up-to-date, one might point to the failure to mention the plunger type of hydraulic valves, or the newer and more efficient types of draft tubes or the far greater efficiencies obtained nowadays from the reaction turbine than from those indicated in the text. Perhaps the most glaring offender in this respect is Chapter IX, Description of Hydro-electric Plants. This touches lightly about 40 plants, of which about a dozen are European, with heads running to 4,600 ft. To be sure, the chapter is of some value to the novice and even to the experienced hydro-electrical engineer. However, the last seven years have been years of great progress in this field and no present work is complete without recording that progress. Yet in general the plants described in this chapter antedate 1914 and some even 1908. A welcome exception occurs in the case of extracts from a 1921 *Electrical World* article on the Queenston-Chippawa development of the Hydro-Electric Power Commission of Ontario.

The same chapter shows lack of references. Dates of design and construction are rare, whereas they should be the rule so as to inform the reader of what stage of the art the plant is contemporary and illustrative. Frequently throughout the book data and formula are given the impress of finality but without either derivation or reference to an authority. Even when the name of the authority is mentioned, there are often left in the reader's mind the questions: Who is he? In what year did he say it? Where is it to be found?

In the matter of giving credit to those who have contributed to the world's knowledge or literature data which are of sufficient value to be copied, this book is a glaring example of a lamentable tendency. Thus, Chapter II is largely from Hoyt and Grover's "River Discharge" and from Water Supply Papers 94 and 200 of the United States Geological Survey, mainly without credit. Mead's "Water Power Engineering," especially the first edition, is copied as to figure and text time and again, and apparently only in a single footnote is credit given.

In Chapter IV the author makes the nearest approach to justification for writing his book. Here, in treating pressure pipes, he includes considerable material from foreign sources and presents a number of helpful diagrams for the selection and design of riveted steel pipe. Much of this matter is evidently original with the author. Likewise his transmission line calculations are reasonably comprehensive and representative of modern practice. However, it is not believed that these and the all-too-few other good points to the author's credit are sufficient excuse for the book as a whole. One is left with the impression that it is a *potpourri*.

Vented and Unvented Traps

REVIEWED BY GEORGE C. WHIPPLE
Professor of Sanitary Engineering, Harvard University, Cambridge, Mass.

PLUMBING FIXTURE TRAPS—An Historical, Statistical and Experimental Engineering Research on Vented and Unvented Traps—By A. E. Hansen, Hydraulic and Sanitary Engineer, New York City: The Author, 2 Rector St. Cloth, 7 x 9 in.; illustrated

In view of the vigorous discussion of the use of the so-called non-vented, anti-siphon or re-sealing trap, especially since the war, this book is certainly a timely publication. Beginning with the introduction of the first plumbing fixtures in Longfellow's home in Cambridge in 1840 and quoting from Waring, Gerhard, and other well known sanitary engineers, the author gives abstracts from modern plumbing regulations and lists of cities where unvented traps are permitted and where they are not permitted. He describes the tests of the "Geco" or Cody trap which were made by the New York City Board of Standards and Appeals in 1918 at the Hallenbeck Building; and then takes up in detail the experiments made by himself at 366 West Broadway, New York City. The results of these experiments are given in detail and illustrated by many graphs. In general it may be said that the experiments showed up the Geco trap in a very unfavorable light. The author says that he does not believe that any anti-siphon trap can be made without mechanical features, or without disproportionate size, which will effectively withstand back pressures. He emphasizes the unreliability of tests made with clean traps and stresses the need of fouling tests. In conclusion, he makes a brief statement on the economic side of the problem.

Engineers who are interested in pending developments affecting plumbing regulations will do well to familiarize themselves with the subjects treated in this book.

Engineering Construction Cost Keeping

CONSTRUCTION COST KEEPING AND MANAGEMENT—A Treatise for Engineers, Contractors and Superintendents Engaged in the Management of Engineering Construction—By Halbert Powers Gillette, M. Am. Soc. C. E., Editor *Engineering and Contracting*, and Richard T. Dana, M. Am. Soc. C. E., Consulting Engineer, Chief Engineer Construction Service Co., New York and London: McGraw-Hill Co. Cloth, 6 x 9 in. pp. 572. $5

In its first edition ("Cost Keeping and Management Engineering," reviewed in *Engineering News*, Feb. 17, 1910) this book was probably the earliest attempt to enunciate principles of management of construction operations; to describe cost-keeping methods; to set forth the vital distinction between cost keeping and bookkeeping, and to correlate management and cost keeping. No book has superseded it in its particular field. The present edition contains all that made the first edition unique and some additional matter, particularly on cost-keeping systems in general and on cost keeping for highway construction. The new material on highway cost keeping is important in view of the great increase in this field of construction in the decade since the first edition of this book was published.

At the beginning of the volume the laws of management are defined and explained. The authors formulate eleven of these major laws and consume 42 pp. in presenting them. There follows in a second chapter 18 rules for securing minimum costs. Systems of paying labor, as, for example, piece rate and bonus systems, and methods of measuring output are next considered. Cost-keeping methods, cost forms and cost diagrams are given in the remaining six chapters. Notable chapters are the one on highway cost keeping, previously mentioned, and one on bookkeeping for small contractors.

Metallography and Metal Structure

STRUCTURE AND RELATED PROPERTIES OF METALS—Circular 113, U. S. Bureau of Standards. Compiled by Henry S. Rawdon, Physicist. Paper; 10 x 7 in.; illustrated. 25c from Superintendent of Documents, Washington, D. C.

Publications of ephemeral character sometimes prove to have more definitely the treatise or textbook character than that of a bulletin. Of the recent examples of this among government publications, Bureau of Standards Circular 113 is noteworthy. It covers the field of metallography and the study of metal structure by etching and microscopic examination in so excellent a form (though in extreme condensation) as to entitle it to a place with the best available treatises.

A subject such as the one here dealt with can hardly be treated in elementary manner. Correspondingly, this "Circular" is not a primer. For a real understanding of its contents the reader requires a large amount of preliminary and additional information. Yet the work is so written that it can be read with profit by engineers of many pursuits who have need of dealing with problems of metal qualities or defects.

The introduction states that the work is not intended to displace or parallel existing treatises on metallography, but to show the value of metallographic examinations for the investigation of metals. It does this, however, not by giving instances of what problems have been solved by metallographic examination, but rather by setting forth in some detail the methods of metallography and the general facts of metal structure revealed by it. It thus presents an up-to-date outline sketch of the entire subject, which the reader desirous of going deeper into the subject can supplement by outside reading at various points where incompleteness is indicated.

The chief value of the work, we believe, as well as its main purpose, lies in presenting an impressive argument for the cultivation and use of metal examination in the study of engineering and metallurgical problems. While this purpose could have been carried out even more effectively by fuller citation of cases from laboratory and field practice (at the risk, however, of making the book more bulky), the publication is to be recommended unreservedly to engineers as an ably written and authoritative outline of a subject with which, in the next generation, every engineer will require to be acquainted.

Belated American Edition

HYDRAULICS AND ITS APPLICATION—By A. H. Gibson, D.Sc., M. Inst., C.E., M. Inst., Mech.E., F.R.S.E., Professor of Engineering in the University of St. Andrews, University College, Dundee. New York: D. Van Nostrand Co. Cloth; 6 x 9 in.; pp. 813; 399 line cuts and half tones. $6.

In 1912, or four years after the appearance of the first edition of this British book, an enlarged edition was prepared by the author. The present volume, which was printed in Great Britain, appears to contain nothing more recent than the 1912 edition, except the title page. The first edition was reviewed, on the whole quite favorably, by Gardner S. Williams in the Engineering Literature section of *Engineering News*, Nov. 12, 1908, p. 535. In the preface to the second or 1912 edition the

author states: The "book has been practically rewritten," with some omissions and re-arrangement and "considerable additions" to "almost every section, particularly those dealing with flow over weirs, through pipes, and in channels *** A chapter dealing with wave motion has been added."

British Water Supply in the War

WORK OF THE ROYAL ENGINEERS IN THE EUROPEAN WAR, 1914-19—Water Supply: (1) France; (2) Egypt and Palestine. Chatham, England: Secretary, Institution of Royal Engineers. Cloth; 7 x 10 in.; pp. 87 and 64; halftones, line drawings, pen sketches and folding maps. 2s and 8 shillings respectively.

Thanks to progressive improvements in the water-supply of the British Expeditionary Forces in France and Belgium, unprecedented concentration of troops became possible. How this was accomplished is told in the first of these volumes.

Besides the elaboration of the water-supply staff, as a part of the Royal Engineers field service, salient features of the water supply development were: "semi-permanent and extensive systems of water supply, with headworks and pipe lines"; mechanical transport; purification plants; well-sinking outfits. Some of the purification plants were mounted on barges. Wallace & Tiernan chlorination plants on motor trucks were used.

In Egypt and Palestine methods similar to those used in France were employed, with variations due to local conditions. The latter included some of the primeval means of raising water.

Each volume contains much detail both as to plant design and field operation, extensively illustrated by halftones, line drawings, folding maps and, in the volume on Egypt and Palestine, by a goodly number of rough but serviceable pen sketches.

Ship Loading and Dispatching

WHARF MANAGEMENT, Stevedoring and Storage—By Roy S. MacElwee, Director of the Bureau of Foreign and Domestic Commerce, United States Department of Commerce, and Thomas R. Taylor, Chief of the Latin-American Division Bureau of Foreign and Domestic Commerce. Shipping Series. New York and London: D. Appleton & Co. Cloth; 6 x 9 in.; pp. 350; 94 line cut and half tone illustrations. $5.

As the author's say in the preface: "This is the first effort to put between covers the vocation of loading and dispatching ships from the administrative standpoint." It is time that this highly important factor in marine operation had a text book and although the subject, and its text, are only of passing interest to the engineer, every engineer who has to design port terminals owes it to himself to get acquainted with the principles and practices the book describes.

Two Views of B. Welchii in Water

B. WELCHII AND THE MONTCLAIR WATER SUPPLY—By M. N. Baker, Associate Editor, *Engineering News-Record* (formerly President Montclair Board of Health). A Paper Read Before the New Jersey Sanitary Association, Montclair, N. J. The Montclair Water Co. Paper; 6 x 9 in., pp. 8.

BACILLUS WELCHII IN A PUBLIC WATER SUPPLY AS A Possible Cause of Intestinal Disease—By Herbert E. Lamer, Health Officer, Montclair, N. J. Reprinted from the *Journal* of the American Medical Association, Jan. 28, 1922. Edited by the Author. Paper; 6 x 9 in., pp. 8.

The paper by Mr. Baker gives in much condensed form some of the statements and opinions published last year in *Engineering News-Record*, June 2 and 9 (symposium) and Sept. 22 (by Sir Alexander Houston) regarding B. Welchii in the Montclair water supply and that germ as a test for water and as a possible cause of water-borne intestinal troubles.

Mr. Larner presents the subject from his viewpoint of health officer of Montclair. He refers, without date, to the symposium in the *News-Record* of June 2 and 9 quoting in support of his argument 4 of the 66 contributors of the symposium, but making no mention of the 62 other contributors, most of whose testimony was against the B. Welchii theory. A broad-minded editorial in the issue of the *Journal* of the American Medical Association containing Mr. Larner's original article, takes into account both the symposium and Sir Alexander Houston's article. This editorial is not included in Mr. Larners's reprint but is well worth securing by those interested in the B. Welchii theory.

Memoirs of J. F. Wallace and Col. Webb

Portraits and brief memoirs of the late John F. Wallace and Col. George H. Webb appear in the February *Bulletin* of the American Railway Engineering Association (431 S. Dearborn St., Chicago).

PUBLICATIONS RECEIVED

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known by the editor the price is stated in each entry. Where no price is given it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be obtained without cost, at least by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or, in case of books or papers privately printed, then to the author or other persons indicated.]

AN INVESTIGATION OF OXYACETYLENE AND CUTTING BLOWPIPES, with Especial Reference to Their Design, Safety and Economy in Operation—By Robert S. Johnston, Engineer Physicist, Bureau of Standards. Washington, D. C.: Bureau of Standards. Paper; 7 x 10 in.; pp. 108; halftones and diagrams. Free while limited stock lasts; 35c. from Superintendent of Documents.

"Apparatus from 14 of the most prominent manufacturers were tested under standardized conditions." Methods and results are given.

ANSWERS TO PROBLEMS IN CONCRETE WORK, Volume I, by W. K. Hatt and W. C. Voss—New York: John Wiley & Sons. Paper, 5 x 7 in.; pp. 3. 25c.

AUSTRALIAN COMMONWEALTH RAILWAYS — Report, 1920-21. Melbourne: Commonwealth Railways Commission. Paper, 8 x 13 in.; pp. 41; folding maps and diagrams.

BETTER BUSINESS LIBRARIES—Talks with Executives—By Louise B. Krause, Librarian, H. M. Byllesby & Co., Chicago. Author of "The Business Library." Chicago: The Indexers Press. Cloth; 5 x 7 in., pp. 98. $1.30.

Many valuable suggestions for the formation, arrangement and use of business libraries are given in this volume. The first two chapters deal with the why and the function of business libraries. The next one is a good plea for the employment of trained librarians. There are chapters on books, periodicals, indexes and digests of periodicals, financial and trade services, government publications (unfortunately confined to Federal Government only), library arrangement and putting business libraries to work. The book deserves the careful attention of all business houses that have or ought to have a good library.

BUILDING CODE, STATE OF WISCONSIN—Revision of 1921. Industrial Commission of Wisconsin, Madison, Wis. Paper; 6 x 9 in., pp. 129.

CANADIAN RAILWAY STATISTICS, 1920—Ottawa, Ont.: Dominion Bureau of Statistics. Paper; 6 x 9 in.; pp. 208.

CHAPTERS ON THE HISTORY OF THE SOUTHERN PACIFIC—By Stuart Daggett, Ph.D., Professor of Railway Economics and Dean of the College of Commerce, University of California. Author of "Railroad Reorganization." New York: The Ronald Press Co. Cloth; 6 x 9 in.; pp. 470; frontispiece. $5.

COMMERCIAL STATISTICS FOR CALENDAR YEAR 1920—Compiled by Statistical Division, Board of Engineers for Rivers and Harbors. From Report of Chief of Engineers, 1921, Part 1. Paper; 6 x 9 in., pp. 1424.

DEPARTMENT OF JAPANESE RAILWAYS—Report for 1919. Tokio, Japan. Paper, 8 x 12 in., pp. 116; map.

DEVELOPMENT OF THE WATER RESOURCES OF THE MAHONING RIVER [including screening stations for Sanitary Purposes]—Report to the City Council of Warren, Ohio, by Alexander Potter, Consulting Engineer, 50 Church St., New York. Paper, 7 x 10 in., pp. 118, illustrated with diagrams and maps, some on folding plates. $1 from the Author.

A plan for water supply from impounded and filtered flood flow for the benefit of Warren, Niles and Youngstown. Has in view a Mahoning Valley Sanitary District, under state legislation of 1919 [illegible] large storage reservoirs upon the Ravenna affluent [illegible] made in connection with but just published.

ELEMENTS OF DIFFERENTIAL AND INTEGRAL CALCULUS WITH APPLICATIONS—By William S. Hall, E.M., C.E., M.S., Professor of Mathematics in Lafayette College. Second Edition, Revised. New York: D. Van Nostrand Co. Cloth, 6 x 9 in.; pp. 250.

The chapters on Definitions and First Principles, Differentials and Rates, and Integration have been completely rewritten. The first edition was published in 1897.

EYE CONSERVATION IN INDUSTRY—Part of the Study of Waste in Industry Conducted Under the Auspices of the Federated Engineering Societies. New York: Eye Sight Conservation League, Times Building. Paper; 6 x 9 in.; pp. 29.

FOREIGN TRADE MARKETS AND METHODS—By Clayton Sedgwick Cooper, Author of "Understanding South America," etc. New York and London: D. Appleton & Co. Cloth; 6 x 9 in.; pp. 440; illustrated.

A comprehensive treatment of the whole subject of foreign trade; where it is to be found, what it demands and what it offers. Not the least valuable feature is a 24-p. chapter on Literature and Study Course for Foreign Trade Representatives which includes a helpful bibliography. Altogether a worth-while and practical book.

A HALF CENTURY OF PUBLIC HEALTH: Jubilee Historical Volume of the American Public Health Association—In Commemoration of the Fiftieth Anniversary Celebration of Its Foundation, New York City, Nov. 14-18, 1921. Edited by Mazyck P. Ravenel, M.D., President. New York: American Public Health Association. Stiff paper; 7 x 10 in.; pp. 461; frontispiece portrait of Stephen Smith, M.D., Founder and First President of the Association. $3.75; cloth, $5.25.

HEATING AND VENTILATION—By the Late John R. Allen, M. Am. Soc. M. E., Director of Research Laboratory of American Society of Heating and Ventilating Engineers, formerly Dean of Engineering and Architecture, University of Minnesota; and J. H. Walker, Superintendent of Central Heating, the Detroit Edison Co., President National District Heating Association, 1922. Second Edition. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6 x 9 in.; pp. 332; illustrated, $3.50.

The first edition of this book was favorably reviewed in these columns Oct. 17, 1918, p. 727, by D. D. Kimball. In the present edition, the preface states: "Several of the chapters have been entirely rewritten and a more logical arrangement has been adopted. The entire book has been thoroughly revised and slightly enlarged (about 65 pp. added). The aim has been to increase in every possible way its value as a college textbook, in which field it has been widely used."

HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO—Report by William S. Murray on Government Owned and Controlled Compared with Privately Owned and Regulated Utilities in Canada and the United States. New York: National Electric Light Association. Paper; 8 x 11 in.; pp. 223; maps and diagrams.

The exact title of this pamphlet is given in quotation marks. The opening words in capital letters denote better the main topic of the report. Mr. Murray's conclusions are adverse to the success of the Canadian undertaking. A summary of the report appears on p. 453 of this issue.

INCOME TAX PROCEDURE, 1922—Including Federal Capital Stock Tax, Federal Estate Tax, and Supplement to Excess Profits Tax Procedure, 1921. By Robert H. Montgomery, C.P.A. New York: The Ronald Press Co. Cloth 6 x 9 in.; 1911. $10.

INDIAN RAILWAY BRIDGE COMMITTEE—Report of Fifth Meeting, Oct. 3-8, 1921. Chairman, G. Richards, Chief Engineer with the Railway Board, India. Paper; 8 x 13 in.; pp. 52; folding diagrams. 2 rupee, from Superintendent Government Printing, India, 8 Hastings St., Calcutta.

Besides details of meetings held on six days, contains various appendixes by members of the committee reporting and discussing bridge impact tests; also rules for design and inspection of railway bridges drafted in September, 1921, by Mr. Richards (title above) for submission to the Railway Board of India, and suggested amendment to the 1918 rules, with discussion thereon.

IRRIGATION 1919 AND 1920 UNITED STATES—Washington D. C.: Bureau of the Census. Paper; 9 x 12 in.; pp. 38; two-page map in colors.

Contains irrigation statistics for 17 arid and semi-arid states. Most of the figures collected in 1920 are for the year 1919 and many corresponding figures for 1909 are given.

S HIGHWAY TRANSPORT AN AID TO THE RAILROADS?—By A. J. Brosseau, Member Board of Directors, National Automobile Chamber of Commerce. An Address before the Shipper's Conference of Greater New York. Reprinted from *Commercial Vehicle*, Jan. 15, 1922. New York: National Automobile Chamber of Commerce, 366 Madison Ave. Paper 6 x 9 in.; pp. 8.

LAND DRAINAGE—By W. L. Powers, M.S., M. Am. Soc. Agricultural Engrs., Chief in Soils, Oregon Agricultural College and Experimental Station, and T. A. H. Teeter, B. S., M. Am. Asso. of Engineers, formerly Professor of Drainage and Irrigation Engineering. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 9 x 6 in.; pp 270. Illustrated. $2.75.

MATERIALS OF CONSTRUCTION: THEIR MANUFACTURE AND PROPERTIES—By the Late Prof. Adelbert P. Mills, of Cornell University. Second Edition, Edited by Harrison W. Hayward, Professor of Materials of Engineering, Massachusetts Institute of Technology. New York: John Wiley & Sons, London: Chapman & Hall, Cloth; 6 x 9 in.; pp. 476; 192 illustrations. $4. 24s. net.

Some chapters have been added, some condensed, some rewritten in this edition. Acknowledgements are made to the following members of the M.I.T. Staff: For "reviewing" Steel, Prof. Henry Fay; Non-Ferrous Metals and Alloys, Prof. R. S. Williams; Stone and Timber, Prof. I. H. Cowdrey; new chapter on Mechanical Fabrics, Prof. G. B. Haven; rewriting Concrete, Dean Peabody, Jr. The first edition was reviewed in *Engineering Record*, June 26, 1915, and in *Engineering News*, July 15, 1915.

MINISTRY OF HEALTH REQUIREMENTS AS TO SEWAGE PURIFICATION, With Extracts from the Reports of the Royal Commission, and Other Engineering Data—By S. H. Adams, Assoc. M. Inst. C.E. London, England: St. Brides Press. Cloth: 6 x 9 in.; pp. 39; illustrated. 6s. net.

Contains very little specific information as to the "Requirements" but many notes and data that are presumably useful in preparing a scheme in accordance with the "Requirements."

MODERN TUNNELING—By David W. Brunton and John A. Davis. New Chapters on Railroad Tunneling by J. Vipond Davis. Second Edition. New York: John Wiley & Sons. London: Chapman & Hall. Cloth; 6 x 9 in.; pp. 612; 120 illustrations. $6.50. 39s. net.

NEW JERSEY WATER RESOURCES AND THEIR DEVELOPMENT—Report by Hazen, Whipple & Fuller, Civil Engineers, New York City. Trenton, N. J.; Department of Conservation and Development. Paper; 6 x 9 in.; pp. 76; illustrated. See abstract elsewhere in this issue.

NINE YEARS' OPERATION OF THE BALTIMORE SEWAGE WORKS—By Theodore C. Schaetzle, Principal Sanitary Chemist of Sewage Works, Baltimore, Md. Reprinted from *Engineering News-Record*, July 14 and 21, 1921, by the Highways Department of the City of Baltimore (August E. Christhilf, Highways Engineer; M. J. Ruark, Division Engineer of Sewers). Paper; 5 x 8 in.; pp. 33; illustrated.

PLAN FOR THE COMPREHENSIVE DEVELOPMENT OF THE PORT OF NEW YORK—Report of the Port of New York Authority, Dec. 21, 1921. New York City: As above, 11 Broadway. Paper; 7 x 10 in.; pp. 56; folding maps.

An abstract appeared in *Engineering News-Record*, Jan. 5, 1922, p. 26.

PULVERIZED COAL SYSTEMS IN AMERICA—By Leonard C. Harvey. Revised Edition. Fuel Research Board, Special Report No. 1, Department of Scientific and Industrial Research. London: His Majesty's Stationery Office. Paper; 7 x 10 in.; pp. 117. 5s. net.

REPORT OF SAN FRANCISCO BAY MARINE PILING COMMITTEE—Chicago: American Wood Preservers' Association, Otis Building. Paper; 6 x 9 in.; pp. 92; illustrated.

SANITATION AND SEWAGE DISPOSAL FOR FARMSTEADS AND COUNTRY ESTATES—By William Paul Gerhard, C.E., Dr. Eng., Consulting Engineer. New York City: The Author, 17 W. 42nd St. Paper; 6 x 9 in.; pp. 12. 30c.

SEWERAGE AND SEWAGE TREATMENT—By Harold E. Babbitt, M.S., Assoc.M. Am. Soc. C.E., Assistant Professor, Municipal and Sanitary Engineering, University of Illinois. New York; John Wiley & Sons. London: Chapman & Hall. Cloth; 6 x 9 in.; pp. 531; illustrated. $5. 30s. net.

SPECIAL ASSESSMENTS: Assessments for Benefits as a Means of financing Municipal Improvements—By the Committee on Sources of Revenue, National Municipal League. February issue of *National Municipal Review*, 261 Broadway, New York City.

STÄDTEBAU—Von Otto Blum, Dr.-Ing., ord. Professor an der Techn. Hochschule in Hanover, G. Schimpff, weil. ord. Professor an der Techn. Hochschule in Aachen, und W. Schmidt, Dr.-Ing., Stadtbauinspektor in Stettin. Handbibliothek für Bauingenieure. Boards; 7 x 10 in.; pp. 478; 482 text illustrations. Berlin: Julius Springer. 78 marks.

STATE DEPARTMENT OF HEALTH OF NEW JERSEY—Report for 1920-21. Cloth; 6 x 9 in.; pp. 350.

STATISTICS OF CITIES AND TOWNS OF IOWA, 1919-20—Des Moines, Iowa: Frank Shaw, State Auditor. Paper; 6 x 9 in.; pp. 224.

ST. LAWRENCE WATERWAY—Message from the President of the United States (Jan. 16, 1922) Transmitting a letter from the Secretary of State Submitting the Report of the International Joint Commission Concerning the Improvement of the St. Lawrence River Between Montreal and Lake Ontario for Navigation and Power. Senate Document 114, 67th Congress, second session. Paper; 6 x 9 in.; pp. 184; folding plates.

STREAM GAGING RECORD CHART, NEW YORK STATE—In Appendices to 1920 Report, New York State Conservation Commission, Albany, N. Y.

TABLE FOR OBTAINING DIFFERENCES OF ELEVATION AND HORIZONTAL DISTANCES FROM VERTICAL ANGLES AND STADIA DISTANCES—Designed by Arthur Alvord Stiles, State Reclamation Department, Austin, Tex. Paper; 5 x 12 in.; p. 141. Free to those "having real need" for the table "as long as limited supply lasts," together with illustrated instructions for binding and for cutting the leaf margin index.

Gives "differences of elevation and horizontal distances for vertical angles and stadia distances." On each two facing pages the extreme left hand column gives observed stadia distances at intervals of 2.5 from 100 to 140 and of 5 from 140 to 535 and the extreme left hand column gives corresponding horizontal differences. The intermediate columns show differences of elevation corresponding to the vertical angles and observed stadia distances. The marginal indexes are cut to show degrees only but include minutes also.

TABLES AND DATA FOR ENGINEERS AND BUSINESS MEN—Compiled by Charles E. Ferris, B.S., Professor of Mechanical Engineering, University of Tennessee. 24th Edition. Knoxville, Tenn.: University Press. Flexible cover; 3 x 6 in.; pp. 229. 75c.

TENSILE PROPERTIES OF SOME STRUCTURAL ALLOY STEELS AT HIGH TEMPERATURES—By H. J. French, Physicist, Bureau of Standards, Washington, D.C. Paper; 7 x 10 in.; pp. 92. Free from Bureau of Standards while stock lasts; 5c from Superintendent of Documents.

UNITED STATES PUBLIC HEALTH SERVICE—Report for 1920-21. Cloth; 6 x 9 in.; pp. 429.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Highway Standards Prevented by Politics

Sir—The editorial in *Engineering News-Record*, Feb. 2, 1922, p. 177, under the caption "Activity on Highway Standards," is more or less an indictment of the highway engineers of the country for failure to change immediately conditions over which they do not have complete control.

We do not have to go far to find several reasons for the state of affairs criticised, but we must travel a long road to find and effectually apply a remedy.

During three years membership on the Executive Committee of the American Association of State Highway Officials, and as member of the special committee which conducted the initial negotiations with the Associated General Contractors, looking toward greater co-operation between the highway officials and contractors, I had opportunity to observe and study several phases of this question, which are not apparent to the casual observer.

A prerequisite to the establishment of proper relations between the contractor and highway engineer, is the adoption by all states, counties and municipalities, of standard proposal and contract forms; a general adoption of a sufficient but reasonable proposal and contract bond; a lower retained percentage on monthly payments to assist the contractor in financing his work; the engagement of intelligent, trained inspectors; and the placing of the chief engineer in absolute authority, back of which there is no recourse to political influence to secure acceptance of questionable work. Along with these, and no less important, is the general adoption of a specification, which for each standard type of pavement and method of procedure, shall be as near an approach to a common standard as the varying local conditions will permit.

Why have the American Association of State Highway Officials and the several county and municipal authorities been thus far unable to make effective the above requisites to a successful co-operation between the interested parties?

Some of the fault undoubtedly lies with the engineers, and to a certain extent past practices among certain contractors are responsbile, but in the main it lies in that old bugaboo, politics and political manipulation for partisan benefit. To this one factor may be traced most of the ills inherent in the conduct of our highway work.

Uncertain tenure of office, and removals of engineers with each changing administration prevent that continuity of effort so necessary to the upbuilding of any set of standards. It takes about two years for any newly appointed engineer thoroughly to acquaint himself with the needs of his state, and the methods and practices of his contemporaries; and just about the time he is ready and fitted to settle down to a constructive policy, along comes a [illegible] changes which [illegible]

Another factor lies in the past [illegible] ment of "rational design," [illegible] search work, and [illegible] of engineers, but on the part of [illegible] governing bodies who control the engineers' [illegible]

neers in states having no funds or facilities for research work must perforce await the results of such research in states where it is under way. They must then make the best possible application of them to their peculiarly local problems.

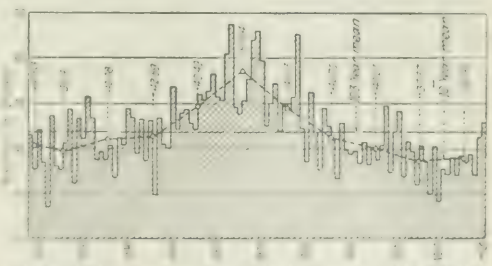
I have come to the conclusion that the fine research work being done by the Bureau of Public Roads by Clifford Older of Illinois, and several other states and institutions should serve as a guide in the future to all other states, since the conditions under which tests are conducted are fairly typical of conditions in the country as a whole, and that work done by others will only be a duplication of effort. Until the worth of the results of these tests have been proved by the only real proof, fairly long time service under any and all conditions, our engineers should not jump at preliminary conclusions and blindly follow a common standard.

Trenton, N. J. W. G. THOMPSON,
Feb. 8, 1922. Consulting Highway Engineer.

Rainfall at Norfolk Compared With Long-Term Records at Boston and Elsewhere

Sir—The continuous decrease in the rainfall at Norfolk, Va., during the past fifty years, to which attention has been called by Ellis B. Noyes (*Engineering News-Rerord*, Aug. 4, 1921), may possibly be a phase of a phenomenon of rather general character. On investigating the rainfall data which the writer has available, the surprising fact is brought out that there is a well marked maximum in the rainfall at stations in various parts of the United States, toward the end of the past century. The accompanying table shows the ten-year means for twelve cities, these particular records not being specially selected but being all the writer has at hand. Six show well marked maxima in the decade 1871-1880 inclusive, two in the preceding decade and three in the following.

The diagram showing the annual rainfall at Boston, Mass., is interesting in this connection, as it indicates that, at Boston at least, the steady decrease during the past fifty years has been merely the down-swing from the maximum that had been gradually approached during the preceding forty or fifty years.



[illegible] THE [illegible] YEARS, 1825 TO 19[illegible]

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NEWS OF THE WEEK

New York, March 16, 1922

Motor Vehicle Registration Shows Increase

Preliminary Returns for 1921 Indicate a Total of 10,325,000 Cars and Trucks

The U. S. Bureau of Public Roads reports that the motor vehicle registration for the year 1921 will total approximately 10,325,000, returns having been received from all states except Virginia, Arizona, and California, for which estimates were made on the basis of the other returns. This represents an increase of more than a million vehicles over the 1920 figure, or an amount equal to the total number at the beginning of 1913. The greatest increases in registration were in industrial sections, the agricultural sections in general showing a smaller amount of increase. No state reported a registration less than the 1920 figure. The total amount collected as fees amounted to about $125,000,000.

It had been anticipated that the 1921 registrations would show a falling off in the rate of increase, but the figures reported indicate that such is not the case. The increase continues approximately at the same rate that has been maintained for the past seven years and shows no indication of the near approach of a condition of saturation in the supply of motor vehicles.

The recent Federal Highway Act provided for the construction of a connected system of highways consisting of not more than 7 per cent of the roads in each state and made an initial appropriation of $75,000,000 to be used in conjunction with state funds. The system to be built is now being outlined and will comprise about 180,000 miles of road, included in which are about 60,000 miles already completed.

With an annual program based on a federal appropriation of $75,000,000 and assuming that the states will continue to match the federal funds in the same ratio as heretofore and that the average costs of the roads built will be $20,000 per mile it will take 15 years, the Bureau of Public Roads estimates, to complete the proposed system. If the federal appropriations are made at the rate of $100,000,000 a year the system can be completed in 10 years, and if only $50,000,000 are appropriated annually it will take 20 years to build it.

Goethals To Report on Columbia Basin Irrigation Project

Major-Gen. George W. Goethals recently completed a month's examination of the field work and studies prepared by the state of Washington in connection with the Columbia Basin irrigation project, referred to in this journal March 2, p. 372. Gen. Goethals is to report to the State of Washington some time in April, giving his findings upon the relative desirability of the two sources of water supply and his opinion on the feasibility of the whole plan.

Award 168-Mile Concrete Road Contract

A contract for the 168 miles of pavement in Maricopa County, Ariz., bids on which were noted in Engineering News-Record March 2, 1922, p. 372, was awarded to Twohy Bros., the lowest bidder. Concrete will be used for 160 of the 168 miles, the remaining 8 miles being classed in the specifications as "special pavement."

A total of about 1,600,000 sq.yd. of concrete will be laid in widths of 16 and 18 ft. Decision has not been made as to whether the thickness will be 5 or 6 in. A considerable portion of the system, however, will be 6 in. thick at the center with a 9-in. "inverted curb" on either edge of the slab.

Cut Funds for Topographic Mapping

Despite a determined effort on the floor of the House to increase the appropriation for the topographic mapping work of the U. S. Geological Survey, an amendment increasing the amount to $425,000, offered by Representative Hayden, of Arizona, was voted down. This leaves the item at $275,000 in the Interior Department bill which later was passed by the House. It is believed some increase will be allowed by the Senate.

The President and the Director of the Budget recommended an appropriation of $430,000 for the topographic work. The amount allowed for the current fiscal year was $330,000. Had Mr. Hayden's amendment been adopted, it simply would have restored the expenditure for topographic mapping to the pre-war rate.

Calls Conference on Business Training for Engineers

A second public conference on business training for the engineer and engineering training for the student of business has been called by the U. S. Commissioner of Education for May 1 and 2 at the Carnegie Institute of Technology, Pittsburgh.

Invitations to appoint delegates to the conference will be sent by the commissioner to commercial, technical and educational institutions as well as to prominent individuals. "It is planned to have the second conference," says Dr. Glen Levin Swiggett of the Bureau of Education, "even more constructive than the first, since which time the curricula of 29 of the 119 engineering colleges reporting to the Bureau of Education have been favorably modified to include one or more of the four committee recommendations." The first conference was held in June, 1919, at Washington.

Bill Would Oust New Jersey Tunnel Commissioners

The New Jersey Assembly this week is expected to enact, over the predicted veto of the governor the bill, already passed, ousting the present membership of the New Jersey Interstate Bridge and Tunnel Commission and naming a new group of commissioners to administer the Hudson River vehicle tunnel and the Delaware River bridge projects. The so-called "ripper bill" would remove from office T. Albeus Adams, chairman of the commission, Samuel Shay, Charles S. Stevens and Frank F. Gallagher.

If the bill becomes a law the new commission would consist of four Republicans and four Democrats, as follows: Republicans, Weller H. Noyes, Tenafly; T. J. S. Barlow, Maple Shade; John B. Kates, Collingswood; Theodore Boettger, Hackensack. Democrats, Robert S. Sinclair, South Orange; Isaac B. Ferris, Merchantville; John F. Boyle, Jersey City, and Frank L. Supplee, Glassboro.

Broken Narrows Siphon Repaired and Placed in Service

The repair of the Narrows siphon, the 36-in. flexible joint cast-iron pipe line carrying water from Brooklyn to Staten Island, New York City, which was broken by a dredge spud Feb. 2 was completed last week and service was resumed. The unusual repair methods were described in this journal March 2, p. 346, by W. W. Brush.

The line was first blown out and then tested for leakage under 35 lb. of air pressure. Bubbles were observed escaping from only one of the 1-in. bolt holes of the special cast-steel sleeve at the repaired joint and this bolt was replaced after which the air leakage was negligible.

Chlorinated water, dosed with 2 p.p.m., was then turned in to the line and allowed to flow to waste for 7 hours before the discharge was delivered to the Staten Island distribution system, At the end of this period tests showed no B. coli in 100-cu.cm. samples and a total bacterial count of only 6.

The repair work, performed by the Merritt & Chapman Derrick and Wrecking Co., cost approximately $55,000.

Bills Seek Change in New York License Law

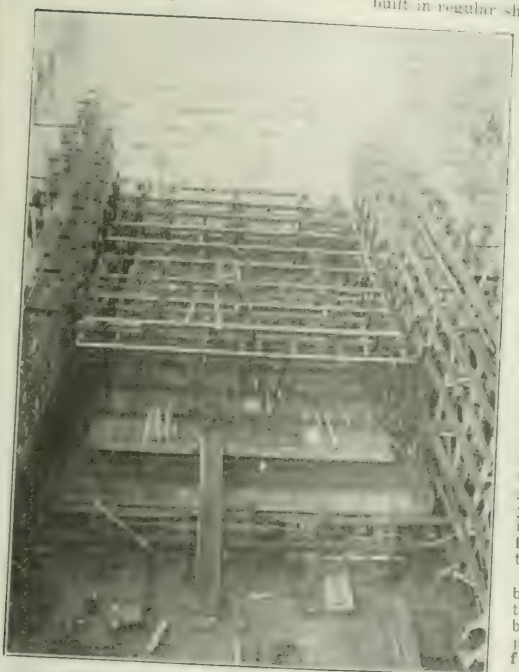
Several bills amending the existing engineer license law in New York State have been introduced in the Assembly at Albany, the purpose of which, according to a recent statement by the New York Chapter of the American Association of Engineers, is to protect politically-controlled county supervisors who, under existing conditions, have jurisdiction over highways, bridges, culverts, and other public works requiring engineering skill. The bills in question are said to be an attempt to exclude engineers engaged in public works from the provisions of the license law.

$2,500,000 Asked To Fight Teredo

President Harding on March 9 asked Congress to include in the Navy bill for next year a supplemental appropriation of $2,450,000 for use in counteracting the damage caused by the teredo at the Mare Island Navy Yard in San Francisco Bay. The destructive effect of marine borers in these waters has been frequently noted in these columns in the past year and a half. The situation at Mare Island has become most serious and requires immediate remedy.

Large Bridge-Pier Caissons Being Built at Shipyard

Work is in progress in the yard of the New York Shipbuilding Co. at Camden, N. J., on the construction of the two great pier-foundation caissons for the Delaware River bridge, to connect Philadelphia and Camden. The shipbuilding company is sub-contractor for this part of the work, Holbrook, Cabot & Rollins and the Keystone State Construction Co., associated, being the contractors for the piers. Both caissons are being built in regular shipbuilding berths, occupied at other times by warships. One of them, Caisson A, is shown in an early stage of construction in the picture herewith.



BUILDING PIER CAISSONS FOR THE DELAWARE RIVER BRIDGE IN A SHIPYARD

Caisson A is shown in the [illegible] of the New York Shipbuilding Co. [illegible] permitting work to go on [illegible]

Each of the two caissons is 70 ft. x 143 ft. in outside dimensions and comprises a steel working chamber about 8½ ft. high surmounted by steel trusses about 15 ft. deep, both longitudinal and transverse. The shell of the caisson above the working chamber will be built of timber. The total height of the caisson proper will be about 40 ft., but the first caisson will be built up at the shipyard after launching with about 25 ft. of cofferdam on top of the caisson.

Heavy timber bulkheads divide the working chamber into five compartments. The four bulkheads, each 36 in. thick, are shown in the view, in place on the ways, ready for the setting of the cutting edge, steel and roof plating of the working chamber. It is expected that these bulkheads will be used [illegible] sinking of the caissons. To protect them [illegible] a heavy timber [illegible] will be placed over the caisson, to be removed as soon as the structure has entered the water. The first of the caissons will probably be launched within the current month.

Havana Port Work To Start Soon

The Parkhan Construction Corp. of New York City, expects to commence work soon on the docks and piers of the Port of Havana Docks Co., Havana, Cuba. The piling and foundations have been [illegible] to the Raymond Concrete Pile Co. and the reinforced concrete superstructure to the Lozier Construction Co., both of N. Y. City. Other subcontracts will be awarded shortly.

The new work is part of a general improvement originally contracted for several years ago, but which has been deferred [illegible] The [illegible] contract includes the [illegible] a reinforced concrete [illegible] wharf shed and a steel and concrete [illegible] The pier will be [illegible] long and 210 ft. wide at the deck level. The shed warehouses will be of [illegible] stories in height, and 150 ft. [illegible] ft. wide.

Few Colorado Engineers Are Without Employment

[illegible]

Jurisdiction Award Action Approved by F.A.E.S.

Executive Board of American Engineering Council Holds Meeting in Chicago March 10.

Confirmation of the action of the National Board for Jurisdictional Awards in its efforts to bring the carpenters' union to accept the board's decisions in building controversies was given by the executive board of the American Engineering Council at the meeting March 10, in Chicago. Members of the Federated American Engineering Societies were urged to insert in all specifications and contracts a stipulation that the decisions of the Jurisdictional Board shall be observed. With the exception of the carpenter's union the other sixteen international unions have supported actively the findings of the board.

Report was made of the passage of federal legislation to reform the U. S. Patent office, the successful outcome of which is attributed largely to the efforts of the federation.

WORLD ORGANIZATION DISCUSSED

World engineering organization to promote international peace was discussed and a committee was authorized to consider the various phases of the question, together with possible constitutional changes should the Engineering Institute of Canada make application for membership.

The Sterling reclassification bill was endorsed rather than the Lehlbach bill, since the salary schedules on the former are approximately 10 per cent higher than in the latter and conform more nearly with the report of the original reclassification committee's report.

Employment service, which the committee on that subject believes should be turned back to the jurisdiction of the constituent societies, retains its *status quo*, with a new committee authorized to bring in a new report. It was intimated that possibly some working arrangement might be made with the American Association of Engineers. The existing committee states in its report that the fundamental object of the F. A. E. S. is the rendering of service to the public where engineering problems are involved, while employment service is essentially personal, the direct personal contact of the engineer being with the constituent societies.

A report on the publication of a bulletin by the society was laid on the table and later taken therefrom and the committee asked to bring in information or proposals by a private publisher. Among several subjects laid on the table were the consideration of the Muscle Shoals project, the utilization of national parks, tariff on technical books, the proposed Great Lakes-St. Lawrence waterway and participation in an international engineering congress.

The recommendations of the Conference on Mississippi River Flood Relief were approved. A committee was authorized to look into the question of [illegible] standard rating system which Richard Bolton has invented to see whether it is [illegible] F. A. E. S. should consider. The question of basic wage rates [illegible] by the American Society of Mechanical Engineers was referred to a committee.

The financial outlook of the federation for 1922 is much brighter than appeared at the time of the meeting of the council in January.

J. L. Campbell New Head of Railway Engineers

Is Chief Engineer of the El Paso and Southwestern Railway System—Member 15 Years

John Logan Campbell, chief engineer of the El Paso & Southwestern Ry. System, who was elected president of the American Railway Engineering Association at its Chicago meeting March 14-16, was born in 1863. His education was received in the public schools, at Ewing College, Ill., and at the Normal University, Lebanon, Ohio, after which he taught school for three years. In 1888, he went to the southwest, entered engineering work in land and mining surveying as deputy county surveyor of El Paso County, Tex.

Mr. Campbell entered railway work in 1894 as resident engineer on construction of the Rio Grande Northern R.R. He was chief engineer of the Rio Grande Dam & Irrigation Co. projects (the predecessor of the Rio Grande project of the U. S. Reclamation Service) from 1894 to 1898, during part of which time he was also locating engineer for the Rio Grande, Sierra Madre & Pacific Ry. and chief engineer of location and construction of the El Paso & Northeastern Ry. (now the Eastern division of the El Paso & Southwestern.

Elected President A. R. E. A.



John Logan Campbell

After being locating engineer for the Atchison, Topeka & Santa Fe Ry. in 1899 and 1900, he was engineer in charge of relocation and reconstruction of the Arizona & New Mexico Ry. during its change from narrow- to standard-gage in 1900 and 1901. From 1901 to 1905 he was chief engineer of location and construction of the St. Louis, Kansas City & Colorado. R.R. (now the St. Louis-Kansas City line of the Rock Island System). From 1905 to 1920, as engineer maintenance of way, he was in charge of location, construction and maintenance of the El Paso & Southwestern System. Since 1920 he has been chief engineer of the road.

He became a member of the American Society of Civil Engineers in 1901, and of the American Railway Engineering Association in 1906.

Group Conferences on Design Begun by Am. Soc. C. E.

A series of three sub-section group conferences on design, the result of a questionnaire sent to members in regard to technical subsection meetings, was begun March 15 by the New York Section of the American Society of Civil Engineers. The plan provides for group meetings on the afternoons of three meetings of the section, the first preceding the joint meeting on the Port of New York. James H. Edwards, assistant chief engineer, American Bridge Co., presided and introduced for discussion the topic "The Importance of the Design of Details as Evidenced by Recent Theater Failures."

Call for Bids on Hetch Hetchy Power-House Equipment

San Francisco city officials have issued a call for bids, to be opened April 12, covering the generating equipment for the Moccasin Creek power house on the Hetch Hetchy project. Decision has not yet been made as to whether the city will sell this power in bulk or will use it only for its own needs. For this reason alternative bids are asked for. If the power is to be sold wholesale the full capacity of the plant will be installed; if not, the probability is that the first installation will consist of only two units.

The specifications for the water wheels call for bids on two, three or four units of 25,000 hp. capacity each. The hydraulic valves in the penstock just outside the power house are covered by separate specifications. Specifications for the electrical equipment call for two, three or four generator units, exciters and a spare exciter, each unit to have a capacity of 20,000 kva. The city is now building a 1¾-mi. spur from the Hetch Hetchy railroad to give rail access to the new power house site.

The continuous flow from the Hetch Hetchy source of supply is considered sufficient for 60,000 hp. under the 1,300-ft. head at the Moccasin Creek plant but with the forebay reservoir capacity equal to about two and a half days flow through the 600 sec.-ft. aqueduct, it is considered economical to install a total of 100,000 hp. if this amount of power can be sold wholesale.

Power Company Wins in Suit Over Eel River Dam Contract

The Superior Court of California has rendered a decision in favor of the Snow Mountain Water & Power Co. and against W. A. Kraner, contractor, in the suit over the contract for the construction of a dam on Eel River, about 35 miles from Ukiah. Work on the dam was stopped last June when the structure was nearing completion. The contractor charged breach of contract and the company claimed the contract had been abandoned. The suit involved $743,000 and has been under way here for several months. A number of well known engineers were retained as expert witnesses by both sides.

Articles descriptive of the design and construction of the dam appeared in *Engineering News-Record*, May 5, 1921, p. 750 and p. 752. Work on the dam has recently been carried to completion by Stone & Webster, to whom a contract was awarded after the lawsuit with the former contractor began.

Unemployment Small in Ranks of American Association

Two and one-half per cent of the members of the American Association of Engineers are looking for positions according to the records of the employment department. Many of these hold temporary positions, so that the actual number unemployed is below 2 per cent. Apparently the worst of the unemployment period has been past. A survey made by the employment department covering 200 widely-separated localities indicates that there is a continued improvement in fundamental conditions of engineering employment. The spring construction season is nearly here, with many million-dollar construction projects either under way or ready to start. Not much railroad work is anticipated and the big demand for railroad engineers in the past will probably never again exist. The many states with substantial highway programs offer opportunities for engineers. The following table shows the trend of employment:

	Feb. 1922	Jan. 1922	Feb. 1921
Applicants for employment..	1,968	1,872	2,303
Positions received.....	312	323	558
Men referred	1,475	1,428	3,535
Men Placed.....	172	156	286

The average monthly salary of positions filled in February was $186; for the same month last year the average salary was $195. The highest salaried position filled during February was $8,000 per annum. The lowest salary was $110 a month. The greatest demand for engineers at this time exists in the South Atlantic states and the Central West. Demand exceeds supply in the case of architectural engineers and draftsmen and structural engineers who are specialists on buildings. Salaries for men in this field are increasing. The employment of mechanical and electrical engineers depends considerably on the industries which have been going through a period of depression and readjustment. The association officials in charge of employment state that engineering employment, after the long period of depression, is well on the way toward a normal condition.

Bill Fixes Higher Fees for Motor Trucks in New York

Increases in the registration fees for motor trucks are provided for in a bill introduced in the New York Senate Feb. 20 by Senator Seymour Lowman, chairman of the committee on internal affairs. For a truck whose gross weight exceeds 10 tons a license fee of $150 is proposed, as compared with a fee of $55 for a truck weighing between 10 and 11 tons under the provisions of the existing act. The license fees proposed in the new bill and those now operative are given in the accompanying table:

PROPOSED MOTOR-TRUCK FEES IN NEW YORK STATE

Gross Weight, Tons	Proposed Fee	Present Fee	Increase
2	$15	$10	$5
> 2 — 3	20	15	5
> 3 — 4	25	20	5
> 4 — 5	30	25	5
> 5 — 6	50	30	10
> 6 — 7	60	35	25
> 7 — 8	75	40	35
> 8 — 10	100	45–50	50
> 10	150	55+*	95

> Greater than.

* Increase in fee beyond this point is $5 per ton up to $70 for 14-ton gross weight, and then $10 additional for each ton over 14.

Detroit Studies Action of Tires on Asphalt Pavement

The city of Detroit, Mich., is engaged on a research program to determine the distribution of motor truck loads on asphalt pavements by various types of tire, the degree of resilience obtainable and the tractive resistances for various types of pavements. The work which is in charge of J. A. McCabe, research engineer, is preliminary to a decision regarding the installation of a motor-bus service in connection with the street railways.

Arthur St. Laurent Chief Engineer of Canadian Public Works

Arthur St. Laurent, recently appointed chief engineer of the Department of Public Works of Canada, has been in the service of the department since 1888, three years after his graduation from the Ecole Polytechnique, Montreal.

He was assistant engineer in the district office at Winnipeg for ten years, after which he was entrusted with the construction of a bridge over the Saskatchewan river at Edmonton, at a point where the current was particularly swift. In the face of considerable opposition Mr. St. Laurent constructed the bridge piers of concrete, which subsequently justified his judgment by standing against a spring flood which swept away all the ordinary structures in the valley.

At a later date he designed the locks and dam at St. Andrews in the Red River, near Winnipeg, and constructed the Laurier Avenue Bridge at Ottawa and the government grain elevator at Montreal. In 1908 he was appointed Assistant Deputy Minister of Public Works.

Plans Submitted for Ideal Section of Lincoln Highway

Plans have been received by the U. S. Bureau of Public Roads for the Ideal Section of the Lincoln Highway in Lake County, Indiana, during the coming summer. This section is to be a federal-aid highway. The plans submitted by the Indiana State Highway Department show that the section will be nearly 1½ miles in length and will be placed in the middle of a 100-ft. right of way. The roadway is to be 40 ft. wide and provision is made for the use of concrete, bituminous concrete or brick sections with 5-ft. gravel shoulders on each side and is of a thickness calculated to withstand heavy traffic.

Night travel will be made safer by electric lights 35 ft. above the roadway and at suitable intervals on one side of the road. All electric wires will be buried beneath the ground. For pedestrian travel a 5-ft. gravel sidewalk will be placed in one of the 25-ft. strips of parking which are to be on each side of the road and the parking will receive effective landscape treatment.

It is not thought that present traffic justifies the width of roadway to be built but rather it is intended as an object lesson for the future and the traffic studies to be made on it will aid in settling such questions as whether two roads some distance apart can serve traffic better than a single wide road, the best methods of traffic regulation and other questions which are becoming more important each year.

Federal aid will be granted on this highway at the rate of $20,000 per mile.

U. S. Commerce Chamber Did Not Announce New Air-Ship Line

Word has been received from the Chamber of Commerce of the United States that a widely circulated report that the Chamber had announced the formation of the new General Air Service was in error. The Chamber had nothing to do with this announcement, which was noted in *Engineering News-Record* of March 2.

City Management Class in Chicago A.A.E.

Among the self-help classes of the Chicago Chapter of the American Association of Engineers is one on city management, with about a dozen lectures. The subjects of this course have included municipal organization, the problems of city managers and aldermen, the preparation of budgets and estimates, and an outline of city government. Two lectures on the budget system are to be given March 17 and 24 by John A. Richert, chairman of the city finance committee of the city council.

Building of Public Schools Opens Construction in Pittsburgh

With school buildings costing $3,000,000 under construction in four sections of the city, and plans being laid for the erection of additional buildings, for which $3,000,000 in bonds have been sold, an impetus has been given to construction operations in Pittsburgh. It is expected that three of the buildings now under construction will be ready for occupancy for the new term of school. Immediately upon the acceptance of building plans for the additional schools by the Board of Education, the second group, involving $3,000,000 will be started.

The awarding of the general contract for a three-story building for the Mellon National Bank, which will cost approximately $3,000,000, has also been announced; the contractor is the Mellon-Stuart Co. of Pittsburgh. Foundations were completed a few months ago by the Hughes Foulkrod Co. of Pittsburgh at a cost of $300,000.

Business Cycles to Be Subject of Exhaustive Study

Representatives of various trade associations of the United States will meet in Washington on March 21 with members of the United States Chamber of Commerce, the Department of Commerce and the committee of the President's Conference on Unemployment, which is to undertake an exhaustive study of business depressions and with a view to mitigating this evil. Research bodies and private individuals have contributed $50,000 to make the study, which the conference expects to complete within six months. Wesley C. Mitchell, of the National Bureau of Economic Research, New York City, has been made director of the survey and Edgar Eyre Hunt, of the President's Conference, has been named secretary. A tentative plan for the study of unemployment and methods for controlling the business cycle has already been submitted to the Committee by Mr. Mitchell. It includes an exhaustive inquiry into methods of stabilizing industry.

Cheyenne Elects Engineer as City Commissioner

Cheyenne, Wyo. having the commission form of government, elected on a progressive ticket last November, H. A. True, Jr., a civil engineer, who on Jan. 1 took office as one of its three city commissioners. It is expected that Mr. True will handle the department of streets and possibly water, the city having a municipal water system.

Mr. True is 38 years old, a graduate of the University of Wisconsin, an associate member of the American Society of Civil Engineers and a member of the Wyoming State Society of Civil Engineers. Since graduation his engineering experience has included service with the U. S. Reclamation Service in Colorado and Nebraska; the Spanish-American Iron Co., Cuba, where he also assisted in railroad and harbor engineering; the Central Colorado Power Co., Colorado; the United Sugar and Land Co., Kansas, making relocation of canals, surveys of water supply, designing and installation of pumping systems and power plants; and the Field, Fellows & Hinderlider Engineering Co., of Denver, Colo., where he had charge of parties making investigation surveys for large irrigation projects in Wyoming, New Mexico and Colorado.



Since 1911 Mr. True has lived almost continually in Wyoming. He was for two years assistant state engineer, and was later put at the head of the Carey Act Department of the Wyoming State Land Office.

Norfolk To Begin $5,000,000 Port Development Project

By a majority of nearly 6 to 1 the voters of Norfolk, Va. on Feb. 7 authorized the city government to proceed with the issuance of $5,000,000 worth of bonds for port development. The bonds will be issued as soon as all requirements of the law have been complied with, and bids on the work will be asked for within the next two months, the plans having been already perfected. Preliminary work consisting of soundings etc. will be started at once.

The money, as outlined and estimated by the engineers of the port commission, will be used as follows:

[illegible]

Record Fire Loss in 1921

The National Fire Protection Association has just issued a bulletin stating that the fire loss in the United States for 1921 exceeded that of any previous year. While final figures are not available, the total will be $[illegible],000,000.

W. D. Pence Returns to Consulting Practice

William D. Pence, Chicago, has returned to consulting practice after seven years as engineer for the Wisconsin Railroad and Tax Commissions and eight years as a member of the engineering board of the Bureau of Valuation, Interstate Commerce Commission. He has opened an office at 8 So. Dearborn St., Chicago, and will give attention particularly to railway and public utility matters.

Mid-West Cement Makers Indicted

Twenty-six cement manufacturing companies of the Middle West, and forty-eight of their officers, have been made defendants in an indictment returned by a federal grand jury in Chicago March 8 but not made public until a few days ago. The defendant companies have an annual output of about 25,000,000 bbl. All are members of the Midwest Cement Credit and Industrial Bureau, also named in the indictment. There are eight counts in the indictment, charging combination in restraint of trade, conspiracy and a violation of the Sherman anti-trust law.

House Committee Reports River and Harbor Appropriations

The army appropriation bill as reported to the House by its appropriations committee recommends $27,635,260 for river and harbor improvements and $325,000 for surveys of rivers and harbors, including the proposed Miami and Erie canal.

For the Engineer Corps of the army $372,500 is recommended, which is $125,000 less than for the current year. The estimate includes the following: engineer depots $110,000, decrease of $90,000 from current year; engineer school $35,000, decrease of $10,000; engineer equipment of troops $75,000, decrease of $700,000; civilian assistants to engineer officers $40,000, no change; engineer operations in the field $85,000, decrease $135,000; military surveys and maps $25,000, no change; construction engineer wharf at Fort Mills, Philippines, $15,000, increase $12,000; construction of roads, bridges and trails in Alaska, $425,000.

Vogelson Chief of Philadelphia Bureau of Surveys

John A. Vogelson, since 1910 chief of the Bureau of Health of Philadelphia, became chief of the Bureau of Surveys in the same city on March 15, at a salary of $8,000 a year, filling the vacancy that has existed since George S. Webster resigned more than a year ago to become a member of the Delaware River Bridge Commission. Mr. Vogelson has been in the employ of the City of Philadelphia since 1901 except for brief periods while serving as principal assistant engineer of the department of water works and sewer construction at Manila, P. I., in 1905-6, and as assistant engineer on filtration with the New York City Department of Water Supply.

His Philadelphia work prior to becoming chief of the Bureau of Health in 1910 was all connected with the design, construction or operation of the various water filtration plants of that city. Before entering Cornell in 1897 (C. E., 1900), among other engagements dating from 1892, he was associated for a time with J. B. Lippincott at Los Angeles.

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York. Spring Society Meeting, Dayton, Ohio, April 5-6; Subject, "Flood Problems."

NATIONAL FIRE PROTECTION ASSOCIATION, Boston, Mass.; Annual Meeting, Atlantic City, May 9-11.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, Philadelphia, May 15-19.

The Building Officials' Conference will be held in Indianapolis, Ind. April 25-28 inclusive.

The Harvard Engineering Society will hold its regular monthly meeting at the Harvard Club, New York City, March 24. W. L. Hamilton will give an illustrated talk on the technique of aerial photography.

The Association of Professional Engineers of New Brunswick held its annual meeting at St. John, Jan. 27, electing E. B. Wass, president; C. C. Kirby, vice-president; and J. A. Waring, secretary.

The Illinois Scetion, American Water Works Association, will meet at Urbana, Ill., March 29 and 30.

The General Contractors' Association, New Orleans, La., elected the following officers at its annual meeting Jan. 31: President, A. M. Fromherz; vice-president, Lionel F. Favret; treasurer, John Reiss; secretary, J. M. de Fraites; assistant secretary, D. M. Hollingsworth.

The Engineers Club of Minneapolis elected the following officers at its recent annual meeting: President, Walter H. Wheeler; vice-president, W. T. Ryan; treasurer, O. F. Moore; secretary, Arthur F. Mellen.

The Wisconsin Engineering Society at its annual meeting held Feb. 24-25, elected the following officers: President, J. Donohue; vice-president, John C. White; secretary, Prof. L. S. Smith.

The Canton (Ohio) Engineering Society, has elected as president, E. J. Landor, engineer and contractor.

Personal Notes

WILLARD B. JONES has been temporarily appointed assistant structural engineer in the Water Department, Baltimore, Md.

W. E. SHEDDAN, former assistant City engineer of Jacksonville, Fla., has been appointed city engineer succeeding F. M. EDWARDS, resigned.

GEORGE MATTIS, formerly engineer for the California Railroad Commission and superintendent of streets of Oakland, Cal., has been appointed as one of the engineers to survey and value the property of the San Francisco-Oakland Terminal Railways.

CHARLES A. BROWNE, state highway engineer of Florida, has been appointed engineer for Orange County, Fla., to supervise the expenditure of $2,250,000 which the county has voted for road expansion. WILLIAM F. COCKE, formerly state highway commissioner, has been appointed to succeed Mr. Browne as state highway engineer.

IVAN E. GOODNER, for the past year chief engineer of the Columbia Basin irrigation project, has been appointed chief engineer of the Washington State Department of Conservation and Development with offices in the State Capitol at Olympia. In his new position he will supervise not only the Columbia Basin project, but all the state reclamation work in irrigation and drainage.

JAMES J. WALSH, who for twenty-one years had been associated with the late Howard C. Holmes, will continue the business as Mr. Holmes' successor under the name of the Howard C. Holmes Co., San Francisco, Cal.

DANIEL A. YOUNG has been appointed state engineer of Vermont succeeding Herbert M. McIntosh, resigned. Mr. Young was formerly an instructor in civil engineering at Union College, Schenectady, N. Y., but at the time of his appointment was with the state highway department of Vermont.

ALVA SMITH, for fifteen years city engineer of Emporia, Kan., has resigned. He plans to move to California.

JOHN W. LAYLE, superintendent of highways at Bridgeburg, Ont., has resigned to accept a similar position at Fort Erie, Ont.

D. H. KNIGHT of Kokomo, Ind. will succeed WILLIAM R. PAYNE, resigned, as city engineer of Frankfort, Ind.

E. R. THOMAS, city engineer of Port Arthur, Tex., has resigned. His successor has not yet been announced.

MORRIS A. ZOOK, for seven years resident engineer of the Bureau of Valuation, Interstate Commerce Commission, at Washington, has resigned to enter private practice in Plainfield, N. J.

J. F. PRICE, road supervisor of Venango Township, Erie Co., Pa., has resigned.

COL. WILLIAM BARCLAY PARSONS, Engr. O.R.C., has been appointed deputy chief engineer of G. H.Q. Engineer Headquarters of the organized reserves, U.S. Army. During the organization of the reserve forces following the World War, Col. Parsons commanded the 363rd Engineers, from which duty he is now relieved to take up the broader duties involved in his new assignment.

A. W. FUCHS was erroneously reported in *Engineering News-Record*, Feb. 16, to have resigned from the United States Public Health Service. The fact is that Mr. Fuchs is associate sanitary engineer for the service and has been detailed to make a malaria survey of the Missouri Pacific R.R.

COL. GEORGE L. WATSON, consulting engineer, New York, has incorporated his private practice with that of the George A. Johnson Co., consulting engineers, New York.

BUSINESS NOTES

THE PITTSBURGH TESTING LABORATORY announced at its annual meeting held in Pittsburgh Feb. 2 the retirement of its president, George H. Clapp, his reappointment as a member of the board of directors of the company and the election of Col. James Milliken to the presidency of the company. Col. Milliken, as a mechanical officer of the Pennsylvania R.R., has had wide experience in designing, constructing and shipping railroad equipment.

THE CONCRETE ENGINEERING CO., Omaha, Neb., has established a branch office at Dallas, Tex., in charge of Russell Jolley.

A. R. HANCE has succeeded L. T. RUSSELL as Northwestern sales manager for the Bucyrus Company with offices in Portland, Ore. Mr. Hance has been in the sales department of the company in the central and eastern territories for six years.

E. W. PITTMAN, president of Pittman-Smith Engineering Co., has been made general manager of the Penn Bridge Co., Beaver Falls, Pa.

LEO HUDSON, consulting engineer, and John P. Myron, formerly with the Pittsburgh Filter & Engineering Co., have formed a partnership under the name of Hudson & Myron, with offices located in the Wabash Building, Pittsburgh.

J. W. JOHNSTON, assistant general manager, Portland Cement Association, has been transferred from the Chicago headquarters to New York. His work in Chicago has been assumed by G. E. Warren, acting assistant general manager.

THE CHILLINGWORTH ENGINEERING CORPORATION announces that it has associated with it Frank H. Plum, Herbert Pluemer, George E. Mellin and Harold von Thaden, formerly of the C. W. Hunt Engineering Corp. and with the consent and approval of the Hunt organization will carry on a business of a character similar to that conducted by the Hunt corporation.

OBITUARY

W. K. STRINGFELLOW, for the past eight years city engineer of Findlay, Ohio, died Mar. 3.

MATTHEW FITZ GERALD, railroad contractor, who built the Oakland Avenue car line in Oakland, Cal., died Feb. 27.

H. E. STEVENS of Winston Bros., general contractors, Minneapolis, Minn., died at his home in St. Paul, Feb. 15. Mr. Stevens made the first survey of the Northern Pacific Ry. from Bismarck, N. D. to the Yellowstone Valley and later was superintendent of Shepard & Sons when they constructed the Great Northern Ry. in Minnesota and the Dakotas.

JOSEPH WOOD, director of the Pennsylvania R. R. and formerly first vice-president of the Pennsylvania Lines, West, died March 4 at his home in Pittsburgh. He was a graduate of the Pennsylvania Polytechnic College as a civil engineer, and immediately entered the employ of the Pennsylvania R.R. as a rodman. He progressed by rapid stages in the railroad service, becoming superintendent of motive power at Fort Wayne, Ind.; general superintendent of transportation of Pennsylvania Lines, West; general manager of Pennsylvania Lines, West; and later first vice-president of Lines West of Pittsburgh and president of the Vandalia Railway Co. and the Grand Rapids & Indiana Railway Co.

WILLIAM A. THOMAS, former superintendent of construction for the dock board, New Orleans, La., died recently at his home in New Orleans, aged 80 years. He had also served the city as expert in the building of levees along the Mississippi River.

HENRY P. CORBIN, consulting engineer of the International Boundary Commission between the United States and Mexico, died at El Paso, Texas, Feb. 18.

FRANK H. CLEMENT, engineer and contractor, died at Palm Beach, Fla., Feb. 18. He was formerly with the engineering corps of the Texas Pacific R.R. and later with the Southern Pacific and Northern Pacific railroads. He had engaged in construction work on the Niagara Falls power tunnel, and was a director of the Giant Portland Cement Co.

EQUIPMENT AND MATERIALS

Gas Engine Crane-Excavator

A crane-excavator which will operate either a clamshell or a drag bucket is being manufactured by the Koehring Machine Co., Milwaukee, Wis. The new machine has a lifting capacity of 20 tons and handles a one-yard clamshell bucket, loaded, at 45-ft. radius. It is mounted on crawler tractions with a full-circle swing turntable. Power is furnished by a 100-hp., four-cylinder automatic gasoline engine provided with

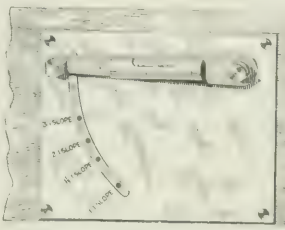


a [illegible] system and air-distributing type [illegible] starter.

The crane has three speeds, forward and reverse, and, in steering, use is made of a speed change differential, [illegible] one side faster or slower than the other side, when [illegible] to be turned. When the operator desires to change from clam- [illegible] to dragline work all that is necessary is to [illegible] the rope [illegible] of the clamshell cables from their drums, coil the cables up with the clamshell bucket and reeve in and hook fast the cables with the sockets for the dragline bucket. Another feature is a double drum with two cables for the boom hoist. The cables lead out over sheaves on each side of the boom and, after passing over the requisite number of sheaves to give the right number of parts of line, meet in an equalizer.

New Slope Level Device

A device for indicating slopes on construction work has been placed on the market by the David White Co. of Milwaukee. As shown in the accompanying drawing, it consists of a radial limb on which a spirit level tube is mounted



and an arc perforated with holes on which various slopes are indicated. The device may be attached to any straight-edge or board and the slopes secured by setting the arm at the notch specified and bringing the level bubble to the center of its tube.

A New Industrial Locomotive

A seven-ton gasoline locomotive has been developed by the Industrial Equipment Co., Minster, Ohio, formerly The Cummings Machine Co. It has an all-steel box-girder frame; special high-manganese-chrome alloy steel is used in the axles, jack shaft and friction-disc shaft, and Carnegie rolled-steel wheels



are used. The power unit is a Buda engine.

To insure maximum transmission of power and proper alignment of all working parts the engine and drive-disk assembly are combining in one complete unit with a two-point suspension, the recognized standard today in the automotive field.

A number of parts are eliminated by changing the method of braking. When the brake is applied two heavy iron shoes, diametrically opposite, grip a [illegible] brake wheel on the jack shaft. With a pressure of approximately [illegible] it is possible to [illegible] the [illegible]. Another special feature is the stationary [illegible] at either end of the [illegible] in order to get forward, reverse and change in speeds.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Rapid-Fire Survey of Business Conditions

Postal savings transactions in February showed a slight increase in deposits over withdrawals for the first time since January, 1921.

New bond issues offered last week exceeded $87,000,000, and by groups were as follows:

Foreign	$34,250,000
Public utility	8,710,000
Industrial	5,900,000
Railroad	12,025,000
State and municipal	23,774,600
Land Bank	4,800,000
Total	$87,459,000

The feature of the market was the Treasury Department's announcement of a new issue of four-year non-callable, tax-exempt 4¾-per cent certificates, to mature March, 1926, which may be acquired only through exchange of Victory 4¾s. Public utility financing was heavier than for any other week this year.

Call money was at 4@5½ per cent last week; time loans at 4¾@5. The present bond market is largely controlled by the money market, where funds are easy.

Business depression and unemployment will be studied at a conference of representatives of trade associations, Chamber of Commerce of the United States, Department of Labor, and the President's Unemployment Conference, called for March 21 by the Department of Commerce.

An economy minister for Germany, or a "minister to effect savings" is a demand by the Stinnes-Stressmann German People's Party that has been acceded to by the Wirth Government.

English wholesale prices declined, according to the Economist's index number, from 4,284 to 4,239, at the end of February, which is the lowest since July, 1916. Comparison of averages for the different groups is as follows:

	Mar. 1. 1922	Feb. 1. 1922	Mar. 1. 1921
Cereals and meat	948.0	907.5	1,176.5
Other food products	640.5	654.5	771.0
Textiles	1,037.5	1,066.5	1,038.0
Minerals	696.5	730.0	1,053.0
Miscellaneous	936.5	925.5	1,137.5
Total	4,239.0	4,284.0	5,176.0

French living cost is estimated to have decreased only 20 per cent since the closing months of 1920. Taking the first half of 1914 as 100, the total average cost of living was 370 in the first quarter of 1920, and 297 in the last quarter of 1921.

Retail food prices declined in seven of fifteen representative cities of the United States, according to the Bureau of Labor Statistics, as follows: Kansas City, 4 per cent; Louisville and Jacksonville, less than 0.5; Little Rock, Pittsburgh, Providence and Charleston, 1. In seven cities there were increases. Minneapolis and St. Paul, 2 per cent; Baltimore, Indianapolis, Milwaukee and St. Louis, 1; Detroit, less than 0.5. As compared with the average cost in the year 1913, the retail cost of food on Feb. 15, 1922, showed an increase of 47 per cent in Baltimore and Fall River; 46 in Providence; 45 in Detroit; 42 in Milwaukee; 40 in Minneapolis and St. Louis; 38 in Pittsburgh and Jacksonville; 37 in Indianapolis; 36 in Kansas City; 33 in Little Rock; and 31 in Louisville.

Pig iron output per day in gross tons has been at the following rates during each month since the end of the war.

	1922	1921	1920	1919
Jan.	53,063	77,945	97,264	106,525
Feb.	58,214	69,187	102,720	105,006
Mar.	.....	51,468	108,900	99,685
Apr.	.....	39,768	91,327	82,607
May	.....	39,394	96,312	68,002
June	.....	35,494	101,451	70,495
July	.....	27,889	98,931	78,340
Aug.	.....	30,780	101,529	88,496
Sept.	.....	32,850	104,310	82,932
Oct.	.....	40,005	106,212	60,115
Nov.	.....	47,183	97,850	79,745
Dec.	.....	53,196	87,222	84,944

Steel production is at the rate of approximately 20,000,000 gross tons a year, which is 3 per cent higher than the average rate of 1912 and 1913.

"Corner Turned in Birmingham" writes the assistant chief engineer of the Tennessee Coal, Iron & R.R. Co., who is Construction News correspondent in that city; "the Tennessee Co. has blown in two blast furnaces in the last two weeks that have been idle for a year and is preparing another for blast. Other companies are doing the same. Construction news should increase in quantity and value very shortly." Cast-iron pipe makers shipped 10,000 tons to the Pacific coast in January and have loaded 3,000 tons since then for the same destination. The Japanese Government ordered 14,000 tons of rails early this year and an additional 10,000 recently. Three cargoes have moved out of Mobile for Japan this year.

Petroleum output of the world for 1921 was 759,030,000 bbl., an increase of 9.2 per cent over 1920, according to the American Petroleum Institute. The following countries exceeded 10,000,000 bbl.:

	1000 Bbl. 1921	1000 Bbl. 1920
United States	469,639	443,402
Mexico	155,064	163,540
Russia	28,500	25,429
Dutch East Indies	18,000	17,529
Persia	14,600	12,352

Fuel oil used by United States railways in 1921 amounted to 27,615,000 bbl. domestic and 11,209,000 bbl. Mexican, against 33,986,000 bbl. domestic and 11,861,000 Mexican in 1920.

Unfilled tonnage on the books of the U. S. Steel Corporation at the close of February was 4,141,069, as compared with 4,241,678 at the close of January. This is the lowest figure reported since September, 1914.

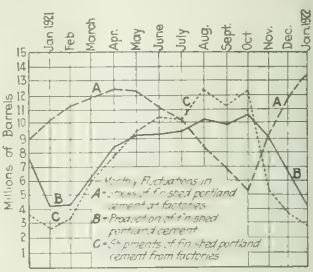
Employees doubled in number in Detroit industries since March 1, 1921, according to the Employers' Association. The increase from January, 1922, to February was 8,664.

Factory workers' earnings were $3.18 per week lower in January, 1922, than

(Concluded on p. 467)

Cement Output in 1921 and January, 1922

The statistics shown in the following table, prepared under the direction of F. F. Loughlin, of the United States Geological Survey, are based mainly on reports of producers of portland cement, but in part on estimates. These estimates were made necessary by



the lack of returns from three large producers. Production for January, 1922, was 46,000 bbl. fewer than in January, 1921; shipments, 290,000 bbl. more; stocks, 2,848,000 bbl. more.

PRODUCTION, SHIPMENTS, AND STOCKS OF FINISHED PORTLAND CEMENT IN JANUARY, 1922, AND IN 1921 BY MONTHS

Month 1921	Production (bbl.)	Shipments (bbl.)	Stocks at end of Month (bbl.)
January	4,098,000	2,539,000	10,300,000
February	4,379,000	3,331,000	11,400,000
March	6,763,000	6,221,000	12,000,000
First Quarter	15,240,000	12,091,000	33,700,000
April	8,651,000	7,919,000	12,600,000
May	9,281,000	9,488,000	12,450,000
June	9,296,000	10,577,000	11,150,000
Second Quarter	27,228,000	27,984,000	36,200,000
July	9,568,000	10,301,000	10,414,000
August	10,244,000	12,340,000	8,280,000
September	10,027,000	11,329,000	6,953,000
Third Quarter	29,839,000	33,970,000	25,647,000
October	10,506,000	12,114,000	5,348,000
November	8,921,000	5,195,000	9,091,000
December	6,559,000	3,697,000	11,938,000
Fourth Quarter	25,986,000	21,006,000	26,377,000
1921 total	98,293,000	95,051,000	121,924,000
1922 January	4,052,000	2,829,000	13,148,000

The Bureau of Foreign and Domestic Commerce, of the Department of Commerce, reports that imports of hydraulic cement in January amounted to 17,036 bbl., valued at $37,595; the total for 1921 was 122,317 bbl. valued at $388,828. Exports of hydraulic cement in January were 70,725 bbl. valued at $204,899; total exports in 1921 were 1,181,014 bbl. valued at $4,276,986. The exports in January went to Cuba and the other West Indies, 21,097 bbl.; South America, 22,902 bbl.; Mexico, 13,651 bbl.; Central America, 12,367, bbl.; Canada, 231 bbl.; other countries, 477 bbl.

Next week—Earnings of well-known companies in 1922 and 1921 tabulated.

Car Surplus, Shortage and Freight Loading

The total revenue freight loaded for the week ending Feb. 18, 1922, was 780,924 cars, a decrease of 7,488 cars from the preceding week. This is the first decrease in loading for the year to date, the climb having been consistently upward since the holiday week ending Jan. 7. The reduction in the loading can probably be attributed very largely to the fact that Lincoln's birth day was celebrated as a holiday in many parts of the country. The decline affected nearly all commodities, with the exception of miscellaneous which gained 1,469 cars, and live stock, 53 cars.

SURPLUS AND SHORTAGE STATEMENT—FEB. 15 TO 23, 1922

Districts	Flat Cars		All Box Cars		All Coal Cars		Total All Cars	
	Surplus	Shortage	Surplus	Shortage	Surplus	Shortage	Surplus	Shortage
Eastern	2,185	.....	21,707	173	27,954	.....	54,785	197
Allegheny	2,135	.....	19,396	.....	48,559	.....	72,566	.....
Pocahontas	219	.....	1,257	.....	1,330	.....	4,326	.....
Southern	3,262	8	13,687	66	13,300	11	34,140	87
Northwestern	2,686	15	20,972	.....	2,415	.....	33,850	35
Central Western	2,189	.....	19,067	72	8,629	34	46,949	106
Southeastern	980	.....	9,852	62	3,374	.....	18,198	92
Total	13,656	23	105,938	373	105,570	45	264,814	517
Canadian Roads	5,100	.....	27,815	.....	275	.....	40,550	.....
Grand Total	18,756	23	133,753	373	105,845	45	305,364	517
Jan. 23, 1922	17,967	26	188,379	190	185,589	7	437,687	517

The serviceable car surplus for the week ending Feb. 23 was 264,814 cars, a decrease from the preceding week of 13,667. Box and coal cars contribute about equally to this surplus, being 105,938 and 105,570, respectively.

Later reports show 417,964 freight cars idle on Feb. 28, compared with 437,678 on Feb. 23, or a reduction of 19,714.

Of this total, 245,100 were surplus freight cars in good repair and immediately available for service if traffic conditions had necessitated them being placed in use while the remaining 172,864 were freight cars in need of repairs in excess of the number normally regarded as being unfit for service because of their physical condition.

Surplus box cars in good repair totaled 95,361, a reduction since Feb. 23 of 10,577, while surplus coal cars in good order numbered 97,634, which was a reduction of 7,936 within the same period. Tabulations show a decrease in slightly less than a week of 1,018 in the number of surplus stock cars, the total being 19,955.

Cement Prices at Lehigh Mills

Cement quotations at mills of the Lehigh Portland Cement Co. arrived too late to be incorporated in the regular monthly price list in the Mar. 2 issue of *Engineering-News-Record*. Current prices, in carload lots, to contractors, not including charge for bags, are based upon the following mill prices:

Metropolitan District	$ [illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

Laborers Union in San Francisco Volunteers Wage Reduction

San Francisco street laborers of the United Laborers Union, No. 1, have voluntarily agreed to a wage reduction from $6 to $5 per day. This affects about 250 men on the employ of the city board of public works.

Open Shop Reported Successful in Dallas

No serious labor troubles have been encountered in Dallas, Tex., since the Open Shop Association has been operating. *Dallas*, the official publication of the Dallas Chamber of Commerce, reports that the organization has 1,000 members and placed 9,811 workers in 1921 with its free employment bureau. About $30,000,000 worth of building permits have been taken out in the last two years. At a recent meeting builders stated that a specification with an open-shop clause in the building contract was a guarantee that the structure would be built without delay and the owner would receive a full day's work for a full day's pay.

Review of Business Conditions

(Continued from p. 466)

in January last year, in New York state. Part time schedules and elimination of overtime brought down the average earnings to $24.34 per week.

Building permits in February 1921 and 1922 issued in four cities were:

	Feb. 1922	Feb. 1921
Syracuse, N. Y.	$178,520	$229,640
Rochester, N. Y.	376,215	390,358
Binghamton, N. Y.	134,307	48,138
Los Angeles, Cal.	7,579,798	3,131,670

Chicago permits in February numbered 634, of which 288 were for residences and 192 for apartments. This record exceeds the permits taken out in any previous February in the city's history. Permits for construction involving $21,485,350 were taken out in January and February.

Representative Public Bond Sales in February

Municipal bond sales in the United States, for the month of February, 1922, exceeded $67,000,000, as against $65,000,000 for February, 1921. Among the important issues of the month were: City of Philadelphia, Pa., $9,000,000 4.25s; Pittsburgh School District, Pa., $5,000,000 4.3s; State of Massachusetts, $4,000,000 4.023s@4.23s and State of Georgia, $3,000,000 6.85s. Following are some representative sales:

REPRESENTATIVE BOND SALES OF FEBRUARY, 1922

State	Purpose	Amount	Maturity	Rate Per Cent	Yield Per Cent	Sold For	Dated
[illegible]	Water	32,000	1923–54	4½	3.91	103.089	Mar. 3, 1922
	Sewer	100,000	1922–61	4			
Massachusetts	Sewer	213,000	1922–59	4½			
	Park	230,000	1923–43	4½			
	Water	500,000	1923–62	4			
New Mexico	Highways	1,000,000	1932–52	5		101.7946	Jan. 1, 1922
Acadia Parish, La.	Levees	177,000		6		100.14	
Allen Ind.	Hospital	140,000	1922–41	5½	5.23	102.028	Feb. 1, 1922
Beaver Creek Irr. District, [illegible]	Irrigation	583,000		6		95	
Fresno Co., Calif. Reclam. Dist.	Irrigation	583,000		6		95	
School Dist. Wash.	School Bldg.	20,000	Due yearly 1925–40	5½		100.10	Mar. 1, 1922
Charlottetown, N. S.	Highways	250,000	$200,000 Apr., 1927 $ 50,000 Apr., 1928	5	4.34	102.968	Apr. 1, 1922
Clinton, Ind.	Hospital	100,000		5		100	Feb. 11, 1922
School District, [illegible]	School Bldg.	150,000	Due yearly 1923–41	5	4.87	101.16	Mar. 1, 1922
[illegible]	Highway	58,368	1941	4½		100	Dec. 1, 1921
[illegible]	[illegible]	500,000	1924–51	4½	4.18	104.072	Feb. 1, 1922
[illegible]	Highways	145,000	1927–36				
Grand River Drainage Dist., Mo.	Drainage	600,000		5½		96.40	
Hancock, Ohio	Bridge	7,500	1923–26	6		100	Jan. 15 1922
[illegible]	Drainage	38,500	1928–42	5	4.98	100.17	Mar. 1 1922
[illegible]	Road	150,000	1952	6		102.93	
Paradise Irr. Dist., [illegible]	Irrigation	140,000		6		95.07	
[illegible]	Court House	200,000	$8,000–1925–38 $10,000–1939–43 $12,000–1944–62	5½	5.16	101.17	Mar. 1 1922
	Bridge						
[illegible]	Road	56,000	1932–42	5½		97	Mar. 1, 1922
[illegible]	[illegible]	400,000	1925–51	5	4.76	102.71	Jan. 1 1922
[illegible]	[illegible]	[illegible]					
[illegible]	[illegible]	[illegible]					
[illegible]	[illegible]	[illegible]				

Plumbing Contractors in Chicago Accept Landis Award

Fifty leading plumbing contractors in Chicago have signified their intention of operating their shops under the terms and wages of the Landis award. The rules posted in each shop state that the new agreement would go into effect Mar. 11, that all union rules and restrictions would be eliminated at that time and that any competent plumber would be employed regardless of his union affiliations. To establish the fact that union men will work with non-union men, one non-union man will be put to work to every five employees should the old employees remain at work.

The plumbers were in a position to hamper seriously many of the construction jobs which have been going on with the backing of the citizens committee to enforce the award. F. W. Armstrong, general manager of the citizens committee states that the action of the plumbers means $750,000 worth of new plumbing contracts.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of March 2; the next, on April 6.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$2.63	$3.25	$4.00	$2.63—$2.66		$3.50	$3.10	$3.25	$3.75
Structural rivets, 100 lb	3.50	3.80	5.50	3.43	3.90	4.25	4.50	—3.75	6.50
Reinforcing bars, ¾ in. and larger, 100 lb	2.53	3.15	3.50	2.53	—2.56	3.42½	2.75	3.25	2.75
Steel pipe, black, 2½ to 6 in. lap, discount	61%	68%	45%	59½%	61.9–5%	44%	58.8%	53%	35.10
Cast-iron pipe, 6in. and over, ton	47.30@48.30	37.63	48.30	+43.10@44.60	46.00	52.00	48.00	+50.00	55.00
Concreting Material:									
Cement without bags, bbl	+2.40	2.39	—2.25	1.94	2.24	2.90	2.73	2.94	2.40
Gravel, ¾ in., cu.yd	1.75	1.85	+2.25	2.00	1.50	2.50	2.25	1.50	1.50
Sand, cu.yd	1.00	1.15	+2.25	2.00	1.00	1.10	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd	1.75@1.85	1.90	—2.73	1.60	2.25	3.50	2.25	3.00	2.00
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	49.00	37.00	34.00	43.00	38.00	34.75	—28.00	20.00	.....
Lime, finishing, hydrated, ton	15.80@16.80	18.00	25.00	18.00	29.00	24.00	22.00	27.00	21.00
Lime common, lump, per bbl	2.75@3.48	1.25	2.50	1.40	1.40	2.70	1.75	2.75	11.00
Common brick, delivered, 1,000	—19.40@19.90	8.75	+11.15	11.00	15.00	12.00	15.50	14.00	16.00
Hollow building tile, 4x12x12, block	Not used	.07975	— 115	.0821	.0752	.08	....	.10	.20
Hollow partition tile 4x12x12, block	.11120	.06525	—.115	.0657	....	.10	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal	.87	.94	+.109	.97	—.98	1.14	+1.06	.86	1.05
Common Labor:									
Common labor, union, hour	.60	.35	.....	.72½	.....	.50@.55	.56¼	.50@.60	.....
Common labor, non-union, hour	.....	.20	—.25	.35@.40	.40@.50	.35@.40	.47½@.56	.50	.20@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations are delivered except tiles, which are "on trucks." Common lump lime per 280-lb. net; both lump and hydrated quoted f.o.b. cars New York. Sand gravel and crushed stone are quoted alongside dock. Cement and steel pipe delivered to contractors on job. Gravel ready mixed $2 per cu.yd.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed store quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to contractors in yards at San Francisco. Lumber price is for No. 1 fir, common.

Seattle quotes on Douglas fir instead of pine. Common lump lime per 180-lb. net.

Montreal quotes sand, stone, gravel and lump lime per ton. Lime and tile are delivered; cement, sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 96.38 cents). Bag change is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net.

Changes Since Last Week

The minimum price of structural steel shapes and reinforcing bars, at the Pittsburgh mills, is practically confined to $1.40 per 100 lb. on large tonnages. The nominal quotation of $1.50 on the part of certain independent manufacturers has made it increasingly difficult to purchase at the recent price of $1.35 @$1.40. Steel shapes are quoted at $2.26 as against $2.91 in Minneapolis warehouses; reinforcing bars at $2.56 as compared with $2.81 per 100 lb. last week. Seattle quotes structural rivets at $3.75 reduced from $4 per 100 lb. Cast-iron pipe up $5 per ton in Seattle; slight advance in Chicago. Advance of $1 per M. ft. on Douglas fir in San Francisco. Linseed oil down 3c in Minneapolis and advanced 2c. per gal. (5 bbl. lots) in San Francisco.

Dealers' prices on portland cement in carload lots, f.o.b. Montreal, are quoted at $2.40 shipped by rail from the mill and at $2.45 per bbl. by tramway. Consumers' prices quoted at $2.70 f.o.b. railway siding and $2.73 f.o.b. tramway. Prices to consumers in less than carload lots are quoted at $3 per bbl. at the warehouse and $3.38 on the job. All prices are net, not including bag charges, discount for cash or Government sales tax.

A total of 386 mills reporting to the National Lumber Manufacturers' Association for the week ending Mar. 4, show 177,466,413 ft. of lumber cut; 176,745,070 ft. shipped and orders for 176,022,065 ft. b.m. Production stands at 25 per cent; shipments at 25½ per cent and orders at about 28 per cent below normal.

Seattle reports building construction greatly increased; unemployment situation also visibly improved during the last week. Common labor, non-union, is obtainable in Dallas at 25c. as against the old rate of 35c. per hr. Chicago building trades accept new wage cut.

A Consolidation of Engineering News and Engineering Record

McGraw-Hill Company, Inc.—James H. McGraw, President

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. Mehren
Editor

Volume 88 | NEW YORK, MARCH 23, 1922 | Number 12

Tablet to Alfred Noble

IT WAS a fine thing for the American Institute of Consulting Engineers to put a tablet commemorative of Alfred Noble in the Engineering Societies' Building. No civil engineer of recent years, probably no civil engineer in American annals, fastened himself so securely in the sympathies of American engineers. He was not merely a great engineer, but a kind-hearted, high-thinking and, above all, a modest man. So outstanding were his qualities that for the last dozen years of his life he was accorded the place of leadership by his fellow engineers with none to dispute his position. Had there been no tablet to him, his engineering works would have proclaimed his greatness, but they could not have told future generations of the esteem and affection in which he was held by his contemporaries. This the new tablet will do. It is an expression of regard that will pass to coming generations the feeling of his own age toward a great American engineer.

The Monument Proposal

LAST week's unveiling of a tablet to Alfred Noble suggests inquiry as to the fate of the project to erect a monument to him in Washington. It was a worthy proposal. It would not only have done honor to one deserving of it, but would have been a symbol of the public service rendered by engineering. We understand that the increase in costs has pushed into the future the realization of the project. It should not be dropped. The tablet in New York does not take the place of the monument. The former speaks only to engineers. The monument would express the importance of engineering to the whole public.

Engineering Memorials

IT IS gratifying to learn that the United Engineering Societies, operating the Engineering Societies' Building in New York, is encouraging the erection of memorials in the building, and that it has adopted rules to insure the maintenance of harmony and of artistic standards. In this country, we are not sufficiently mindful of the past. We have grown so rapidly that precedents have been quickly supplanted. In fact we have prided ourselves that we are not bound by precedent. Undoubtedly it is necessary and wise to adapt ourselves to changing conditions, but nevertheless we stand on the shoulders of the past and daily use its store of knowledge and experience. We should do honor to its achievements, pay our respects to its pioneers and draw inspiration from its victories. Memorials in the societies' building will help accomplish these ends.

Not only are tablets to be encouraged, but other forms of reminders—such as busts and statues—are called for. Events as well as men are to be commemorated. Already it has been suggested that there should be tablets to the engineering regiments which served in the great war—a fitting subject in a fitting place.

There should be a steady response as the years go by to the encouragement of the United Engineering Societies.

Wayside Gravel Pits

GRAVEL production from wayside pits for road building is receiving the fire of commercial producers. They charge that where the practice has been followed, particularly by highway departments doing force account work, true costs are seldom disclosed and that inferior material is produced. Two articles, by J. A. Prior and H. J. Kuehling, published last week and in this issue, touch somewhat on both cost and quality of product from local pits. Production cost is really not a factor of the problem. With freight rates against them the commercial producers have no chance in cost competition with local pits. It is cost of gravel in the road that counts with the highway official and so long as freight rates put a handicap of hundreds of dollars per mile of road on all gravel that has to be hauled by railway car, the probable higher production cost of wayside-pit practices will be regarded with equanimity. There is point, obviously, to the charge that quality is inferior because these local developments have neither the equipment nor the skilled direction of the commercial plants. This chance of inferiority increases as screening and washing become necessary at local pits. Pit practices are not abstruse, however, and there are few instances where gravel production for concrete aggregate cannot be confidently undertaken. In brief, the commercial sand and gravel producer has to accept the handicap of haulage costs which a permanent plant location imposes, or he has to become a peripatetic producer with portable plants moving to where construction is going on. Is not this last alternative the solution of the gravel producer's problem of finding a market in road work?

High-Head Impulse vs. Reaction Wheels

INTEREST in the water wheels installed at the Caribou Plant, described on another page, does not center entirely in the fact that they are the largest impulse turbines ever built but also in the selection of this type of wheel in preference to the reaction turbine, which has so rapidly come to the front of late for high heads. While no reaction wheel has been built for so high a head as at Caribou, the development has been in that direction and such a wheel was seriously considered in this design. Final decision in favor of the impulse wheel was made on account of its probable greater reliability, simplicity and readiness of renewal, in spite of the lower first cost and higher efficiency of the reaction turbine. Where so much power is concentrated in one unit, particularly in a location so remote as is common in the Pacific Coast plants, the considerations that favored the impulse wheel outweigh the gains due to slightly greater efficiency and low cost.

Ingenious Railroad Location

THE way in which the contractor works out the transportation problem on a remote job may easily make the difference between profitable and a losing venture. The need, therefore, for an accurate analysis of transportation conditions increases with the inaccessibility of the scene of operations. While there is room for wide difference of opinion in the solution of a complex transportation situation, fundamentally there is always a right and a wrong way in which to attack the problem. It is always a safe course, for example, to search for and utilize the natural advantages. On the Caribou project, survey parties tried to locate a construction railroad around the face of a high cliff. There were reasons why the line should be kept near a certain level, but construction along this level would be costly and blasting would interfere with the operation of an important power flume that wound around the cliff for 1½ miles at about the same level. In other words, the problem seemed the more difficult because of the flume. However, the plan finally evolved was to build the railroad on a trestle over the flume, thereby avoiding rock excavation altogether and using two miles of flume for floating the trestle timbers, without transportation cost, to the exact spot desired. Often the practical eye will find natural advantages where none are readily apparent but the acme of ingeniousness is to turn to advantage that which at first appears as an obstacle.

An Episode

ROMANCE—that is, the extraordinary, the different, the adventurous—is the commonly accepted perquisite of engineering. Most engineers, to be sure, rarely experience it. Their daily work is as the daily work of other men, pleasant and absorbing if they like and are suited to it, mere drudgery if they have missed their vocation. Once in a while, though, there breaks through the clouds of practicality a ray of pure romance, the kind the story book writers delight to tell about and so few engineers realize. The Caribou job brings one such to mind. The scene is the superintendent's office in the mountain camp at the end of that twenty-mile line of tunnels, reservoirs, inclines and construction road. The telephone rings and word comes that ten miles away in the wettest of the wet tunnels a pump has broken. It is nine o'clock at night and the foreman says that he can keep the water down to safe limits until about four the next morning; if a new part is not in place by then they will have to abandon the heading. The superintendent gets busy on the phone. The machinist, in the main camp, hasn't the broken part but in two hours time he can make one, provided he can get together the men who have gone off work. The construction train is somewhere along the line; it is located and ordered back to the machine shop, with flat car and steam up ready to start as soon as the new part is put aboard. Schedules are rapidly worked out and men assigned to each of the two inclines, shut down for the night, where the car has to be lifted up the thousand or more feet to the upper level. Repair men are rushed to the tunnel itself to put together the broken pump. Meanwhile bulletins from the sump, the machine shop, the inclines and the railroad piece together the procedure that will keep the water down. The activity of many men, all working to a common end, centers here in this little room where one man, seeing the job as a whole, justifies his position as directing head. A common enough episode, perhaps, but of the very essence of engineering and one in which even the prosaic engineer may recognize some of the elements of romance.

Fire Resistance Obligations

EXPOSURE fires of such magnitude as that in the Burlington Building in Chicago are sufficiently rare to cause some concern when they do occur. Queries as to the sufficiency of our fire-protection practice naturally arise when a modern building, which satisfies any accepted requirements of city code or underwriters' rulings, is gutted of its contents in less than an hour. The disposition may well be to inquire whether after all wire-glass should not be required in front as well as in rear exposures to guard against the risk of burning structures across a street. In this, as in all other fire protection questions, a reasonable attitude must be taken. It must be recognized that absolute protection against fire is impossible and that the ideal fire-resistant vault cannot be duplicated in a building in which people must live or work. Furthermore there is an economic limit beyond which protection against the occasional danger cannot be carried. Wire-glass on street fronts would decrease exposure risk but whether enough to warrant its imposition by law is certainly doubtful. Rather does it seem that improvement in codes and laws must be expected in the removal or restriction of those structures which menace their better built neighbors. Is it wiser to require the owner to erect a building safe against any possible danger that his neighbor may invite, or *all* owners to reduce the hazards to which they subject adjoining property?

Rates a World-wide Problem

AMERICAN railroad men will be interested to learn that their British brethren are grappling with problems very like their own. British business men are now working for a reduction of railway rates to a general level 50 per cent above prewar figures with rates on small lots 100 per cent above prewar. The railways would like assurance that such reductions will stimulate traffic. They are told that the lower rates *may* stimulate traffic but that the present rates will, in all probability, take away some that they now enjoy. This "assurance" does not seem to have aroused great enthusiasm on the part of the railways. Freight in the United Kingdom is seeking the highways. Hardware, we are told, is now being distributed from Manchester by road up to a distance of 40 miles. Cotton in large volume travels by road from Liverpool to Manchester. Dundee firms have diverted from 25 to 80 per cent of their traffic to sea and highway. So great have these defections become that the railways are now pressing for authority to engage in highway transportation. This is opposed by some of the business organizations but there seems to be a feeling that such a step would be reasonable and might lead to an effective co-ordination of rail and highway transportation that would make for the general economic advantage. Sooner or later we too shall find ourselves turning toward the creation of a national transportation machine that will link up effectively, each in its proper place, the railroads, the waterways, and the highways of the United States.

Staking Out the Airways

IN THE March 2 issue of the *Engineering News-Record* it was reported that the board of directors of the Chamber of Commerce of the United States had authorized the appropriate department of the chamber to urge legislation looking to the promotion and regulation of commercial air transportation. The personnel of the advisory committee that recommended this action appears to indicate that it is the product of hard-headed business thought rather than of visionary enthusiasm. That the step is timely is indicated by the almost simultaneous announcement of a corporation which plans to engage in air transportation on a large scale as a commercial enterprise. Sooner or later, of course, air transportation must submit to the yoke of federal regulation. Much is to be gained, therefore, by laying down now a broad and soundly conceived foundation upon which to develop as the industry progresses an effective code of air regulations designed to meet both governmental and commercial requirements. Such a course will make for genuine and uninterrupted progress and will make it possible to avoid a repetition of the harrassing and wasteful confusion that has attended the imposition of governmental regulation on our railroads and other public utilities. In such matters the stitch in time may save ninety and nine.

Changes in Sewage-Works Plan at Indianapolis

ALTERED conditions of financing and increased knowledge of sewage treatment no doubt contributed largely to the decision of the Indianapolis Board of Sanitary Commissioners to treat screened sewage by the activated-sludge process—but for only half of the year—instead of adopting filters and humus tanks for the secondary process, as advised by George W. Fuller in 1917. C. H. Hurd, in an article elsewhere in this issue, estimates that the change will save $1,000,000.

Mr. Hurd's experiments on barrel screens, placed tandem, three in a channel, followed by a concentrate or sludge thickener, have convinced him that 30 per cent of the solids can be removed if the sewage comes to the screens without pumping or other undue agitation. His apparatus is old in the paper mill industry. Mr. Fuller estimated a 10-per cent removal by screens, although he stated that higher percentages of removal were possible with sewages containing trade wastes carrying suspended matter of relatively large size, a condition usually existing in Indianapolis sewage because of the packing-house industry.

Full advantage has been taken of the fact, which Mr Fuller recognized, that the White River can care for a clarified sewage half the time. Closing down the activated-sludge plant half of the year will reduce operating costs by saving aeration charges and will simplify the sludge-disposal problem. Moreover, the plant has been so designed that no pumping is necessary to put the sewage through the screens or primary clarification process.

Five years ago much was made of the recovery of nitrogen. Now with a dull or no market for fertilizer and the sludge-drying problem not fully solved, it is significant that the activated-sludge treatment is still looked on with favor. The numerous engineers who have stood on the banks of the Houston Ship Channel at the outlet weir of the activated-sludge plant at Houston, Tex., and noted the crystal clearness of the effluent, could not but be favorably impressed regardless of the fact that the sludge dewatering and fertilizer-recovery problem had not been solved.

The Indianapolis results with both the new type of sewage screens and the activated-sludge process will be awaited with interest by the sanitary engineer. Interest is heightened and expectations increased by the fine laboratory and experimental equipment wisely provided by the Board of Sanitary Commissioners.

Morris Canal Abandonment and New Jersey Water Supplies

ABANDONMENT of the Morris Canal in New Jersey, provided for in legislation noted in this week's news section, means more than the final obsequies over another disused inland waterway. Wisely and justly consummated, the negotiations for abandonment would greatly simplify some of the business and political factors entering into a solution of the water-supply problems of the New Jersey Metropolitan District in accordance with any one of three of the four plans outlined in the report by Allen Hazen, abstracted and commented on editorially in our issue of March 16. Canal abandonment in favor of the state would increase the safe yields from these projects, since because of the canal claims Mr. Hazen's estimates were lessened by amounts which, although small compared with his totals, are considerable daily quantities of water.

More significant than the amount of water involved is the removal of a long-standing source of contention in the State Legislature and in the municipal water problems of northeastern New Jersey that would result from a wise and just outcome of negotiations for the abandonment of the Morris Canal. Such an outcome would give the State of New Jersey and its most important group of municipalities a better chance than has existed since the failure to adopt the recommendations of the State Water Supply Commission report of 1884 to work out a joint water-supply project that would provide adequately and cheaply for the needs of the New Jersey Metropolitan District for 50 to 100 years to come. This would need to be followed by the acquisition for the district of sources af water supply developed and now owned and operated by the East Jersey Water Co. and its associates, partly under cover of these very Morris Canal rights. These private interests are entitled to just compensation for doing what the state and the municipalities failed to do in the way of providing water supplies. It is believed by many that attempts to monopolize the water supply of the New Jersey Metropolitan District have not been so profitable as was expected and that this, together with the gradual extension of the state control of sources of water supply and of charges for water, combine to make the allied interests quite willing to accept a fair value for their water properties in northeastern New Jersey.

The New Jersey situation presents an opportunity for broad-minded co-operation by state and municipal interests on the one side and private interests on the other to end a conflict that has lasted forty years and that should no longer be continued as a bar to important to municipal life, health and prosperity as that of public water supply.

High Head Impulse Wheels at New Feather River Plant

Caribou Hydro-Electric Plant in California Has Two 30,000-Hp. Impulse Turbines Under 1,008 Ft. Head—Water Brought From Headwater Reservoir by Tunnel, River and Pipe

In the Caribou hydro-electric plant on the Feather River in California there is an excellent example of Western water-power practice, both in the pioneer nature of the construction and in the development of flow and head through a series of reservoirs and tunnels. The plant is described here in two articles, the first on the general features by a member of the staff of the firm which designed and built it and the second, on the complications surrounding the early construction, by a member of the staff of this journal. In the "From Job and Office" section of this issue will be found some further notes on the construction of the plant.—Editor.

General Features of Design of the Caribou Plant

By Albert A. Northrop
With Stone & Webster, Inc., Boston, Mass.

As a part of the consecutive development of the Feather River in California the Great Western Power Co. has recently completed the initial development of the Caribou hydro-electric plant by the installation of two 30,000-hp. double-hung impulse turbines operating under 1,008 ft. head. The final capacity of the power house will be six similar units. The work included building a dam, driving two tunnels and the construction of an inclined penstock, partly in pipe line and partly in tunnel as well as the construction and equipping of the power house proper, all in a remote district to which new railways and roads had to be built.

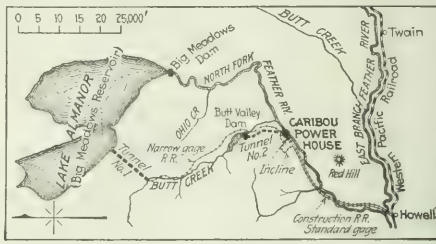
The Feather River, second largest in potential power of the four big California streams, rises in the Sierra Nevada Mountains in Plumas County, some 200 miles north of San Francisco. It flows west and then south for 140 miles until it joins the Sacramento in the broad and gently sloping Sacramento Valley. The upper half of the stream contains about 640,000 potential horse power in a total fall of a little less than 5,000 ft. A mining venture was the forerunner of the first Feather River power plant. To furnish water under a high head for hydraulic sluicing operations, a tunnel was driven through the mountain to connect the two ends of a great bend of the river. When California made hydraulic sluicing unlawful, in order to save her rivers from filling with silt, the Great Western Power Co. purchased the tunnel, together with the water rights. At this site they built the Big Bend hydro-electric station in 1909 with an installed capacity of 87,000 hp.

Four years later a storage reservoir, holding 300,000 acre feet, was created high up in the mountains to regulate the flow of the stream near its headwaters. An earth dam was built across the north fork of the river at a place called the Big Meadows, about 35 miles up stream from the Big Bend plant. There, at an elevation of approximately a mile above the sea, a reservoir called Lake Almanor, was formed covering 15,500 acres of almost level ground. The lake is fed from a drainage area of 504 square miles of snow topped mountains.

With this great store of water an accomplished fact, the development of the entire stream became commercially attractive. Seven power plants are planned, which will utilize 85 per cent of the 4,285 ft. fall in the 75 miles from the Big Meadows reservoir to Oroville, and will develop a total of 640,000 hp.

The Caribou plant, the second of these, is about 25 miles above Big Bend and 10 miles below Big Meadows reservoir. It is some 200 miles north by northeast of San Francisco near the main line of the Western Pacific Ry. at Belden, Plumas Co., Cal. A ten-mile construction railroad runs from this station to the power house.

The plant has an installed capacity of 60,000 hp. with space provided for another 30,000-hp. electric unit in the present power house. Eventually the power house will be doubled, additional tunnels driven and a total of 180,000 hp. developed at this location.



LOCATION OF CARIBOU TUNNELS AND POWERHOUSE

As stated, the water is led from the Big Meadows reservoir to the power house by means of tunnels. The first tunnel taps the floor of the reservoir and leads the water under about 250 ft. of cover to a neighboring valley. Here it discharges from the tunnel and joins the existing creek, flowing with it for six miles of gentle slope until it reaches the lower end of a broad expanse of meadow land into which the valley widens. Where the valley narrows again, just before the stream plunges into a steep walled canyon, a simple earth-filled dam is placed. This forms the Butt Valley reservoir some two miles in length from which the water passes into the second tunnel, leading direct to the power house and the wheels.

The general layout of the project then is first, the two mile tunnel, which taps the lake; a conveniently located valley that serves as an open canal for six miles; a small earth dam to form a secondary reservoir; a second tunnel, also about two miles long, and at its lower end the penstock and power house.

Big Meadows Reservoir.—The Big Meadows reservoir, Lake Almanor, was created in 1913, four years after the construction of the Big Bend plant. It was made by sluicing into place an earth dam 600 ft. long. This formed a lake with a surface area of 15,500 acres, an average depth of 19.5 ft. and a capacity of 300,000 acre feet. The topography at the dam site will permit the crest to be raised 28 ft. higher. This would provide for storage of 1,250,000 acre feet with a surface area of 27,000 acres. The average yearly run-off from the 504 square miles of drainage area above the dam is 842,000

acre feet, so that raising the dam to the full additional height of 28 ft. would only serve the purpose of conserving the occasional floods and thus obtain a more nearly uniform flow.

At the time of creating the reservoir, the question of its probable water-tightness was carefully investigated. The rock in this general region is broken and is far from water-tight. It was found, however, that the volcanoes of the region had spread a blanket of volcanic ash from 8 to 10 ft. thick and so extremely fine as to be water-tight. With this impervious covering to line the reservoir and a safe earth dam, unusually broad of base, the success of the reservoir was assured.

Tunnel No. 1.—Tunnel No. 1, leading from the reservoir to the intermediate valley, is 11,200 ft. long with an area of 46 sq.ft. and is approximately rectangular. It has a slope of 1 per cent and a capacity of 800 sec.-ft. The tunnel has a concrete floor but above this it is timber lined. Concrete collars for water-breaks are built at suitable intervals to prevent a velocity developing behind the timber lining. A gate at the lower end, regulating the flow through the tunnel, insures its always being full of water to preserve the timbers from decay. About 700 ft. of the tunnel through disintegrated sandstone was lined with concrete instead of timber. The flow from the lake is controlled by a 7-ft. electrically-operated gate at the tunnel entrance.

The course of this tunnel passes from the country rock of slate into what was, in prehistoric times, an open valley but which centuries ago was filled with lava. Upon cooling, this lava opened up in myriads of cracks so that the river, once flowing in the valley below, now finds its way through the countless cracks in the lava itself. It was in material of this kind that much of the tunnel was driven.

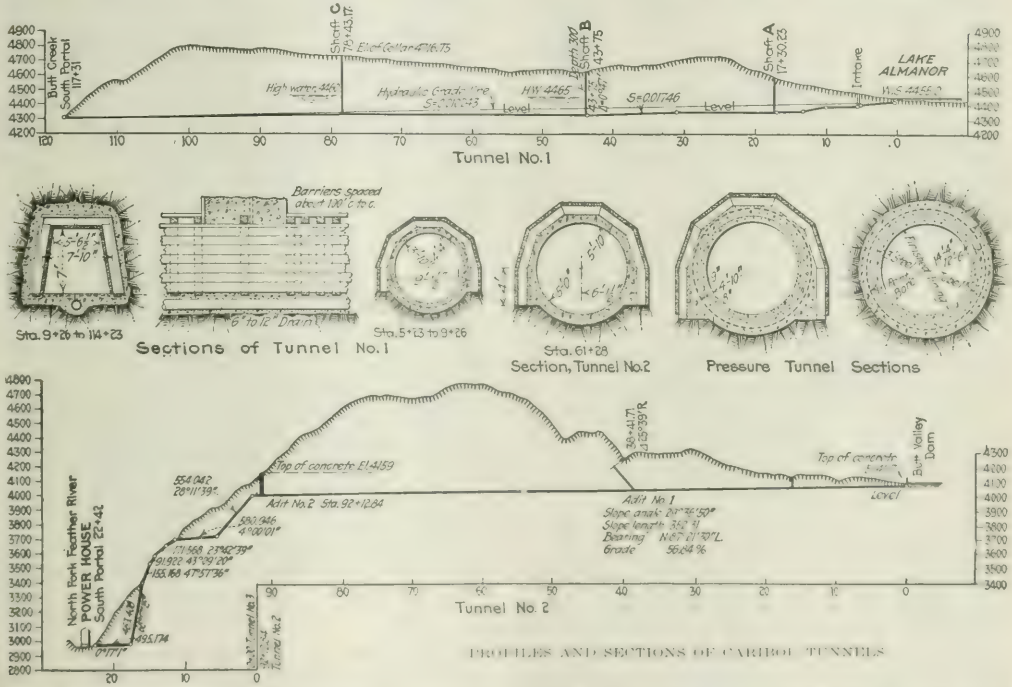
Even before the headings were started from the shafts, trouble was anticipated from water accumulating at the downstream headings. To provide against this the junction point was estimated where the headings from two adjacent shafts would probably meet. The up-hill shaft was then sunk below the hydraulic gradient far enough so that the tunnel could be driven with no grade at all from this up-hill shaft to the estimated meeting point with the tunnel coming up hill along the hydraulic gradient from the shaft down hill. As this level portion was all below the hydraulic gradient, the efficiency of the tunnel was not impaired and the infiltering water was made to run away from the heading to the upstream shaft without being pumped.

Once at the shaft, the water was handled by electrically-driven pumps with a reserve set of steam pumps held in readiness to start up on five minutes' notice. At one shaft alone, 5,000 gal. per min. were pumped to the surface against a head of 250 ft.

Tunnel No. 2.—The water which discharges from Tunnel No. 1 flows down a small valley for six miles, where a simple earth dam directs it into the second tunnel which leads to the brink of the gorge above the power house. The dam is about 30 ft. high and consists of two parallel embankments of tunnel waste, dumped from trestles and filled between with fine materials sluiced from the adjacent hillsides.

A concrete spillway carries the flood waters around one end of the dam and at the other end the water is admitted to the tunnel through a 9-ft. electrically-controlled sluice gate installed in a reinforced-concrete gate house.

The tunnel is a circular concrete tube 10 ft. in diameter with an area of 78.5 sq.ft. and a capacity of 1,350 sec.-ft. Its length is 9,200 ft., with slope of 0.8 per cent.



PROFILES AND SECTIONS OF CARIBOU TUNNELS

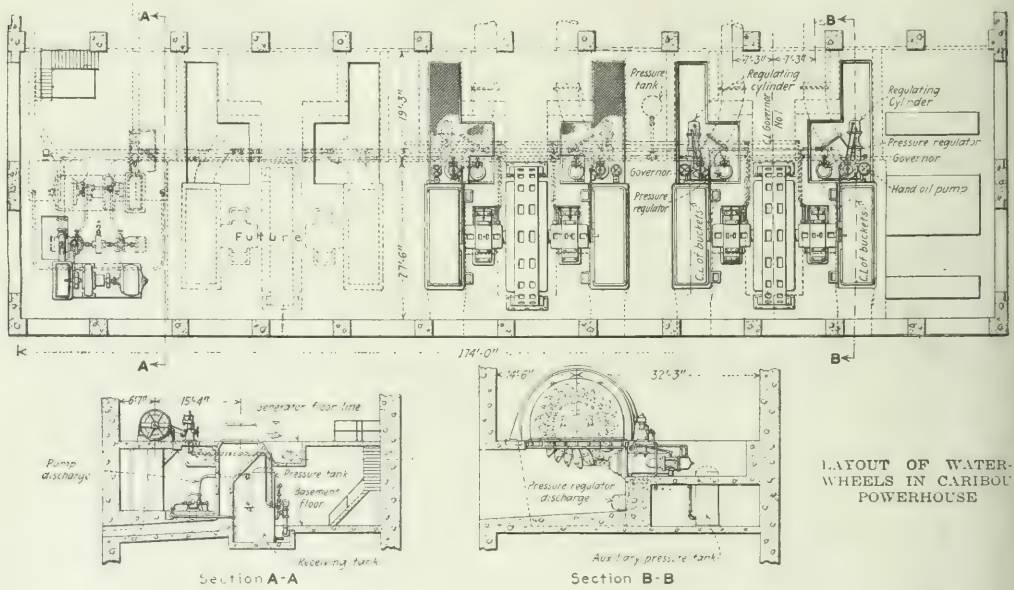
Pressure Tunnel and Penstock.—At the crest of the gorge, the second tunnel merges into a circular pressure tunnel 9 ft. 8 in. in diameter with an area of 73.4 sq.ft. and a length of 550 ft. It is built of concrete, heavily reinforced, for both inside and outside pressures. To insure absolute water-tightness a diaphragm of ⅜-in. steel is imbedded as a central core in the circular concrete wall. It is in effect a thin steel pipe with an inner and outer concrete cover, each heavily reinforced.

When driving the tunnel, timbering was put in where necessary, leaving sufficient clearance for a concrete lining with an outside diameter of 14 ft. The steel pipe, ⅜ in. thick and 9 ft. 8 in. in diameter, was set first using 30-ft. sections and beginning at the lower end. With the first 30-ft. section fastened in place, the pipe served as an inside form for the first or outer layer of concrete lining. Some bracing was necessary on the inside of the pipe and for this purpose wood rings were used, thus making it possible for workmen to climb through the inside of the pipe during this stage of the work. The concrete outside the pipe was poured with a minimum thickness of 12 in. and was reinforced where the rock walls were weak enough to require it. When this concrete had set the wood rings were taken out and a cylindrical form was built up inside the steel pipe, beginning at the bottom and extended a section at a time. This was braced so as to give a clearance of 8 in. between form and pipe. The inner shell of concrete was then poured.

Concrete was supplied from a mixing plant at the top of the incline, whence it flowed into place through chutes run down the tunnel. The bottom of the pressure tunnel terminates in a concrete plug from which three steel penstocks continue downward. One of these is a stub capped for the future installation of another 30,000-hp. unit. The lower end of the steel pipe in the pressure tunnel was imbedded in this stub poured monolithic with both inner and outer concrete in the tunnel.

This reinforced-concrete pipe changes into two steel pipes as it nears the surface of the hillside. Each of the two steel pipes is 1,335 ft. long and 66 in. in diameter with the steel ranging from ⅝ to 1⅛ in. in thickness. Owing to the looseness of the material on the hillside back of the power house, these pipes are on the surface for only 520 ft., disappearing into a shaft 550 ft. deep. It is built on a slope of one horizontal to two and a half vertical. In it the 66-in. pipes divide into the 42-in. pipes which go directly to the wheels.

A surge tank 30 ft. inside diameter is built as a concrete shaft in the hillside rising from the junction of the grade tunnel No. 2 and the reinforced-concrete pressure tunnel. Its crest at present is 1,130 ft. above the center of the nozzles. Eventually it will be raised 35 ft. higher.



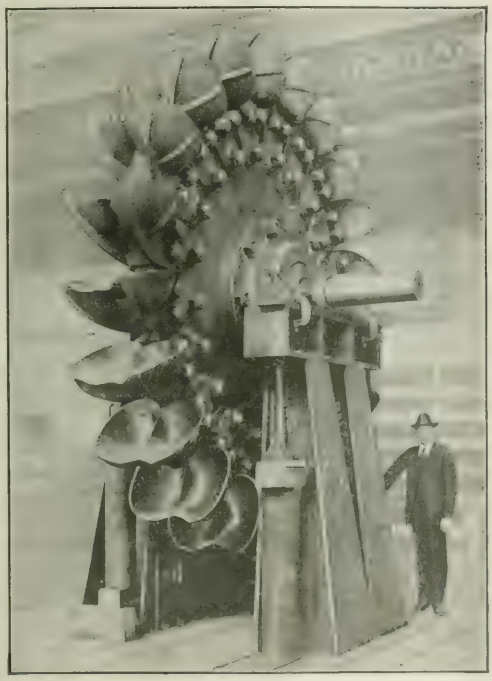
LAYOUT OF WATER-WHEELS IN CARIBOU POWERHOUSE

Plant Arrangement.—The plant at present contains two 30,000-hp. units with space provided and foundation in place for a third unit. The exciter units are placed at one end of the building. In the final installation the power house will be extended and the exciters will then have three units on each side, making the final layout symmetrical. Each present unit consists of one 30,000-hp. generator and two overhung impulse wheels. Each wheel has a capacity of 15,000 hp. and is driven by an 11-in. jet issuing from a fixed needle nozzle. There are but two bearings in the unit. They carry the generator rotor between them while the wheels are carried on the overhang of the shaft just beyond each bearing. The over-all dimension of the unit occupies a floor space of 30 x 40 ft.

Impulse Turbines.—Although the impulse type of wheel was chosen, the Francis type, or reaction wheel, was seriously considered, as the manufacturers stood ready to furnish reaction wheels to operate under a 1,000-ft. head. The choice of the impulse type was made only after a careful comparison of the advantages of the lower first cost, smaller floor space and higher effi-

ciency offered by the reaction type, as against greater simplicity, smaller liability to wear and greater ease in renewing worn parts inherent in the impulse type. The more rugged impulse type won.

Each wheel, without the shaft, weighs 25 tons. It is equipped with 21 cast steel buckets each 36 in. wide and each weighing 1,000 lb. They are all balanced as to weight and to position of the center of gravity. Before leaving the shop each wheel was fully assembled to test it for balance and so accurate had been its construction



ONE OF THE IMPULSE WHEELS ON THE 30,000-HP. CARIBOU UNIT

that a 2-in. nut placed in a bucket on one side caused a complete revolution of the wheel.

The disc is approximately 11 ft. in diameter, 7 in. thick, and is made of oil tempered forged steel of special high tensile characteristics. It is pressed on a cast-steel hub and bolted to it by means of reamed bolts, each machined for a pressed fit of 50 tons. The hub in turn is finally pressed on the shaft with a press fit of 200 tons and is keyed and locked in place.

The shaft is compression forged of open hearth steel, having a tensile strength of 75,000 lb. per square inch. It was given special heat treatment and was hollow bored to insure perfectness of metal. It is 30 ft. long with a maximum diameter of 30 in. and a diameter at the bearings of 24¾ in. It weighs 26 tons, having been made from a 50-ton billet.

The shaft is supported in two heavy-duty bearings, each carrying 200,000 lb. under full load conditions. They are of the self-aligned babbitted type with heavy oil rings and water cooled shells. They are also equipped with forced feed which may be used in emergency or put into continuous service if necessity demands. The bearing is 24¾ inches in diameter by 72 inches in length.

The wheels, which revolve at 171.4 r.p.m., are entirely independent in their control. Each has its own needle control, oil-pressure governor, pressure regulator and gate valve. The only point in common is that the fly balls of the governors are driven from the same shaft. The governors are of the oil pressure type, equipped with relay for hand operation and remote electrical switchboard control, load limiting device to enable carrying constant load irrespective of the load demand, and safety stop which closes the nozzles in case of breakage of the belt driving the speed governor.

The nozzles are of the stationary type, needle controlled, and with steel and bronze wearing rings throughout. The needle tip and nozzle throat rings are readily renewable. The needle stem extends directly backward to form the piston rod of the regulating cylinder. The nozzle body is of cast steel tested to 750 lb. per square inch. The disruptive force tending to separate the flanges of the nozzle hood is more than a half million pounds. The nozzle opening is 13 in. in diameter. The inlet is 38 in. inside diameter and is connected to the penstock by a long radius elbow expanding to the penstock diameter of 42 in. An hydraulically operated 42-in. valve is located on each 42-in. penstock line just outside the power house.

Water hammer, or increased pipe-line pressures, are controlled by a pressure regulator connected to the inlet pipe back of the nozzle, which is operated by the governor directly and can be arranged to act as a synchronous by-pass or a water saving device.

The plant was designed and built by Stone & Webster, Inc., of Boston, through S. L. Shuffleton, its western manager. William N. Shannon and E. C. Macy were superintendents of construction.

Transportation Problem Paramount in Plant Construction

IN LAYING out a construction program for the Caribou hydro-electric development, every endeavor was made to get camps established and have the labor forces organized before the winter of 1919. Although at an altitude where there is some snow throughout the winter, the weather is ordinarily such that a good deal of work can be done in the winter months, provided camps and sources of supplies are established before the rainy season begins. As the country involved is very rough, and for the most part did not even have trails that pack animals could use, the first necessity was a construction railroad. Alternate routes were surveyed and it was finally decided to build four separate railroad lines on different levels connected by inclines at four convenient points.

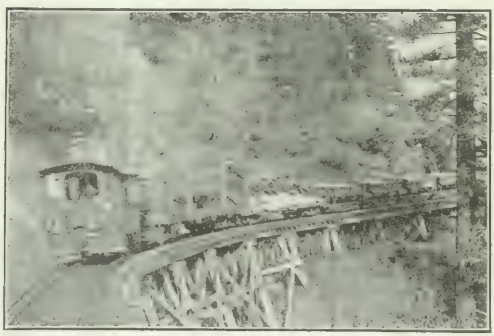
While problems connected with locating this transportation system were being worked out, twelve camps were located along the 24-mile stretch from Lake Almanor, the upper end of the conduit line, to the railroad station at Howells where it was decided to establish railroad connection at the lower end of the project. As soon as supplies could be delivered by pack trains or otherwise, these camps were opened and several hundred men were put to work at the critical points.

Spur From Main Railway.—The first important determination was the location of construction headquarters for the entire job at Camp Nine, about half a mile from

the power house site and 9 miles up the north fork of the Feather River canyon from Howells. The Western Pacific R.R. follows up the north fork of the Feather as far as Belden, where it leaves it to turn into Indian River canyon. Decision was made to build a 10-mile broad-gage line from Belden on up the north fork and directly into the power house, so heavy machinery could be delivered to the overhead cranes without rehandling. All the rest of the construction railroad system was made narrow-gage.

The disadvantage of having equipment on the job for more than one gage was offset by the fact that the narrow-gage lines are accessible only by inclines and only special equipment, of whatever gage, could be taken over these inclines, that is, the cars require special freight stops, called strong-backs, at the rear end, as well as slings in place of the ordinary coupling. Distinct advantages of using narrow-gage on the upper levels were (1) less first cost, (2) less time for construction, (3) easier location in rough country than would be the case with broad-gage and, (4) lower capacities in hoists than would have been required for handling broad-gage equipment (the hoists have a capacity of 20 tons).

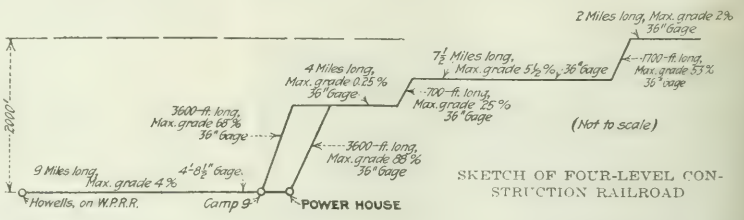
In order that narrow-gage cars could also be taken to the power house from the upper levels, a third rail was



NARROW-GAGE CONSTRUCTION TRAIN ON OLD BUTT VALLEY FLUME

laid on the ties from the foot of the narrow-gage incline at Camp Nine to the power house site. Thus a saw-mill on the upper end of the work, built for supplying lumber for construction purposes, was able to deliver lumber for concrete forms and timber for the penstock tunnel without rehandling. Exclusive of the inclines, the railroad system comprised 10 miles of standard-gage track and 11 miles of narrow-gage line. The broad-gage had a maximum grade of 4 per cent and 45-deg. curves. On the narrow-gage the grades ran up to 5½ per cent and curvatures as low as 80-ft. radius were used. Fifty-pound rails were used throughout both systems. The contractor's railroad equipment included six 18-ton narrow-gage locomotives and 48 narrow-gage cars, as well as five broad-gage locomotives ranging from 35 to 50 tons in weight.

Locating Inclines.—Because the narrow-gage line had to connect the intake and the penstock line, passing Butt Valley dam and the saw-mill en route, the questions of where the two upper inclines would be located was largely determined by topographical conditions. In the case of the incline at Camp Nine, however, selecting the best location was not a simple matter. Several possible locations were surveyed and it was finally decided worth while to build more than a mile of additional track on the level above in order that the incline might follow up a ridge or "hog-back" that afforded a steeper slope at the



SKETCH OF FOUR-LEVEL CONSTRUCTION RAILROAD

lower end and avoided precipitous rock ledges near the top. At its upper end this incline terminates at an old miner's ditch used in the days of the 1849 gold rush and which has a grade of 0.25 per cent. The railroad was located for 2 miles to follow the bench built for this ditch, thereby effecting a considerable saving in time and cost of construction.

At Belden the Western Pacific R.R. is located on a bench, cut in the south side of a narrow canyon, and in order to get the branch line down to the stream so a crossing to the north fork could be made economically, two switchbacks had to be built almost entirely on trestles. These trestles required 500,000 ft. of lumber. To get this branch railroad in to Camp Nine as quickly as possible, work was also carried on from the upper end, working down the canyon. Doing this meant that equipment and supplies used at the upper end had to be transported 40 miles from the railroad. In the course of this circuitous trip they were rehandled eleven times, traveling by boat, teams, pack-trains and over inclines and newly completed sections on upper levels of the construction railroad. This program paid, however, because when the track-laying crews met, two miles of the broad-gage line had been built down the canyon from the upper end. The 10-mile line was put in service for freight deliveries direct to Camp Nine, in 100 working days. The endeavor to make speed on the project was such that by the time the Howells-Camp Nine railroad was completed, about 2,500 tons of freight had been brought in via the 40-mile barge, truck team and pack-train route. This included materials and supplies for camps that toward the end of this period, accommodated 1,000 men. In order to relieve the strain on this limited means of transportation, freight was occasionally shipped from San Francisco via Reno, Nev., to a branch line terminal at Westwood, thence across Lake Almanor by boat and finally by truck and pack train direct to the several camps.

Railroad on Flume.—A short distance up the canyon from the top of the power house incline, a flume serving the Butt Creek power house winds around the brow of a high cliff, more than a thousand feet above the stream. This flume and power house were built about ten years ago to serve the construction of the Big Meadows dam. After searching in vain for any economical route for the construction railroad, which was required at about the same level as the flume, decision was made to build the



LOOKING UP THE INCLINE AT THE POWER HOUSE

railroad on top of the flume, erecting a timber trestle around and over the flume structure to support the track. When the flume was built labor and materials were less expensive than at present and fortunately, considerable blasting was done so that the flume had ample clearance. Locating the railroad on top of the flume made it unnecessary to do any heavy blasting along the line, which would have been undesirable from the standpoint of expense and also because it was important not to interfere with the flow of water in the flume.

This solution of the problem had another advantage in that the saw-mill was located not far from the upper end of the flume and timbers for the trestle were floated down the flume, thereby being delivered free of transportation cost where needed.

Sand and gravel for the power house had to be brought in by rail from Oroville, 85 miles away. No suitable material was found anywhere in the Feather River canyon, but fortunately a good gravel deposit was found in Butt Creek Valley and a gravel washing plant established there which supplied sand and gravel to all parts of the work down to and including the upper end of the penstock line. When it came to delivering these materials over the long incline to Camp Nine and thence to the power house, the cost delivered was found to balance that of the Oroville materials, and the latter were used to avoid congestion on the construction railroad.

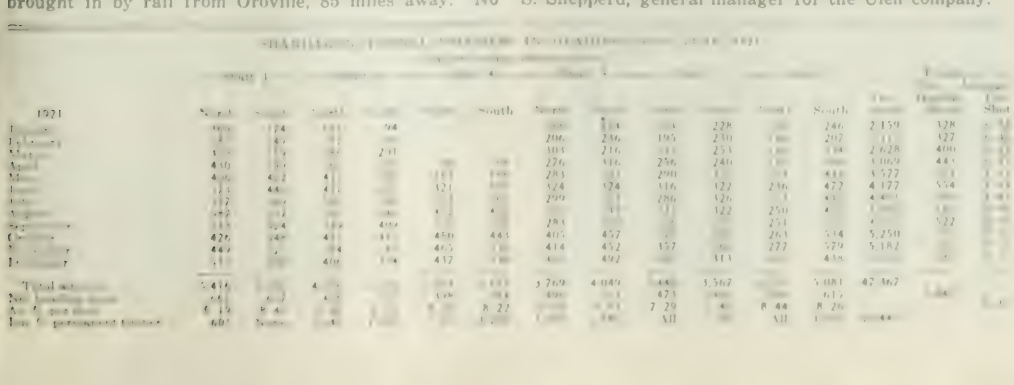
Shandaken Tunnel Progressed Nine Miles During 1921

DURING the year 1921, driving from 12 headings, a progress of 47,367 lin.ft. was made by the Ulen Contracting Corp. on the 18-mile Shandaken tunnel of the Catskill water supply system for New York City. The tunnel will be lined with concrete and will have finished inside dimensions of 10 ft. 3 in. in width and 11 ft. 6 in. in height. The year's work represents 291,772 cu.yd. of rock excavation and 5,845 heading shots, averaging 8.1 ft. per shot.

Shaft 1 was on a two-shift basis for the entire year, two shots being made in each heading every 24 hours. At Shaft 3, three heading shots were made each day with the exception of the month of October, when two shots per day in each heading were made. Shaft 4, until Aug. 1, was on a swing-shift basis, three shots being made at the shaft every 24 hours, but after this date two shots in each heading were made each day. Shaft 5 was on a swing-shift basis until Oct. 1 and after this date was on a two-shift basis in each heading. Shaft 6, due to timbering and unstable rock, has been on a swing-shift basis for the entire year, three shots being made every 24 hours at this shaft. At Shaft 7 one shot was made in the north heading and two shots in the south heading each day. Work was carried on continuously for the entire year excepting holidays. No work was done on the day shift on alternate Sundays.

The maximum monthly progress for any heading on a two-shift basis was made in the north heading at Shaft 3 during August when 593 ft. was driven in 58 shots, giving an average advance of 10.22 ft. per shot. During the same month the south heading at this shaft, which was on a single-shift basis, advanced 346 ft. in 29 shots or 11.29 ft. per shot. Several shots were made in this heading which exceeded 14 ft.

The accompanying table gives the details of the year's operations, which were under the direction of Thomas S. Shepperd, general manager for the Ulen company.



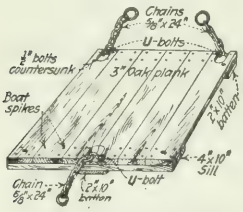
FROM JOB AND OFFICE

Hints That Cut Costs and Time — *For Contractor and Average Engineer*

Plank Skip Carries Fifty Sacks of Cement

BY G. W. MCALPIN
Huntington, W. Va.

A USEFUL flat cement-skip is shown by the accompanying sketch. The deck of this skip is of 3-in. oak plank boat-spiked to sills 4 x 10 in. One ½-in. bolt in each corner adds stiffness. Instead of links short chain lengths are used to provide fastening for a three-way chain. The U-bolts to which the chains are attached are set in recesses large enough to permit the chains when slacked off to fall flush with the deck. In this way no obstacle which might tear the sacks is presented when the skip is dumped. The short chains, being pliable, will also pull out from under a pile of sacked cement more readily than the old style link. The heads of the U-bolts are protected by 2-in. oak battens, which prevent them catching and tearing the sacks when the skip is landed on a pile. The three chains are of the same length and fasten by means of a large link to the hooks of the usual three-way chain. The length of the chains permits the hook in the three-way chain to clear the top of the pile. A load of 50 sacks of cement is usually carried on the skips but as many as 100 sacks have been carried without straining it.



PLANK SKIP FOR SACKED CEMENT

Concrete Pavement Cut and Broken Up With Improvised Machines

BY JULIAN MONTGOMERY
City Engineer, Wichita Falls, Tex.

IN JULY, 1921, the City of Wichita Falls, Texas, granted the Wichita Falls Traction Co. permission to lay 4,000 ft. of track through one of the business and residential sections of the city. For about 3,400 ft. of the distance the street is paved with 6-in. two-course concrete containing light hog wire in the bottom course as reinforcement. The other 600 ft. is paved with 3-in. wood block on a 5-in. concrete base. The laying of the track therefore involved the removal of a 7-ft. strip of pavement and repaving after the track had been laid. The city issued instructions that precautions be taken against the injury of the pavement on either side of the track strip. These instructions specifically prohibited breaking up the 7-ft. strip until it had been cut free from the pavement, though it was decided a cut through the 2-in. top course would be sufficient.



FIG. 2—CONCRETE BROKEN WITH 600-LB. HAMMER



FIG. 1—IMPROVISED CHISEL CUTS 2-IN. CONCRETE

Pavement Cut. — The work was let to a local contractor who felt that hand picking or hand chiseling would be too expensive so he rigged up a concrete mixer with an automatic drop hammer which struck a chisel supported by springs at the bottom of the hammer leads. (See Fig. 1.) The hammer was raised by a walking beam. For this particular work a 100-lb. hammer gave the best results. The sides of the 7-ft. strip were marked and only two men were required to operate the machine, one man guiding it and watching the chiseling and the other man operating the engine. The cutting was slow enough to allow the men to pull the machine forward without any trouble.

Breaking Up the Pavement.—In order to break up the pavement after it had been cut the contractor designed an automatic trip hammer which consisted essentially of a 600-lb. hammer on a 14-ft. handle raised by a cable running over a sheave in a steel frame about 16 ft. high. This rig was also mounted on a concrete mixer. (See Fig. 2.) The trip apparatus was attached to the hammer by hand, but the tripping was automatic. The base of the hammer handle contained a large horizontal screw, one end of which was attached to the frame of the mixer. On the other end was a handle. By turning this handle the side swing of the hammer was controlled. Five men operated this machine.

The rate of progress in breaking the pavement depended upon the chisel machine which was operated at night in order to provide enough work for the breaking-up machine.

When the wood paving was reached the blocks were cut to the line with a sharp axe. After their removal the hammer easily broke the concrete base. The broken pavement was piled on one side and served as a traffic barricade. Excavated dirt was piled upon the opposite side and used to cure the new concrete pavement laid in the 7-ft. strip.

The work was done under the direct supervision of the writer, with J. B. Upchurch, assistant in charge of paving, associated with him. The contractor was I. H. Roberts, Wichita Falls, Tex.

Drift Bolts Driven Under Water

By D. H. Fleming
Owen Sound, Ontario

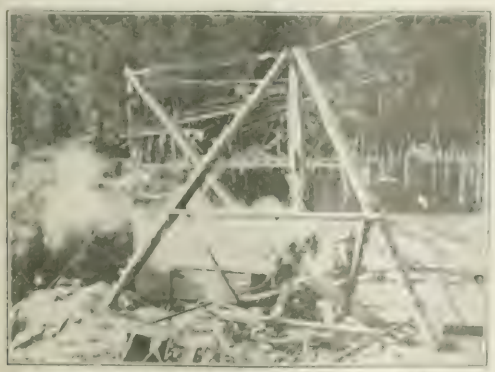
On A dock-construction job being executed in Owen Sound, Ontario, the contractor was required to place 12-in. x 18-in. caps on wood piles one foot below water level. The caps were secured to each pile by a 1¼-in. drift bolt 36 in. long. To do this the caps were bored and the bolt driven close to the water level. Then, to avoid splashing, a piece of 1½-in. iron pipe was slipped over the drift bolt, a follower was inserted and the driving completed without difficulty.

Engine Direct-Connected to Derrick Economizes Operating Space

By R. V. Sass
Superintendent of Construction, U. S. Reclamation Service, Cody, Wyoming

On THE SHOSHONE Project in northern Wyoming the U. S. Reclamation Service has constructed a hydro-electric plant for the development of about 5,400 kw. The power plant is in a canyon so deep and narrow that construction work was handicapped. Some specially-designed plant proved satisfactory in handling the work, and part of that plant was a 5-ton derrick. A guy derrick was unsatisfactory on account of the overhead cableway and concrete distributing chutes. There was insufficient room for a hoist engine in connection with a stiff-leg derrick, so the derrick herein illustrated was employed.

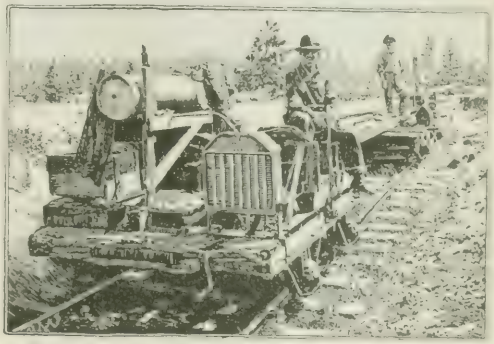
The derrick was of the stiff-leg type operated by a 4 x 7 double-cylinder engine direct-connected to a crab winch with sliding gear. The mast was 30 ft. long and the boom 40 ft. long. The boom line was rigged to one drum and the load line to the other. By shifting the gears either drum could be operated. The tag lines were hand-operated. This derrick was used in the excavation of about 4,000 cu.yd. of material.



[illegible] DERRICK

Automobile Engine Supplies Power to Move Freight on Broad-Gage Road

As A PART of its construction system, the Southern California Edison Co. maintains a two-mile length of railroad between Huntington Lake and the head of the 2,100-ft. incline at Cascada, which connects with the San Joaquin and Eastern R.R. system. When any quantity of material is being handled a standard steam locomotive is used for moving it over this two-mile stretch, which is without grade. However, for long periods, and particularly in winter, the freight movement is so light that to maintain the licensed crew necessary to operate the steam locomotive is uneconomical.



FORD ENGINE MOVES STANDARD-GAGE FLAT CARS

To provide motive power for the movement of light freight, therefore, a Ford automobile engine was mounted on a steel-frame flat-car, as shown in the accompanying illustration. This was done at moderate expense in the company's own shops.

The 30-gal. tank shown herewith is a reserve water supply. It is set high so that water will flow by gravity into the radiator through a short length of hose permanently attached to the tank outlet.

Straight-Edge With Indicator Discloses Rough Spots in Pavement

EXCEPTIONAL smoothness on new paving on Minnesota highways is attributed by Lieut. H. Mallen, deputy commissioner and chief engineer of the State Highway Department, to the use of a straight-edge on asphaltic tops and the use on concrete pavement of what is locally called a transverse strikeboard.

The accompanying view shows H. G. Overholt, a Minnesota inspector, using the straight-edge, which he developed. The device is made from a 2 x 4-in. timber. On the top, at the middle, is a carefully balanced indicator hinged on a fulcrum with [illegible] arm [illegible] the length of the other. Attached to the shorter arm is a weighted pin which extends through a perforation in the timber and rests on the pavement surface when in use. The pin has [illegible] end of the indicator is another pin driven into the timber but not



PAVEMENT STRAIGHT-EDGE WITH INDICATOR

attached to the indicator. When the straight-edge rests evenly on a flat surface, the indicator points to the head of the stationary pin. When the straight-edge is pushed over an uneven area, the playing pin raises or drops and the bulge or depression is indicated. When more than ¼ in. variation in the 10-ft. span is shown, the area is rolled again.

On concrete pavement where the straight-edge cannot be used, the department is using a straight board with rounded edges. This discloses any unevenness when drawn over the soft concrete.

Check Method of Staking-Out Skewed Concrete Highway Bridge on Curve

By Oliver W. Gatchell
Assistant Engineer, State Highway Department, Logan, Ohio

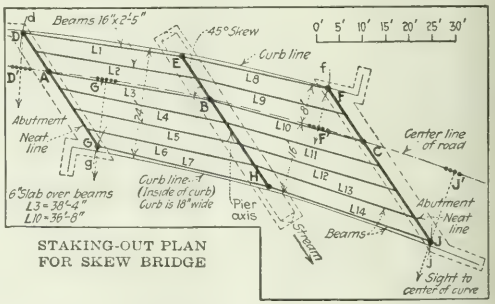
Modern reinforced-concrete highway bridges built on a skew, on a grade and on a curve with roadway widened and superelevated, with curbs and bridge rail fitting the curve, require special methods in the field for staking-out and control of construction. For example, let us take a bridge of two 40-ft. spans having the pier axis skewed 45 deg. with the center line, and both abutments parallel to the pier axis, the roadway center line being on a 20-deg. curve with a normal 16-ft. roadway widened to 24 ft. and superelevated 18 in., all the beams being non-parallel and of different lengths.

Statement of Problem.—Required so to locate skew abutments and piers with respect to the roadway center line that necessary clearance of curbs from the center line is furnished, with such a span between abutments and pier as to accommodate beams of specified varying lengths.

Treatment.—Locate and permanently flag the center of curve. With instrument at any convenient station on the curve establish *B*, then the groups of points *D'*, *G'*, *F'* and *J'*, which are chain pins stuck in the ground at 1-ft. intervals along the center line near where the radii through *D*, *G*, *F* and *J* will intersect. Set up at *B* and locate the axis of the pier, measuring off points *E* and *H*, using plan dimensions. From *E* and *H* with a steel tape carefully strike the small beam arcs *d*, *f*, *g* and *j*, using the lengths given for the outside beams. The remaining condition for the location of points *D*, *F*, *G* and *K* is that they must be radially distant from the center line an amount equal to the clearance between the center line and the inside of curb, plus the offset, if any, between the inside of the curb and the center of the outside beam at the abutment neat line. For this bridge, at *G* and *J* this offset is zero, and *D* and *F* half the width of the curb, making the radial distance to these pairs of points 16 and 8.75 ft., respectively.

To locate a point, say *D*, cut the beam arc *d* by chaining out the radial distance 8.75 ft. from that pin in group *D'* which lines up when sighting the center of the curve from the beam arc *d*. *F* is located similarly, while for the points *G* and *J* the chainman holding on the pin group lines a flag held at the beam arc on the center of the curve, all lining being by eye.

The sighting process, while involving a small amount of cut and try, is nevertheless accurate and the method checks itself. All the outside beams being of proper length, the lengths of the interior beams will check closely. The spacing of interior beams at abutments is to be adjusted to the field measurements of *DG* and *FJ* in preference to spacing shown on plans. The staking-



STAKING-OUT PLAN FOR SKEW BRIDGE

out method presented confines any small error in the paper plan to throwing the abutments and pier slightly out of parallel, yet it furnishes the exact beam lengths and prescribed roadway width. Note that for spans with decks on a heavier grade than 4 per cent the beam arcs measured on the ground should be shortened the proper amount. The method of staking out given is of general application to a skew bridge with parallel supports on a curve. The method was developed in the field and used by P. W. Ott and the writer.

FROM JOB AND OFFICE

Hints That Cut Costs and Time

Proposal To Reclaim Alkali Lands with Alum

Soils which do not "take water" because of an excess of gelatinous silicates, chiefly sodium silicate or water glass, have been reclaimed experimentally by the use of aluminum sulphate. C. S. Schofield, in the January *Reclamation Record*, states that two to three tons per acre have shown a very beneficial effect in improving the permeability but have not changed the character of the soil as to its hardness on drying. With ten tons the treated soil becomes soft and easy to work. The commercial alum is considered too expensive for general use but there are numerous deposits of alum and alum-bearing rocks and shales available in the West.

FROM JOB AND OFFICE

For Contractor and Average Engineer

Plank Housing Protects Steam Shovel During Blasting Operations

IN CONSTRUCTING a road along a steep sidehill, where heavy blasting was required, engineers of the Southern California Edison Co. found that a housing of 2-in. planks in double thickness around the steam shovel used for mucking was a great convenience. During



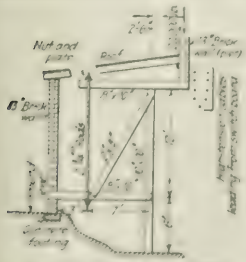
STEAM SHOVEL PROTECTED AGAINST FLYING ROCK

blasting operations, it was not necessary to move the shovel thus protected back as far as otherwise would have been necessary to avoid danger from flying rock fragments. The planking also saved the shovel from damage on several occasions when rocks, loosened by the heavy blasting, came down the steep hillside.

Cantilever Needle Beam Underpins Brick Wall

By B. S. Bascome

IN BUILDING a new brick wall in a power house at Warren, Pa., it was necessary to underpin the piers and pilasters while installing new units and equipment. The major part of the work was carried on by supporting the wall with posts and needle beams. In one instance, however, it was found necessary to resort to a cantilever support on account of the proximity to the wall of the high-tension cables leading from the switchboard. Referring to the accompanying sketch: The reaction of the cantilever beam with a load of 20,000 lb. on one end is taken up by two ¾-in. rods which are anchored to an 8-in. x 10-in. timber laid in place by the weight of a 12-in. brick wall, a distance of 10 ft. from it. The construction was carried on in connection with the installation of a 3,000-kw. Westinghouse turbine for the Warren Light & Power Co. at Warren, Pa.



CANTILEVER SUPPORT WITH 10-TON LOAD ON ONE END

Ready-Mixed Water Color Kept Usable by Small Shot

By H. D. Hurley

Assistant Engineer, Massachusetts Department of Public Works

THERE are many times when it is desirable to use color on a tracing or a blueprint. The ordinary colored inks have not enough body to print well when used on a tracing, or to stand out well when used on a blueprint. Water color, however, will do both, but it is somewhat of a nuisance to prepare it.

The solution is: Obtain a clean ink bottle of the ordinary drafting room type, mix the color to the proper consistency for use in a ruling pen, and place it in the bottle along with ten or a dozen small shot, such as are found in most offices for use in paper weights. When not in use the color will sink to the bottom, but a few shakes will rattle the shot around and stir the color up, and it is ready for use.

Enclosing Pier in Canvas Affords Uninterrupted Winter Work

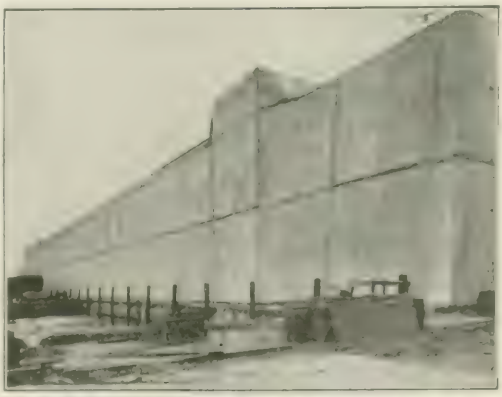
By A. B. Harding

Chief Engineer, J. S. Rogers Co., Builders, Philadelphia

AN INTERESTING example of protection against winter weather is seen in the effective method used in the construction of the new Municipal Pier 4 South, Chestnut St., Philadelphia, Pa. The completion by March 30, 1922, is imperative and as the work started Oct. 1, 1921, uninterrupted progress through the winter months was absolutely essential.

The pier is to be a two-story structure, 550 ft. x 75 ft., consisting of skeleton-steel frame of approximately 1,000 tons; concrete floor slabs; brick walls with limestone trimmings, and steel sash. The first deck will be equipped for cargo and passenger handling, and the second deck is to contain administrative offices of the Department of Wharves, Docks & Ferries, City of Philadelphia.

The usual winter protection of heated aggregates for concrete, anti-freeze compound for brick and mortar, and night protection by tarpaulins were found inadequate to meet the weather conditions and the protection illustrated in the photograph herewith was installed. This protection was afforded by 20-oz. waterproof



20-OZ. CANVAS COVERING PARTLY ERECTED

tarpaulins stretched over a frame made of 3 x 6-in. lumber. The entire structure was thus enclosed. The canvas was turned over at the top and fastened to the finished roof, already in place.

The enclosure, being built on the guard log of the pier, left a space of about 4 ft. between the canvas and the outside columns. In this space radiators, set on the ground level, furnished ample heat for placing the brickwork properly. After the walls were up the canvas protection, with radiators between the canvas and the brick walls, formed an envelope of warm air around the entire building, giving absolute protection to all interior work. At the same time the layout is such as not to interfere in any way with the construction, or in the handling of materials, and every day becomes a full working day, regardless of weather.

The heating plant consists of four sections each carrying about 1,250 sq.ft. of radiation, with expansion traps from each radiator dripping to the ground, heat from the condensate being absorbed by the pier fill. The four sections are directly connected to an 80-hp. vertical boiler operating at 5 lb. pressure, centrally located. Each of the sections is valved so that any combination can be used to offset daily wind and weather conditions. The amount of radiation used was based on 1 sq.ft. of radiation per 300 cu.ft. of volume in enclosure. While the system is only designed to give only 30 deg. to 35 deg. temperature difference, 45 deg. was noted early in the morning after a zero night.

The plant consumes between one and two tons of coal per day and is giving entire satisfaction, the work of the building progressing uninterruptedly.

Construction of the pier is being done by the J. S. Rogers Co., Philadelphia.

Design of Overhead Supports for Outdoor Piping Systems

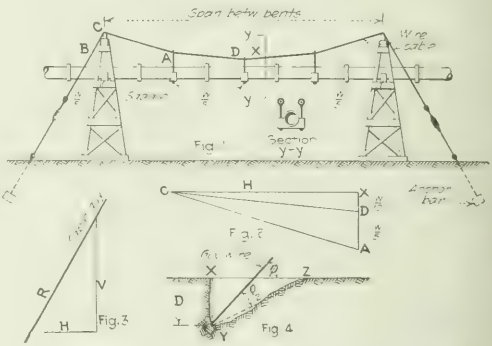
By W. S. Morrison
Assistant Mechanical Engineer, New York Edison Co., New York City

Pipe lines crossing streets or open spaces where the free use of posts is impracticable require some exceptional form of suspension. Where there is considerable load per foot, as in the case of a large gas main lined with brick or other insulating or protective material, a form of support often used is a pair of latticed girders made up of standard steel sections framed between steel columns or towers, the pipe being supported on cradles between the truss thus formed. Steam, air, gas and water mains may be carried by a simple form of wire rope truss. Fig. 1 is an arrangement in common use and has been selected as best suited to the purposes of this article.

The end bents or towers here shown may be of timber or steel, the pipe being supported at intervals by saddles attached to hangers, the cables being carried over the end supports and into the ground and attached to deadmen. Where the load carried is considerable, care should be taken that the saddle be liberally proportioned to the end that the load transferred to or from the pipe is distributed over the pipe. If necessary, the pipe should be reinforced at such points

The stress in the wire rope depends upon the load and the sag permitted in it. Taking the forces about apex *C*, the horizontal component of *BC* must equal the horizontal component of *CA*. Similarly, the horizontal component of the forces acting at point *A* are equal.

In Fig. 2, $XD = W/10$ and $DA = W/5$ in which W = the total load between the end supports. H is the horizontal component of the combined forces due to the



WIRE ROPE TRUSS IN COMMON USE—FORCE DIAGRAMS

loads at *DA* and *AC*, acting in the wire rope on each side of apex *C*. In Fig. 2, *CA* and *CD* give the magnitudes and directions of the rope stresses and the sag of the rope may be found by drawing these rays in Fig. 1, or the rays may be first drawn in Fig. 1 and transferred to the stress diagram, Fig. 2.

In Fig. 3 R is the pull on the guy rope necessary to resist the effect of the load, and V is the vertical component of the force R. The force V is transferred to the end support along with its proportion of the weight of the pipe.

The following formula pertaining to the holding strength of guy anchors of the type shown in Fig. 1 has been developed as the result of observations in practice and is recommended for use where a structure is to be guyed against a pull. Fig. 4 shows diagramatically the way in which a guy anchor would be pulled out of the ground. The earth wedge resisting the pull is *XYZ* and the slope *YZ* has been found to divide approximately the angle ϕ of the guy wire with the ground by two.

D = depth of anchor bar below the surface of the ground, feet;
W = weight of earth per cubic foot;
P = pull on guy wire, pounds;
l = length of anchor bar, feet;
ϕ = angle of guy wire with the ground;
f = coefficient of friction, earth to earth;

$$D = \sqrt{\frac{P\, 2 \tan \frac{\phi}{2}}{Wl\left(f \cos \frac{\phi}{2} + \sin \frac{\phi}{2}\right) \cos \frac{\phi}{2}}}$$

The accompanying diagram, Fig. 5, has been prepared by the writer for ready reference and is calculated from the above formula for an anchor bar one foot long,

FROM JOB AND OFFICE

Hints That Cut Costs and Time

FROM JOB AND OFFICE

For Contractor and Average Engineer

taking the average of 100 lb. per cubic foot for earth with the different friction coefficients for earth on earth as given in handbooks. For example, the pull on a guy wire attached to an anchor bar is 15,000 lb. with an anchor 10 ft. long, using a factor of safety of 5, the pull

TABLE I—STANDARD STEEL GALVANIZED STRAND WIRE ROPE
7 WIRES TO THE STRAND

Diameter	Approx. Weight per ft. lb.	Approx. Strength in lb.
1	0.80	14,000
7/8	0.65	11,000
3/4	0.51	8,500
11/16	0.415	6,500
5/8	0.295	5,000
9/16	0.210	3,800
1/2	0.125	2,300
7/16	0.095	1,800
3/8	0.075	1,400
5/16	0.055	900
1/4	0.040	700
1/8	0.032	500

per foot will be 7,500 lb. Assuming that the earth is composed of dry sand, clay and mixed earth and assuming an angle of 45 deg. between the guy cable and the ground, from the diagram, dropping vertically from the top scale indicating the angle to the diagonal line indicating the coefficient of friction, then horizontally to the line indicating the pull per foot of anchor and from there to the bottom scale, read $D = 8.95$ ft.

Example, referring to Fig. 1: A 12-in. full-weight pipe containing steam is to be carried over a total span of 60 ft. between bents, the pipe lengths will come in 15-ft. sections between flanges and the pipe is to be continuous over the two end supports at a height of 18 ft. above the ground. Required the size of the wire rope necessary to carry the load, the height of point C above the ground and the required depth of the guy anchor below the ground level to resist the pull on the guy wire due to the load, assuming dry clay, sand and

TABLE II—SPECIAL GRADE EXTRA GALVANIZED STEEL STRAND WIRE ROPE

Diameter	No. of wires in strand	Approx. Weight per lb.	Approx. Strength—Crucible S. M. Strand	Crucible Steel	Plow Steel
1 1/2	61	4.75	110,000	183,000	242,000
1 1/4	61	3.95	91,000	152,000	200,000
1 1/8	37	3.30	76,000	127,000	170,000
1	37	2.62	65,000	108,000	144,000
1	37	2.25	51,000	87,500	120,000
3/4	19	1.70	32,000	64,000	90,000
3/4	19	1.25	28,400	47,500	70,000
1/2	19	0.81	20,000	33,000	47,000

mixed earth with a coefficient of friction, earth to earth, of 0.5.

The weight of a 12-in. pipe per foot including flanges is 63.2 lb. The total weight of the pipe between bents will be 63.2 × 60 equals 3,792 lb. If we divide the total span into four sections of 15 ft. each, the load at each support will be 758.4 lb. Drawing the ray DA at an angle of 8 deg. from the horizontal and the ray AC at an angle of 16 deg. with point D a height of 2 ft. from the center of the pipe, the apex C will then be (15 × tan 16°) + (15 × tan 8°) + 2 + 1' = 16 ft. 4½ in. from the ground level. The horizontal component of the load in the rope truss will then be

$$H = \frac{\frac{W}{10} + \frac{W}{5}}{\tan 16^\circ} = \frac{379.2 + 758.4}{0.2867} = 3968 \text{ lb.}$$

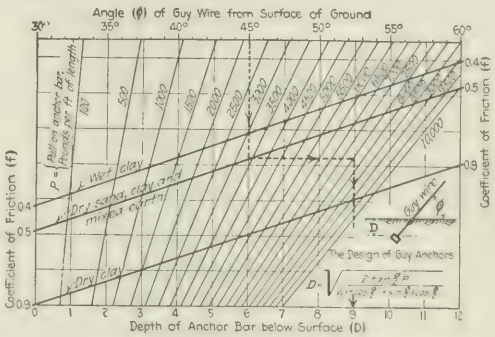
neglecting the weight of the rope itself as its weight will be small compared with the load.

If we use 45 deg. as the angle of the wire rope guy with the ground level, then the pull on the guy wire will be

$$R = \frac{H}{\sin 45^\circ} = \frac{3,968}{0.707} = 5,612 \text{ lb.}$$

But as there are two ropes carrying the total load, the pull on one rope will be 2,806 lb. Applying a factor of safety 5, we should select a rope capable of resisting a pull of 14,030 lb. From Table I a ⅞-in. seven-strand standard steel rope will answer for this case.

The total pull on the anchor bar will be equal to the total resultant in the guy wire and this pull is 5,612 lb.



DETERMINING ANCHOR DEPTH FROM KNOWN FACTORS

With an anchor bar 10 ft. long using a factor of safety of 5 the pull per foot will be 2,806 lb., say 3,000 lb.

Referring to the diagram, Fig. 5, the required depth for the anchor below the ground level is 5.7 ft. for an angle of 45 deg. and a coefficient of friction, earth to earth, of 0.5.

The total load at each end support will equal the vertical component (R) of the tension in the guy wire, plus the load $W/5$, the pipe being continuous and assumed to be carried by hangers or posts a disfance from each end equal to the short spans inside the bents. In this case, then the load at each bent is,

$V + W/5 = 3,968 + 758.4 = 4.726$ lb., or 2.39 tons.

If, in the above example, the pipe were filled with water, the distance between supports remaining the same, the total weight of the pipe between the end supports would be 112 × 60 or 6,720 lb., and by the same method of calculation H would equal 7,031.74 lb. and R, for each rope, would equal 4,972.94 lb. Applying a factor of safety of 5, as before, the rope will be required to develop 24,864 lb. An inspection of Table II will show that a Sieman-Martin ¾-in., nineteen-strand rope with an approximate strength of 28,400 lb. comes the nearest to meeting the requirements. With an anchor bar 10 ft. long the pull per foot, applying a factor of safety of 5, will be 4,973 lb., say 5,000 lb. Inspection of the diagram gives 7.3 ft. as the required depth of the anchor below the surface of the ground to meet this condition.

The vertical load on the end support will, in this case, be

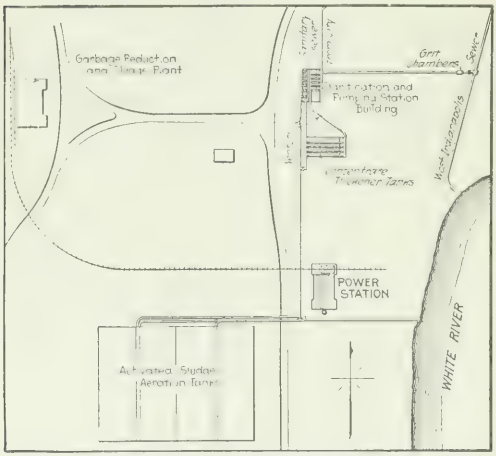
$V + W/5 = 7,031.74 + 1,344$
$= 8,375.74$ lb. $= 4.18$ tons.

Clarification and Activation for Indianapolis Sewage

Three Revolving Cylindrical Screens, Removing 30 Per Cent of Solids, Considered Sufficient for Six Months—Activated-Sludge Process Added for Remainder of Year

By C. H. Hurd
Consulting Engineer, Board of Sanitary Commissioners, Indianapolis, Ind.

CLARIFICATION by revolving barrel screens and tank thickeners is all the treatment it is proposed to give the sewage of Indianapolis, Ind., for about half the time. Five-year tests indicate that there is enough dissolved oxygen available in White River to meet the oxygen demand for six months of each year. For the remaining period of the year, May to October, additional treatment by the activated-sludge process will be provided. Construction of the work is well under way and the clarification portion of the works will be ready for operation within a few months. The sewage will have to be pumped only during the time when the activated-sludge process is used. In the following article



PLAN OF INDIANAPOLIS SEWAGE- AND GARBAGE-WORKS
It is expected that sludge from the new sewage-works will go to the garbage reduction plant.

there are discussed the studies made during the past five years, experiments with screens and activated sludge, deductions drawn from these experiments and the changed conditions which led to the choice of the designs adopted.

Not until the city reached a population of 200,000, which was coincident with the development of the packing house industry, did the discharge of the sewage into White River become a gross pollution and a nuisance of considerable magnitude. The present population is 350,000 making the city the largest on an unnavigable stream in the United States, but from the standpoint of sewage treatment—that is, total organic solids contained in the sewage—the sewage discharge is equivalent to that of a city of at least 500,000 people.

White River, which furnishes the city with water, has a drainage area above the city of 1,800 sq.mi. The characteristic of the stream that affects sewage treatment is its low flow during the hot months of summer and relatively high flows during the balance of the year, particularly during the late autumn and early spring. Monthly average gagings have been recorded during dry periods of less than 175 sec.-ft., while the maximum frequently reaches several thousand.

For the most part, Indianapolis has a combined system of sewers. The dry-weather flow is approximately 50 m.g.d. With the large quantities of organic solids pouring into the river, and the low summer flow, it is readily seen that the digestive power of the river is exceeded. During such periods the oxygen is entirely exhausted for several miles below the city. Fish are destroyed and, on account of the escaping odors, living conditions in the immediate vicinity of the river are almost unbearable.

Prompted by a report to the State Board of Health setting out the conditions in this river and by the appeal of farmers and others living along the stream, the legislature in 1917 enacted a law creating sanitary districts in cities of the first class, applying only to Indianapolis. A sanitary commission was provided with power to construct a sewage disposal plant and to carry on other sanitary work within the sanitary district. This district consists of the city of Indianapolis and the town of Woodruff Place, a municipal corporation located within the city's boundaries.

The Board of Sanitary Commissioners was appointed according to statute and organized during the month of May, 1917. During the following summer considerable investigative work was carried on under the direction of the board, consisting of flow measurements, determinations of the character and strength of sewage and detailed studies of the various trade wastes of industrial plants which were connected either with the sewer system or directly with the river. Much of this information was used as the basis of a report on sewage treatment made by George W. Fuller in September, 1917 (see *Engineering News-Record* Nov. 22, 1917, p. 972). Very little was accomplished during the year 1918 except to continue the collection of data which was started the previous year.

In April, 1919, the sanitary board entered into a contract with the writer, its present consulting engineer, to design and supervise the construction of the complete sewage disposal plant. At this time results of former investigations were analyzed and definite policies determined as to type of plant and general construction problems.

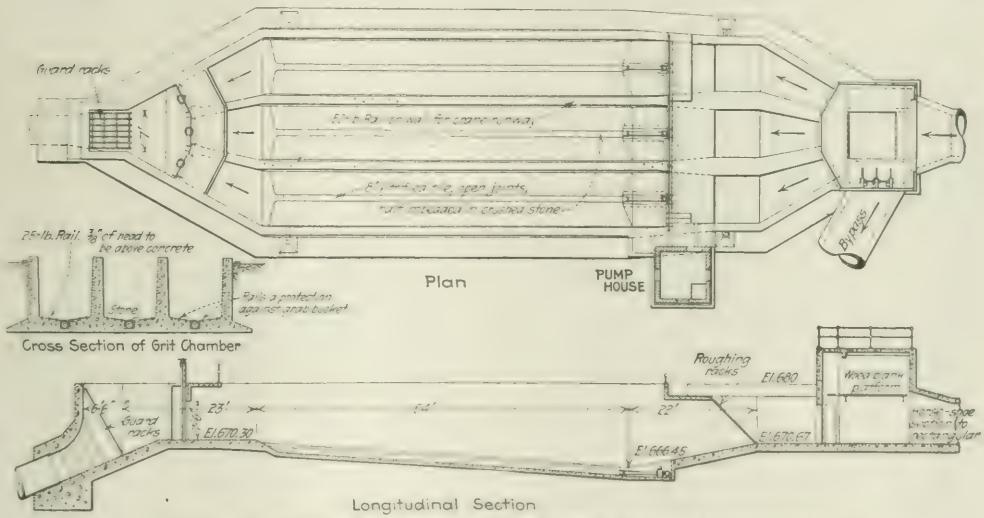
Upon instruction from the sanitary board, Mr. Fuller, in his report (1917) was guided in his recommendations by the provisions of the act of the legislature which limited the fund available for annual operation and maintenance expense but provided a more liberal amount for plant construction costs. In 1919 and at the beginning of the present work the board concluded it would build a plant of a type which would give the highest degree of purification and at the same time would give the highest ultimate economy, considering both operating expenses and construction costs. In conformity to this latter view, the legislature in 1920 amended the act, increasing the maintenance fund, thereby giving the

commission greater power and latitude in the selection of the character of the plant to be constructed. Of the conditions and characteristics necessarily considered in connection with the selection of the type of plant, the dilution factor, the seasonal variation of stream flow and organic matter carried by the sewage are pre-eminent. The degree of purification is also important, as well as the relative freshness of the sewage in its relation to the removal of organic solids. Estimates of construction costs of plants of various types, including the cost of power and general operating expense, were obviously necessary before final analysis could be made and a decision reached as to plant construction.

In connection with the studies as outlined, and by reference to the accompanying table showing oxygen available and required for various conditions throughout the average year, it is quite apparent that with the velocity of flow and the character of the stream bed. White River below Indianapolis is for the most part shallow and has an average fall of approximately 3½ ft. per mile. The stream bed contains many boulders and riffles and, as a whole, conditions are perhaps more favorable for re-aeration and replacement of oxygen than for the average river in the Middle West.

The standard of purification or completeness of disposal is of course dependent upon the extent of the nuisance created compared with the total cost of corrective treatment. The nuisance created below Indianapolis with the full discharge of untreated sewage flowing into the river during dry weather flow is such both in extent and character that the demand for treatment is unquestionable.

The river water is not used as a source of public water supply within a distance of 175 miles below

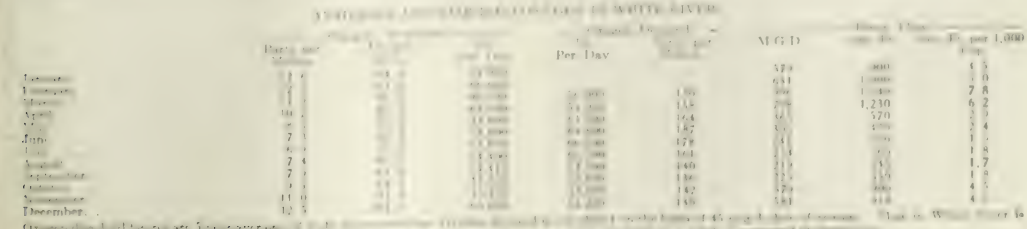


PLAN AND SECTIONS OF GRIT CHAMBER FOR INDIANAPOLIS SEWAGE-WORKS

coarser settling and floating solids removed, at least under present conditions, further treatment might not be necessary except for about six or seven months during the year. If advantage could be taken of this fact in the selection of the design and type of plant, considerable saving could be effected in the total cost of sewage treatment.

The rapidity with which dissolved oxygen becomes depleted in flowing streams depends upon the decomposable organic matter present, and its replenishment is directly affected by the depth of the stream, the Indianapolis; hence during periods of high flow advantage may profitably be taken of the dilution factor, thus effecting a very considerable saving in treatment cost.

By analysis the problem of sewage treatment resolves itself into two parts. During the summer or for approximately six months in the year, complete disposal of organic solids must be made; during the balance of the year, or through the period of greater dilution, only such treatment may be necessary as will remove the coarser organic solids, leaving an effluent within the



range of the digestive power of the river; or, in other words, with the oxygen demand less than the amount of the dissolved oxygen available. From the viewpoint of design and construction a plant to perform the above function must be a combination of a clarifying and complete treatment system.

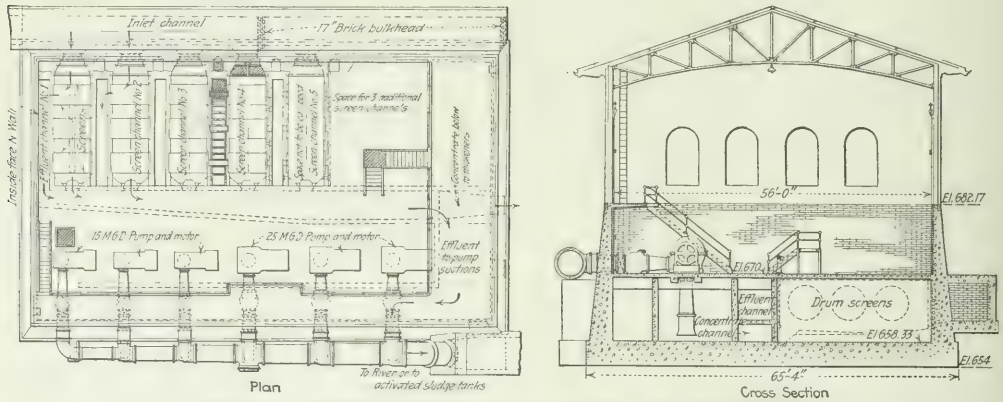
The removal of suspended solids either by screens or rapid sedimentation is dependent to a very large measure upon the relative freshness of the sewage. Indianapolis sewage, as has been stated, is not only comparatively fresh in character but is high in organic nitrogen. Analysis by the Kjeldahl method shows that of the total suspended matter 3 per cent is organic nitrogen. In the coarser solids, removed by fine screens and rapid sedimentation at times due to the inflow of packing house wastes, the nitrogen content is much higher than 3 per cent.

Based on the general assumption that the most practical means of sewage disposal is the separation of organic solids, and with particular application to the higher stages of the river, considerable research and investigative work was done during the years of 1919 and 1920 to determine the most economical method of making such removal. Studies were made of existing screen plants, including those at Rochester, N. Y., and the demonstration plant at Milwaukee, Wis., as well as the plain sedimentation experiments, in which valuable data were obtained, at Syracuse, N. Y. As a result of this investigation, a demonstration plant was installed using a combination of revolving screens and sedimentation units. The results of the tests at this plant gave such promise that the board adopted this system of clarification to be used in the permanent construction.

In selecting the type of plant best adapted to Indianapolis conditions, consideration must necessarily be given to the operation of the whole or final plant. It is not sufficient to determine the cost of producing an effluent of certain fixed standards but the cost of treating and disposing of sludge must also be estimated. In the type of clarification which has been adopted, it has been shown at the demonstration plant that a removal of 30 per cent of suspended solids will give an effluent which would be satisfactory through the period of greater dilution in the river. It has also been shown that the sludge obtained by the removal of the 30 per cent of coarser solids is of such a nature and character that it is easily drained to 85 per cent moisture, after which it may be readily handled and dried.

During the year of 1921 a demonstration activated-sludge plant was constructed and operated in connection with the screen and rapid sedimentation plant to determine the effectiveness of this method of treatment on Indianapolis sewage. Three complete units were installed, with aeration tanks 12 ft. in diameter and 15 ft. high and settling tanks about one-half the capacity of the aerators. Air was supplied through filtros tile in the usual manner, provision being made for filtering and scrubbing the air to eliminate dust or particles of oil which would tend to clog the filtros plates.

At this plant both screened and unscreened sewage is available. In the first run of ten weeks two units were operated under identical conditions to show comparative results with and without screening. The third unit was operated to demonstrate if possible any advantage of mechanical agitation. This run, fairly typical of sub-



COMBINED SEWAGE CLARIFICATION PLANT AND PUMPING STATION

sequent tests, gave the following general results: Tank 1 with unscreened sewage gave an average of suspended solids in the effluent, 25 p.p.m.; oxygen consumed, 30 p.p.m.; stability, 3 days; cubic feet of air per gallon, 1.35; rate per acre, m.g.d., 22; sludge, pounds per m.g., 1,656. Tank 2 with screened sewage gave suspended solids in the effluent, 19 p.p.m.; oxygen consumed, 26 p.p.m.; stability, 7 days; cubic feet of air per gallon, 1.30; rate per acre, m.g.d., 21.5; sludge, pounds per m.g., 1,152.

The above statement does not show the advantage of the uniformity of operation of tank 2 nor the difficulties which were experienced in the handling of undigested solids in tank 1. Tank 3, which was operated as a combined unit using both air and mechanical stirring, did not give a satisfactory stability or effluent and was abandoned at the end of this run.

Encouraged by the results of a small baffled tank used as a circulating unit with filtros tile arranged to give rapid circulation by the air-lifting effect, tanks 2 and 3 have been equipped in this manner, and No. 1 is being operated in the standard form as a control unit. The filtros areas in Nos. 2 and 3 are 10 per cent and 12 per cent respectively. These tanks are similar in construction except that No. 3 has an additional baffle. Tank 1 has 25 per cent filtros tile area. The three tanks are operated on screened sewage.

Delay was experienced in placing the modified plant in operation due to an extremely high river during November and the first half of December. All three units are now "tuned up" and producing an effluent of high stability. They are operating with considerably less than 1 cu.ft. of air per gallon of sewage. Tanks 2 and 3 show a perceptable saving in the use of air over tank 1 and also greater capacity with the same effluent standard.

It is appreciated that the experimental work on activated sludge at this plant has covered a relatively short period compared with the work at Milwaukee and many places in England, but with the developments in the last two years both in this country and abroad and with the low cost of power in the vicinity of Indianapolis this method offers many attractive features.

From data available and based on very conservative estimates the cost of a complete activated-sludge plant will approximate nearly $1,000,000 less than a complete sprinkling-filter installation. Under the conditions imposed, after careful analysis and deliberation, taking into account the probable period of operation and upon the recommendation of its engineer, the Board of Sanitary Commissioners authorized the construction of the activated-sludge plant with the cost not to exceed $3,000,000.

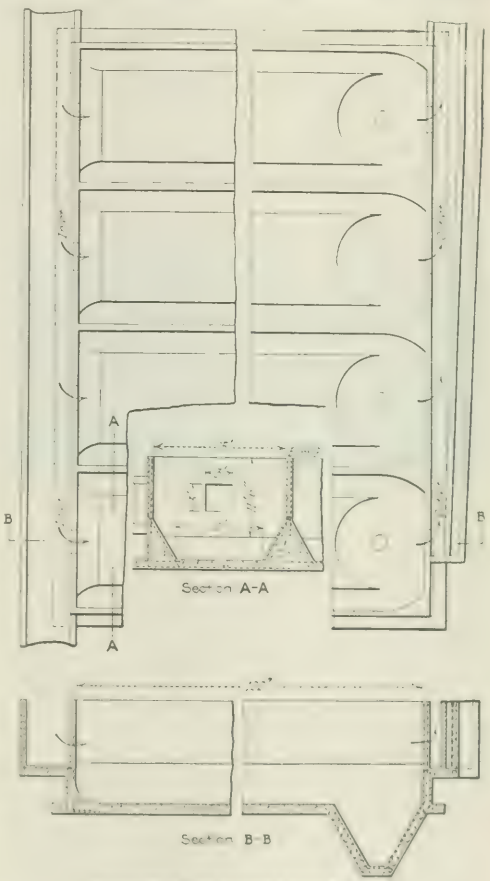
The site selected for the construction of the disposal plant is a 225-acre tract located on the opposite side of the river and two miles below the outfall of the main or east side intercepter. In order to conduct the sanitary sewage to the plant site it is necessary to cross the river with an inverted siphon 1,000 ft. long. To prevent deposits in the siphon it was deemed best to locate grit chambers on the east bank of the river immediately in front of the siphon.

The grit chambers containing the coarse bar screens are constructed with three channels, each 10 ft. wide with walls 10 ft. high. Each channel is provided with independent gates to be used in dewatering and stop planks for regulation of the flow. A controlling gate is also installed at the head of the chambers. It operates as a submerged weir and serves as an overflow for storm water and for rate control. Velocity through the chambers may be regulated from 7 to 1 ft. per sec. Since the siphon and two miles of conduit are between the chambers and the plant, it was possible to construct the channels to give practically constant velocity for any predetermined sedimentation period.

Sixty-inch cast-iron pipe is used in the construction of the siphon, which is laid from 7 to 12 ft. below the bed of the stream. The crossing is now (Jan. 15) about 60 per cent completed and is proceeding in open cofferdam with the use of 40-ft. steel sheet piling. Each 12-ft. length of pipe is supported on four 20-ft. piles and further protected by two guard piles driven on the downstream side. Progress is made at the rate of from 100 to 150 ft. per month.

From the end of the 60-in. siphon the sewage will flow through 10,000 ft. of 78-in. reinforced-concrete conduit, which has been completed. This conduit continues in almost a straight line, is built on a grade of 0.008 and has a capacity of 108 m.g.d. At the point where this conduit delivers sewage into the pump-well it is united with the connecting conduit from the west side intercepter, which is provided with grit chambers and coarse screens of a size corresponding to the flow [illegible]

The original design for the pumping station contemplated pumping the sanitary sewage throughout the entire year. The present plant construction is such that it is unnecessary to operate the pumps in connection with sewage clarification, and pumping is only required during the period of complete treatment or during



CONCENTRATE THICKENER TANKS

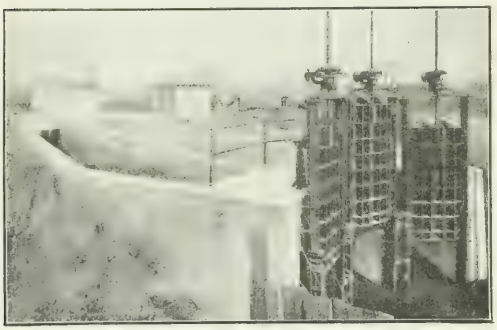
extreme flood conditions. As shown in the plan, the pumping station includes the revolving fine screens which are placed ahead of the pumps. The pumping equipment consists of three 25-m.g.d. electrically-operated centrifugal units and three 15-m.g.d units of the same type and design. The capacity provided is sufficient to take the entire sanitary flow from both the East and West Side intercepters.

More than ordinary care has been exercised in the design of plant buildings. For the most part, a Spanish type of artchitecture has been used. The color effect is gray buff brick and terra cotta trim with green glazed tile roof. All buildings are fireproof and the general arrangement is consistent with the use of the additional acreage, which will be a part of the city park and boulevard system.

The pumping station and clarification building is 194 ft. long, 60 ft. wide and 56 ft. from the bottom of the pump pit to the inside of the roof. The pumps and fine

screens are located 12 ft. below the ground level. An electric traveling crane is installed to handle poth pumps and screens and may be operated from the lower level or from a gallery provided at the ground level. Fresh water pumps, air compressors and priming equipment are installed in the sub-basement; all are electrically driven and connected with a conveniently located switchboard.

The clarification plant for the partial removal of suspended solids comprises 12 revolving drum screens arranged with three in each channel. Beyond the third screen the flow, which has not passed into them,



GRIT CHAMBERS AND REGULATING GATES

proceeds to the concentrate-thickener tanks constructed just outside of the pumping station building. The design of the screens is practically the same as is used in the paper manufacturing industry. The frames are constructed entirely of brass and bronze, 6 ft. in diameter and 8 ft. long, and are arranged to filter from outside, delivering the effluent through openings at the end. In a measure the screens are self-cleansing as part of the effluent in passing through the downstream side of the screens removes adhered solids. The cleansing is further assisted by the rotation of the screen element through this clarified zone. Thirty-mesh phosphor-bronze wire cloth is used as the screening medium.

In order that the screens may give a maximum removal it is essential that the process be carried on without the breaking up of the solid particles. For this reason the heavy concentrated sewage, containing all the retained solids, is conducted by gravity to the concentrate thickeners from which the heavy sludge is continuously removed by mechanical means.

The concentrate-thickener tanks are four in number, 15 ft. wide at the top and approximately 120 ft. long. The tanks will be equipped with slowly moving flights which will move with the current and at the same rate with a maximum speed of 5 ft. per minute.

Venturi meters are being installed both in the line to the concentrate thickeners and in the main effluent conduits. The clarified effluent may be diverted to the river or pumped to the aeration tanks for final treatment. Venturi recorders are placed in the pumping station building and alongside the switchboard for convenience in operation.

For the activated-sludge plant, aeration tanks are being designed, 120 ft. long, 15 ft. deep and of variable width depending upon the baffling to be used. Settling tanks for the sludge produced will be of the same general dimensions as the aeration tanks and will be operated in a manner similar to the concentrate thickeners. Operating galleries are to be constructed over the ends of the tiers of tanks, housing piping, valves and control equipment.

Air for this system and electric power for pumping and for the various mechanical devices will be furnished from the main power plant, in which will be installed four 400-hp. water-tube boilers with chain-grate stokers and complete coal-and-ash handling equipment, four 9,000-cu.-ft. steam turbine blowers, two 750-kw. steam turbine generators and all necessary condensers and auxiliaries.

The building for the power plant will be 140 ft. long, 70 ft. wide and 55 ft. high from basement to roof. Besides housing the power-plant units it will contain storage for 1,000 tons of coal and means for crushing, conveying and unloading under cover.

The administration and laboratory building, now under construction, will contain two full stories and basement. The first floor will be used for superintendents, accountants, store room, time keepers and office; the second floor for the chemical and bacterial laboratory. Space in the basement is provided for experimental and demonstration work. This building is 40 x 65 ft. in floor plan and is constructed in style and type similar to the pumping-station building.

Experiments are now being made at the demonstration plant to determine the most practicable method of sludge disposal. Work is being done with the Maclachlan gas process and filtro pressing. A screw press of the Anderson type will be installed for further dewatering crude sludge. It is expected that the problem of disposing of the activated sludge produced will be considerably minimized by the comparatively short periods when this part of the plant will be operated and by the removal of a large percentage of suspended solids before aeration. At this same site there will be works for garbage reduction which also come under the sanitary board.

Contracts for the grit chambers, river siphon, sanitary conduits and collecting system were awarded in July, 1919, and for the pumping and clarification plant in August, 1921. This part of the plant will be completed and placed in operation during the early summer of 1922. Plans are being prepared for the power plant and activated-sludge system. It is expected that this last division of the works will be in operation within one year from the date of the contract.

Third Water-Supply Conduit for Syracuse

A third water-supply conduit from Skaneateles Lake is being built by the city of Syracuse. For the present only six miles will be constructed. Contract for this portion has been let and it is hoped to have it in operation by Aug. 1. This section will merely compensate for friction loss in the first two conduits, and by adding 3 m.g.d. to the capacity of the two existing conduits will give a total capacity of about 28 m.g.d. until the third conduit is built for the whole distance. All three conduits are of bell and spigot cast-iron pipe. The first conduit was 36 in. in diameter. The second one was 42 in. in diameter for about 1½ miles, and 30 in. for the rest of the way. The 6 miles of the third conduit now being built, at the Skaneateles Lake end, is 36 in. in diameter. T. H. Mather is city engineer of Syracuse.

Railway Curves: Superelevation and Maintenance—II

Editorial Review Shows Variations in Practice and Opinion—Influence of Modern Locomotives —Relations of Curvature to Gage and Grades—Checking and Marking

By E. E. R. Tratman
Associate Editor, *Engineering News-Record*

ASSUMING a satisfactory elevation to have been selected and properly applied to a curve, it soon becomes subject to modification under the influence of traffic and the settlement of ballast and roadbed. Both the alignment and superelevation may in time become more or less out of true, in spite of occasional checking and even if the curve is monumented or marked by line and elevation stakes. Maintenance of line and elevation on curves is left mainly to the roadmasters or supervisors, who examine the curves occasionally. In some cases they are provided with cords of certain length and are supposed to check curves frequently as to their uniformity by means of ordinate measurements. This is held to be sufficiently accurate under ordinary conditions, uniformity in line and superelevation being one of the main requisites for easy riding curves. All roads require observations of curves to be made by roadmasters or engineers traveling over their divisions on trains and noting points where the trains do not ride smoothly. In most cases, it is the aim to keep the elevation as low as will give an easy riding track for passenger trains.

The first installment of this article, in the issue of March 16, 1922, discussed the principles underlying the use of superelevation, and reviewed the practice of more than twenty railroads as to formulas, ranges of curvature and speed, rates of increase in elevation, amounts of maximum elevation, spiralling and run-out. This concluding installment takes up the checking and maintenance of existing curves.

Rail wear is usually a factor in determining the superelevation in maintenance work. But increased rail wear may be a normal result of larger and heavier engines (as noted later), so that excessive elevation may be introduced if this traffic condition is not taken into account. A tendency to excessive elevation in maintenance work is noted particularly by one railroad. Thus, as soon as the elevation is put up so as to make an easy riding curve it is found that enginemen will increase speed, which in turn leads to further increase in elevation. On some portions of the line this condition made it necessary to restrict the elevation to an arbitrary limit of 3 or 4 in.

Engineering inspection and checking of curves is carried out to some extent by the engineering department, but in general this applies to individual curves where excessive rail wear or rough riding of trains indicates that attention is needed. One maintenance engineer expresses the opinion that the engineering department should specify the amount of superelevation, should mark this elevation at the curve and should check the curve at intervals of six months. A longer period might suffice where curves are adequately marked, as noted later, but it does not appear that any road follows such a systematic checking.

Survey and resetting of curves by engineers is done usually under two conditions only: (1) when improvement work is being carried out, such as rail renewal, reballasting or surfacing; (2) when a curve rides badly and the track forces seem unable to adjust it properly, so that the superintendent, roadmaster or local maintenance engineer calls for relining and staking of the curve.

In view of the development in weight and wheelbase of locomotives an inquiry was made as to whether present rules and practice in curve superelevation are proving satisfactory with modern equipment. Most of the replies were in the affirmative but were evidently rather perfunctory. Two exceptions throw a different light on the matter and suggest that other cases of unsatisfactory experience may be found on individual divisions or portions of railway systems. One of these unfavorable replies was simply to the effect that the rules give superelevation which is excessive for certain new engines, so that it has been necessary to reduce the elevation materially in order to avoid derailments.

Another reply is more specific and points strongly to the locomotive as a present factor in curve elevation. On a division having rather crooked alignment and handling a considerable number of heavy freight trains, new engines of the 2-8-2 type, with a wheelbase of 21 to 22½ ft. gave considerable trouble on curves of 6 deg. owing to a tendency of the leading driving wheel to lift from the rail. The curves had been elevated for passenger trains, up to a maximum of 7 in. The new freight engines were supposed to traverse curves of 8 deg. with gage widened ¾ in., but in order to operate them it was found necessary to reduce the elevation about 50 per cent on curves of 4 to 8 deg. and to limit the maximum elevation to 5 in. As freight traffic was the more important, "slow" orders were issued to reduce passenger train speeds at the troublesome points from 50 m.p.h. to 30 or even 20 m.p.h. These engines would not curve freely enough to take No. 8 turnouts at terminals, where the curve was about 9½ deg., as the driving wheels would spread the guard rails or the trucks would get on the wrong side of the frogs.

It is almost universal practice to keep the low or inner rail at grade, and to raise the outer rail to full elevation. An earlier but limited practice of lowering the inner rail by half the amount and raising the outer rail equally, thus keeping the center line of track at grade, appears to be obsolete. Two exceptions are noted to meet special conditions. On double track, one railroad raises the outer rail of the outer track and depresses the inner rail of the inner track, in order to maintain the same level for the rails adjacent to the center line of roadbed. In another case, junction curves leading from the outside of main line curves, have the inner rail dropped in order to obtain the effect of superelevation on the turnout.

At main line junction curves, superelevation of the

outer rail through the turnout or beginning of curve is impracticable, owing to the frog intersection of the curved lead rail and main line tangent. It is usual practice, therefore, to issue slow orders or speed restriction limits for such points and to use a turnout curve which will be satisfactory for these speeds. Two roads report special arrangements at such curves; one begins superelevation of the outer rail at the heel of the frog and the other lowers the inner rail of the turnout when practicable.

For junction turnouts, frogs of No. 14 to No. 20 are used in general, corresponding to curves of 3 and 1½ deg. respectively. The former is considered satisfactory for speeds not exceeding 20 m.p.h. and the latter can be traversed at speeds up to 30 m.p.h. without discomfort to passengers. Recommendations of the American Railway Engineering Association give limits rang-

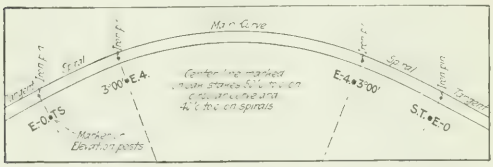


FIG. 1. MONUMENTING AND MARKING CURVES

ing from 9 m.p.h. for a No. 4 frog and 11-ft. switch rail to 40 m.p.h. for frogs Nos. 16 to 24 with 33-ft. switch rails.

Unless curves are permanently referenced or monumented and are checked occasionally from the monuments, the actual curve is likely to vary from the original or true location, due to shifting under traffic and rectification by the section forces. This permanent marking assists the work of maintenance and also the future adjustment or resurvey.

The monumenting consists in placing permanent stakes to indicate the beginning and end of curves and the change from spiral or compound curve to the main circular curve. The center line may also be staked permanently and it is a general practice to set posts showing the amount of superelevation. But the monumenting and marking of line and elevation are practiced systematically by relatively few railroads, and nine out of twenty-seven important roads report that they do not follow either method. Of the others, some mark line only or elevation only, while the remainder mark both and set curve monuments with more or less completeness. Some roads are introducing monuments and marks where curves are resurveyed.

Monuments consist usually of pieces of rail, iron stakes or wood posts placed outside the track and opposite the points of curve, spiral and tangent. On a few roads they are set also at intermediate points, as at 500-ft. intervals.

For marking alignment, center line stakes are placed generally at these same points, and sometimes at intervals of 50 ft. on the main curve and 25 ft. on spirals, as indicated in Fig. 1. Iron pins 1½ or 2 in. in diameter and 3½ to 4 ft. long are most commonly used for this purpose, but splice bars and oak stakes 2 x 2 x 24 in. are employed in some cases. A few roads use stone posts 6 x 6 x 36 in. and one of these roads specifies them for use in all slag ballast. Chisel marks on the iron and stone stakes and tacks in the wood stakes should mark the exact center line.

Instead of the usual terms *PC* and *PT*, one road has adopted the following nomenclature for points on curves, indicating the change as each point is approached: *TC*, from tangent to curve; *CT*, curve to tangent; *TS*, tangent to spiral; *SC*, spiral to circular curve; *CS*, circular curve to spiral; *ST*, spiral to tangent; *CC*, curve to curve (on compound curves).

Many roads follow the practice of indicating the superelevation at each curve by means of posts or signs which are set usually at the sod line or edge of roadbed, 9½ to 12 ft. from center of track and opposite the points of curve, spiral and tangent (see Fig. 1). At curves without spirals, the posts may be set opposite the ends of the runout, on either side of the point of curve. The location of these posts, however, is not always as exact as that of the curve monuments. Usually they are marked with the elevation: 0 at the *PC* or at beginning of runout and the full figure at *PS*, or at end of runout. In some cases, the first or zero post is marked also with the runout inclination (1 in. in 60 or 67 ft.) and the second post shows the full elevation and the degree of curve.

Two types of curve elevation posts are shown in Fig. 2. In the design at the left only the elevation is marked. In the design at the right the end posts have zero elevation on one side and "*T*" (tangent) on the other side; the inner posts show the full elevation and also the degree of curve (down to ¼ deg.). In this

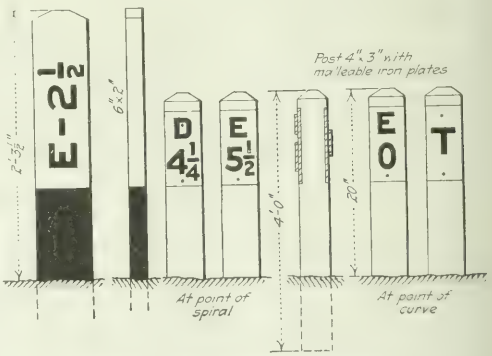


FIG. 2. CURVE ELEVATION POSTS

design the figures are in relief on malleable iron plates bolted to a creosoted post.

Diversity of opinion and practice in the widening of gage on curves, in order to facilitate the passage of locomotives, is as wide as the diversity in elevating rails on curves. Thus on twenty-two railroads standard gage is maintained up to curvatures ranging from 3 deg. as a minimum to 18 deg. as a maximum. In more detail, 3 deg. is the limit on one road, 4 deg. on two, 5 deg. on eight, 6 deg. on one, 8 deg. on six, and 9, 10, 12 and 18 deg. on one railroad each. Four roads report that gage is not widened at all on main track curves, two of them stating that their curvature does not require it. Of the other two, both operating long lines over prairie and mountainous country, one makes an exception for curves of 10 to 12 deg. through yards and the other states that locomotive tires are set to a gage which will allow for curvature.

Difference in wheelbase and wheel gage of large locomotives is theoretically a factor, but so many railroads

now operate engines of long wheelbase that this factor can have little weight in accounting for the diversity of practice noted above. The American Railway Engineering Association recommends standard gage up to and including 8 deg. curves, and then widening $\frac{1}{8}$ in. for each 2 deg. up to a maximum of 4 ft. $9\frac{1}{4}$ in.

Increments in widening are generally $\frac{1}{8}$ in. for each two degrees (or fraction thereof) or $\frac{1}{4}$ in. for each 4 deg. On one road the rule is carried to a refinement of $\frac{1}{16}$ in. for each degree, beginning with 4 ft. $8\frac{7}{16}$ in. for 6 deg. curves. In this case, as in cases where rules require superelevation to be varied by increments of $\frac{1}{4}$ in., it may be doubted whether such close graduation is maintained in practice. For maximum gage permissible, including wear of rail heads, four limits are given by different roads as follows: 4 ft. 9 in., 4 ft. $9\frac{1}{8}$ in., 4 ft. $9\frac{1}{4}$ in. and 4 ft. $9\frac{1}{2}$ in. Rules sometimes specify the use of special track gages for curves to insure accuracy of widened gage.

Diversity of Practice in Gage Variation

The diversity of practice in regard to gage is emphasized by the contrasting statements in railway companies' books of maintenance rules quoted below, although in some cases these statements refer particularly to tangents. It is further noted in some of these books that kinks in gage are as detrimental as low joints in surface and must be corrected. In regard to the second quotation, other roads have rules which approximate the first sentence, but with the term "proper" or "uniform" instead of "perfect," thus giving a very different sense to the paragraph:

A. "Slight variations from gage are not objectionable, provided that they are uniform and continuous over long distances."

B. "Perfect gage is one of the principal features in good track. Gage must be exact and uniform as prescribed."

It is sometimes pointed out in the rules that rectification of gage need not be attempted as long as the width is regular or uniform and does not exceed certain limits. This caution provides against unnecessary labor and work and undue damage to ties and track material by the shifting and respiking of rails.

Turnouts on the inside of curves are objectionable, since standard gage is required through turnouts, so that the normal widening of gage must be interrupted. Some roads require speed reduction on such curves. With turnouts on the outside of widened curves, the standard flangeway width at main line guard rail is increased by an amount equal to the widening of gage.

Increase in gage is obtained usually by shifting the inner rail outward and is maintained for the full length of the main on circular curve. The transition from standard to widened gage is made in conformity with the spiral, or on the tangent if the curve is not spiralled.

A request for suggestions as to means of improving the stability or permanence of track on main-line curves produced but meager results. In general, the replies covered good maintenance and heavy track construction. The first includes correct alignment, with transition curves, uniform gage and uniform superelevation. One suggestion is to facilitate maintenance by placing 40-in. iron pins at all curve points, the center line being marked on the head with a cold chisel.

Suggestions for track construction include heavy rails, ample supply of good ties, well-drained roadbed, a heavy bed of crushed stone or gravel ballast kept well tamped, heavy tie plates, double spiking and the use of sufficient rail anchors or other means to prevent creeping. In view of the lateral pressures, some engineers suggest shoulder tie-plates, large ties and a heavy shoulder of ballast. Canting or inclining the rails inward from the vertical, so as to be perpendicular to the pressure, is advocated by two roads, one of which points out that this inclination should be given by special tie plates and not by adzing the ties. A corollary to this is the statement that in no case should the rails be allowed to turn out or incline outward from the vertical due to wheel pressure or tie wear.

Reduction of superelevation is the most radical suggestion, one engineer making this definitely and another indirectly by pointing out that if superelevation is increased to suit the speed the speed is likely to be further increased. In the first reply, it is remarked that such reduction probably will give greater relief than any other measure. It is considered specially desirable for tracks used by both fast passenger trains and slow heavy freight trains. On certain portions of this road, trouble from derailment has been practically eliminated by reducing the superelevation of 3 deg. curves from 5 in. to a maximum of 3 in. As it is expensive to carry out such a change over a considerable mileage it may be introduced in connection with other work, or when the track is being ballasted or surfaced.

Grade Compensation on Curves

To equalize train resistance it is usual to compensate or reduce grades for curvature, in order that the combined grade and curve resistance will not exceed the grade resistance on tangent. The present information given as to present practice in this respect supplements earlier information in *Engineering News* of April 16, 1908, p. 419, and Aug. 15, 1912, pp. 278 and 308. The rate of compensation should properly take into account the local physical and operating conditions.

Uniform compensation or reduction of grade at the rate of 0.04 per cent per degree of curve, regardless of variations of curvature and speed, is by far the most general rule, although some railroads specify or allow modifications to meet special conditions, especially in the use of increased compensation where steep grades reduce the speed or where stations may necessitate the stopping of trains. On one large system there is no prescribed rule but the matter is left to the judgment of the local engineers.

The minimum compensation noted is 0.03 per cent, used by two roads. The maximum is 0.05, used by three roads, though only one of these makes it a uniform standard. One engineer reports that dynamometer tests have shown 0.04 to be insufficient for sharp curves, and recommends going as high as 0.06 per cent. Out of twenty-four roads, sixteen use 0.04, mainly as a uniform rule. Two use 0.03; four use 0.035, one uses 0.045 and one uses 0.05.

Some of the modifications or qualifications for compensating grade on curves according to local conditions are noted below:

1. On maximum grades with a large amount of curvature, 0.04 per cent compensation is used up to 10 deg. curves, but this is increased to 0.05 on grades with few curves. Grade at stations must not exceed 0.4 per cent. A decrease of 0.1 per cent in grade must be allowed for vertical curves.

2. Compensation is 0.04 per cent, the uphill end being equated and carried out on the tangent.

3. A good rule is 0.035, as 0.03 is scarcely sufficient and 0.04 makes the pull on the drawbar a little less on heavy curves than on tangents.

4. Although our rule is for a standard compensation of 0.04, a correct and scientific rule would recognize in some way the degree of curve as being a function of curve resistance. Thus if 0.04 is proper for a curve of 12 deg. it does not follow that it is proper for one of 2 deg.

5. Although the American Railway Engineering Association suggests 0.03 compensation up to 2 deg. curves, we use 0.04 for all degrees and have found it satisfactory.

6. Ordinarily, 0.035 is used, but this is increased to 0.04 on steep grades with sharp curves.

7. Ordinarily 0.04, but 0.05 at stations or points where trains are likely to stop.

8. Compensation is 0.03 on the open line and 0.05 at points where speed is restricted or trains stop.

9. Compensation is uniformly 0.04, for although present conditions may call for reduced speed at certain points we cannot tell when conditions of increased power or decreased tonnage may make it desirable to maintain regular speed. There should be a greater rate of compensation where the track is used by both freight and passenger trains, since there is more friction and resistance where the superelevation is adjusted for normal and safe passenger movements but also carries full-tonnage freight movements.

As to the basis of these rules, most of the reports state that it is general practice and experience and all of them state that no recent tests have been made. Two refer to tests made about twenty years ago, three accept the recommendations of the American Railway Engineering Association and one bases its practice upon the Wellington investigation of 1878.

Conclusion

From the information presented in this article it is apparent that considerable diversity of opinion and practice exists in regard to curve work. Since proper condition of curves is so essential to efficient operation and economical maintenance, it is rather surprising that the permanent marking and monumenting of curves is not more general. Such work is inexpensive and in many cases a policy of checking the curves and then marking them would be well worth while. As to means of increasing the stability of track on curves and thus reducing maintenance work and expense, suggestions are mainly for heavier construction, although an important suggestion is for a general reduction in the amount of superelevation of rails.

It is evident that present formulas for superelevation of rails on curves give results which are barely applicable under modern conditions. In fact, these results would be misleading if they were not modified materially in the light of actual experience. It is evident also that modern heavy locomotives with long rigid wheelbase constitute a factor that must be reckoned with in curve layout and maintenance. Variation in gage of driving wheels on different axles in order to facilitate the passage of curves is common practice, but there is little uniformity and the arrangement appears to be mainly arbitrary. Under such conditions the engineer is at a disadvantage in deciding what amount of widening of the track gage should be introduced on curves.

Curve elevation and grade compensation for curvature both involve scientific investigation as a basis, although practical considerations must modify the application of results thus obtained. It appears, however, that no extended modern investigations or tests have been made to determine the accuracy of existing methods or the extent to which mathematical analysis needs to be modified to meet modern conditions. Reliance is placed largely on tests and investigations made many years ago, when size of engine and weight of train were very different from conditions involved in present railway operation. On the other hand, even greater reliance is placed upon actual experience and observation, since theoretical methods now in use do not meet practical conditions. For these reasons, a broad and thorough investigation of train resistance under modern conditions with modern equipment appears desirable.

It has been pointed out that curve superelevation and alignment, with other items of track maintenance work, were neglected during the war and under government operation of the railways. Since the war, labor and other conditions have not been favorable to prompt restoration of normal standards of maintenance. Consequently, there is a wide field for revision and improvement and perhaps an opportunity for important innovations.

Year's Count of Traffic at Toll Bridge Analyzed

TRAFFIC figures covering a full year's count (July 1, 1920, to July 1, 1921) have been obtained by the State Highway Department of Connecticut at the toll bridge over the Connecticut River on the Old Saybrook-Old Lyme road, which is part of the shore route between New Haven and New London.

This road is a direct route between New York City and the summer resorts to the north. The bridge, therefore, carries a heavy tourist traffic with extreme

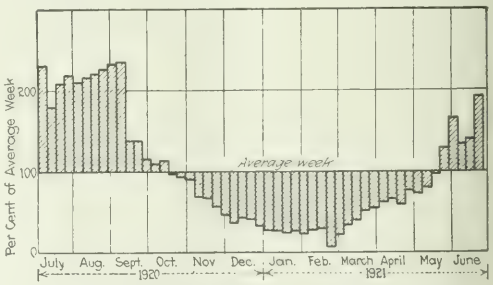


FIG. 1 TRAFFIC IN PER CENT OF AVERAGE WEEK

seasonal variations. The data have been summarized in the form of charts, which are reproduced herewith.

Fig. 1 shows a comparison of each week in the year with an imaginary "average week," obtained by dividing the total number of vehicles for the year by 52. On this particular chart the months of August, December and January have fairly steady weekly traffic.

Fig. 2 shows the division of the actually counted year's traffic on the Old Lyme bridge according to the days of the week. This is fairly representative of results obtained by short-period traffic counts. The chart represents the average of every Sunday, Monday, etc., for

the entire year reduced to the percentage of the weekly traffic. The Monday percentage in the case of this particular year is probably raised by two holidays—Labor Day and July 4.

Fig. 3 shows the monthly and seasonal variation in traffic. Had the astronomical summer period from June 21 to Sept. 21 been used, instead of the calendar months June to August, inclusive, over one-half the yearly traffic would have occurred in that quarter.

Fig. 4 indicates the relation of the various types of vehicles using the bridge. Horse-drawn traffic, it will be noted, is exceedingly small, only about 0.4 per cent of the total.



FIG. 2. DAILY VARIATION OF TRAFFIC IN PER CENT

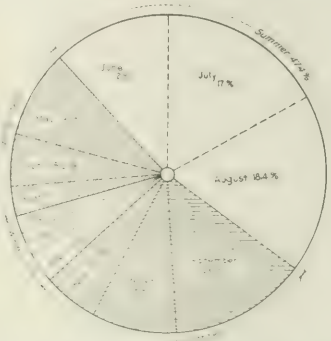


FIG. 3. SEASONAL VARIATION OF TRAFFIC IN PER CENT



FIG. 4. RELATION OF TYPES OF VEHICLE

Varying Electrification Systems in England

A conflict of electrification plans has arisen in England, owing to the preference of three different systems by three railways which are to be included ultimately in one of the large groups formed by amalgamation of existing companies. Each of the three railways has an extensive suburban service near London. The London & Southwestern Ry. uses a 1,500-volt direct current system and the London, Brighton & South Coast Ry. uses a single-phase alternating current system. Now the Southeastern & Chatham Ry. proposes a 3,000-volt direct current system for its suburban lines. Such diversity being undesirable, meetings of electrical engineers and general managers were held in order to arrive at some basis of agreement. According to the *Railway Gazette*, London, these meetings were unsuccessful and the Minister of Transport has appointed a committee of electrical engineers and railway officers to consider the possibility of securing some degree of uniformity in future schemes for electrification.

Condition of Wood-Stave Pipe on Reclamation Projects

DATA on the condition of 196 separate installations of wood-stave pipe on 18 projects of the U. S. Reclamation Service are given in the December *Reclamation Record* by William H. Nalder, engineer, Denver office. He makes the following general observations:

1. One condition, which, while not universal, is in general quite typical of the operation of these pipe lines, is that they are full of water only part of the time, a condition generally recognized as conducive to the early decay and destruction of wood pipe.

2. Many installations are in soils that are more or less heavily impregnated with alkali and carry alkali-laden water. This contact with alkali appears to have resulted in several instances in the early destruction of the steel bands and wire winding of the pipe.

3. There are 65 installations reported as being made between the years of 1916 and 1920. All but three, or 95.4 per cent are reported in fair or better condition. The three installations reported in poor or worse condition were made in 1916 and 1917 and were of untreated fir staves placed in moist earth and kept full of water during the irrigation season only. They were in sizes of 10 and 12 in. and are under maximum hydrostatic heads of 10 and 15 ft.

TABLE I. WOOD-STAVE PIPE CONDITIONS ON U. S. R. S. PROJECTS

Condition	All Installations				1910 and Earlier				1911 to 1915, Inclusive				1916 to 1920, Inclusive			
	Number	Per Cent	Length, Ft.	Per Cent	Number	Per Cent	Length, Ft.	Per Cent	Number	Per Cent	Length, Ft.	Per Cent	Number	Per Cent	Length, Ft.	Per Cent
Perfect	1	0.5	1,030	0.3					1	1.7	1,030	0.9				
Excellent	7	3.6	16,182	3.9					3	5.1	12,046	10.1	4	6.2	4,136	2.9
Very good	7	3.6	4,956	1.2					3	5.1	4,156	3.5	4	6.2	2,751	1.9
Good	120	61.5	226,811	53.7	34	48.0	42,251	29.2	32	54.2	46,649	39.1	54	83.7	131,211	90.6
Fair	53	15.9	65,687	16.1	20	28.0	43,579	30.2	11	18.6	23,188	18.7				
Poor	17	8.7	67,111	17.0	7	9.9	34,372	23.4	7	11.9	28,669	24.1				
Very poor	5	2.6	9,111	2.1	4	5.6	9,091	6.2	1	1.7	5,122	0.4				
Bad	1	0.5	111	1.0					1	1.7	3,930	3.3				
Worst condition	4	2.1	1,771	1.2	4	5.6	1,771	10.2								
Unreported	1	1.0	1,000	1.0			1,000	7.1								
Total	196	100.0	410,785	100.0	71	100.0	46,500	100.0	59	100.0	133,162	100.0	65	100	144,882	100

4. Of the 59 installations made during the period of 1911 to 1915, inclusive, 50, or 84.7 per cent, are reported as in fair or better condition. Of the nine in the group reported as being in poor or worse condition two are of untreated fir in moist earth, full during the irrigation season only, one is redwood buried in alkali soil that has destroyed the winding, two are untreated continuous fir laid in gravelly soil, and for four no information could be had as to the nature of soil or hydrostatic head.

5. Of the 71 installations made during the period of 1910 and earlier, 54, or 76 per cent, are reported as fair or better condition. There are three installations made in 1911 and one in 1904 which are all the installations reported

as being made prior to 1905. All of these are reported to be in fair conditions, although all are reported as having been moved and relaid.

To eliminate as much as possible the personal element entering into the use of the terms ranging from "perfect" to "no good" in describing one condition of the pipe the data have also been grouped under the two headings "fair or better" and "poor or worse." It is thought that all pipe described as being in a fair or better condition still is giving satisfactory service and that all pipe described as in a poor or worse condition was not at the time of examination giving satisfactory service, although it may have been doing so shortly before that time. This segregation and grouping is shown in Table I under the same general headings as to dates of installation as those used in Table I.

TABLE II. CONDITIONS OF PIPE ACCORDING TO CONSTRUCTION

Construction	All Installations: Fair or Better Lines	All Installations: Fair or Better Length, Ft.	All Installations: Poor or Worse Lines	All Installations: Poor or Worse Length, Ft.	1910 and Earlier: Fair or Better Lines	1910 and Earlier: Fair or Better Length, Ft.	1910 and Earlier: Poor or Worse Lines	1910 and Earlier: Poor or Worse Length, Ft.	1911 to 1915: Fair or Better Lines	1911 to 1915: Fair or Better Length, Ft.	1911 to 1915: Poor or Worse Lines	1911 to 1915: Poor or Worse Length, Ft.	1916 to 1920: Fair or Better Lines	1916 to 1920: Fair or Better Length, Ft.	1916 to 1920: Poor or Worse Lines	1916 to 1920: Poor or Worse Length, Ft.
Wire-wound fir staves																
Buried	93	144,560	22	76,866	43	61,440	13	46,151	31	32,179	6	23,975	29	50,941	3	6,740
Above ground	27	44,191	2	1,087	5	5,188	2	1,087	7	13,006	....	.....	15	25,997	...	.....
Wire-wound redwood staves																
Buried	2	38,649	1	512	....	.....	....	.....	1	1,727	1	512	1	36,922	...	.....
Continuous fir staves																
Buried	14	26,445	2	8,624	1	3,500			11	22,162	1	8,624	2	783	...	.....
Above ground	22	45,760	2	13,033	5	16,402	2	13,033	10	16,917	....	.....	7	12,441	...	.....
Continuous redwood																
Buried	1	450	....	.....	....	.....	....	.....	....	.....	....	.....	1	450	...	.....
Above ground	7	10,608	...	.....	...	.....	...	.....	....	.....	...	.....	7	10,608	..	.....
All types	166	310,663	29	100,122	54	86,530	17	60,271	50	85,991	9	33,111	62	138,142	3	6,740
Totals in percentages	85 1	75.6	14 9	24 4	76.0	59.0	24.0	41.0	84.7	72.2	15.3	27 8	95.4	95.4	4.6	4 6

Wisconsin Produces Aggregates Locally at Low Cost

Itemized Cost at One Quarry and Six Gravel Pits—One Pit Operated by Day Labor—Some of Best Material Never Washed

By H. G. Kuehling
Construction Engineer, Wisconsin Highway Commission, Madison, Wis.

QUALITY of material, plant equipment and operation, and other items entering into the production cost of local aggregate are seldom the factors which decide its use. Handling and transportation are the deciding factors. They will be a greater factor as road jobs reach out farther from shipping points.

The argument is sometimes offered that the average contractor is not an economical producer of material. This may be true. Where there is a difference from $2,000 to even $6,000 per mile in favor of using local materials, contractors and producers may as well make up their minds that the road will be built of them.

The cost at commercial plants in Wisconsin, is about 90c. per cubic yard based on 60c. a ton for sand, 70c. a ton for gravel, and a 1:2:4 mix. To this must be added the freight haul of about 40 miles (a very short haul for many states) which gives a freight cost of about 95c. per cubic yard and the cost of unloading, which will be 25c. more, or a grand total of $2.10 per cubic yard on board the vehicle that is to haul the material to the road.

The cost of the local material in the bins ready to spout into the hauling vehicle, on three jobs where the Wisconsin Highway Commission maintained a cost engineer during the past season, was less than 94c. per cubic yard. This was in the production of 60,844 cu.yd. of sand and stone actually used, the waste sand being charged against the used sand. These quantities were 18,717 cu.yd. in one pit that required washing and had a large quantity of boulders and so also required considerable crushing; 22,470 cu.yd. in a second pit that required washing and some crushing, and the remainder on a third job where four separate pits were used requiring four set-ups, with no washing but some crushing.

With this basic difference of over a dollar a cubic yard considerable additional expense would be justified in producing the local materials. And when there is added the fact that the haul from the local pit is very likely shorter than from a railway station, this difference will become more startling. The fact that some contractors will not like to produce material will not be an excuse for missing the above savings.

The uncertainty of output, both daily and total, is sometimes advanced as an argument against local pits. There is no particular difficulty in arranging a local pit to produce an average of 200 cu.yd. per day, enough to build over 300 ft. of standard 18-ft. concrete highway. This with many other facts and costs is shown on the accompanying table. This output can readily be doubled by increasing the plant capacity or by stock piling before paving operations begin, or by both methods.

The total output can be determined and fairly well defined by proper test pitting. It is true that in some cases pits have had to be abandoned. During the past year in Wisconsin one pit operated by a contractor was abandoned and commercial material shipped in. In this case, however, the contract covered just such a contingency and the contractor was paid 20c. per square yard extra. At that the contractor built an extra mile of concrete that was not planned to come from the chosen pit. The taxpayers still benefited to the extent of 20c. per square yard on many thousand yards. While isolated cases may fail in total quantity, there is no special reason to expect failure where proper test pitting is done under the supervision of a competent geologist.

In speaking of daily output, the local pit must not be too severely condemned as we have all seen many jobs short of material even when commercial pits were furnishing it. This may have been due to breakdowns or changes in the pit, for such do occur; inability to get railway cars in sufficient quantities; too ambitious producers who contract for more than they can ship and then try to keep all customers going with partial orders; or to irregular deliveries by railway companies which are anxious to move more important and better paying freight. In the case of the local pit, the troubles, where they do exist, are close to the job and the work

can be better planned than when the contractor does not know whether or not he is to get a shipment on the siding.

Still another argument sometimes presented against local materials is that they are not as good in quality as commercial materials. This argument is not generally sound, for local material from the same glacial deposits as the commercial aggregates will give the same quality of sand and gravel if treated in the same way, just as crushed stone from two parts of the same ledge is the same if both parts are crushed and screened alike.

There seems to be a rather common impression that to be good concrete aggregate, the material must be washed. Some of the best material produced in Wisconsin is never washed and would only be harmed if it were. Many concrete road gravels are injured by too much washing which removes the finely-divided silica which should be retained to give a more nearly perfect gradation in the sand. There is no doubt that washing increases the output and assists in separating the sand from the coarse aggregate, but one should not overlook the fact that it might be harmful. A small amount of finely divided clay is not harmful and may be even beneficial, while the presence of the fine silica or lime dust mentioned above is decidedly beneficial.

The cost table accompanying this article is one that has been compiled from very carefully obtained data, based on actual expenditures. It is based on a regular scheme of cost information used by the Wisconsin Highway Commission. In a similar way the operations on several day labor paving jobs have been studied and carefully subdivided. This particular table also includes the costs of a day labor quarry operation which might be of some interest. This table warrants study by anyone contemplating local gravel production. It shows where best to concentrate efforts to cut down costs and another year's operation by these same counties will cut down the costs shown in this table.

COST OF PRODUCING GRAVEL AND STONE FOR CONCRETE ROADS FROM LOCAL PITS IN WISCONSIN

	Washington Co		Rock Co.				
	Slinger	Jackson	Pit No. 2	Pit No. 3	Pit No. 4	Pit No. 5	Waterlogged Nesnah Quarry
C.Y. sand produced	5,541	7,539					
C.Y. stone produced	13,176	14,931					
Total produced	18,717	22,470	4,170	5,559	3,932	5,996	8,614
Days operated	90	104	24	27	18	34	127
Avg. daily production, C.Y.	208	216	174	169	218	176	68
Max. daily production, C.Y.	425	432	272	276	303	317	
Operation	Cost per C.Y.	Cost per C.Y.	Cost per C.Y.	Cost per C.Y.	Cost per C.Y.	Cost per C.Y.	Cost per C.Y.
Cost of undeveloped pit	040	.044					
Cost of material in pit			129	.100	.101	.162	100
Assembling and erecting equip.	152	039	170	062	.056	.021	072
Moving equip. during const.	001	003		130	.218	.079	
Returning equip. to storage		001				068	
Stripping	085	047	187	060	048	141	
Drilling—labor							135
Drilling—fuel, oil, etc.							.042
Drilling rental of equip.							161
Drilling depreciation of equipment							
Repairs to rented equip.							
Blasting—labor							020
Blasting dynamite, caps, etc.							011
Breaking up rock							021
Delivering to crusher—labor							015
Delivering to crusher—fuel	158	012	085	057	067	058	
Delivering to rental equip.	038	029	056	026	045	075	
Delivering to dep. equip							
Delivering to rep. to equip	108	124	050	064	058	057	
Crushing & screening—labor	113	.232	060	067	063	077	668
Crushing & screening—fuel	018	024	057	043	076	041	135
Crushing & screening—rental of equip.	011	005					
Crushing & screening—depreciation of equip.	095	043	105	112	115	116	146
Crushing & screening to repair rented equip.							
Washing—labor							
Washing—fuel	025	.017					
Washing & drying—rental	013	.007					
Washing—depreciation	023	.037					
Washing—repairs to rented equip.	017						
Handling & loading—labor	030	021	125	141	144	063	030
Handling & loading—fuel	008						046
Handling & loading—depreciation	007						
Rehandling & loading—labor							
Rehandling & loading—fuel							
Rehandling & loading—depreciation							
Rehandling & loading—rental of equip.							
Rehandling & loading—repairs to rented equip.		004					
Supervision & overhead	026	041	045	026	042	064	042
Superintendence	007	012	005	021	041	026	041
Engineering			010			012	016
Insurance & compensation							
Workmen's							
Accident							
Miscellaneous	004		012	024	016	009	
Total	916	642	1 104	971	1 161	1 008	1 454

Fireproof Office Building Gutted by Severe Exposure Fire

Upper Half of 15-Story Burlington Building Swept Clean—Unprotected Windows on 80-Ft. Street Appear Main Factor

HALF the contents of the 15-story office building of the Chicago, Burlington & Quincy Railroad Co., Chicago, were completely destroyed on the night of





FIG. 2. SOUTH COURT FACE

Wire-glass windows in metal frames here. Many panes melted in the fire, though little heat from outside fire reached this side.

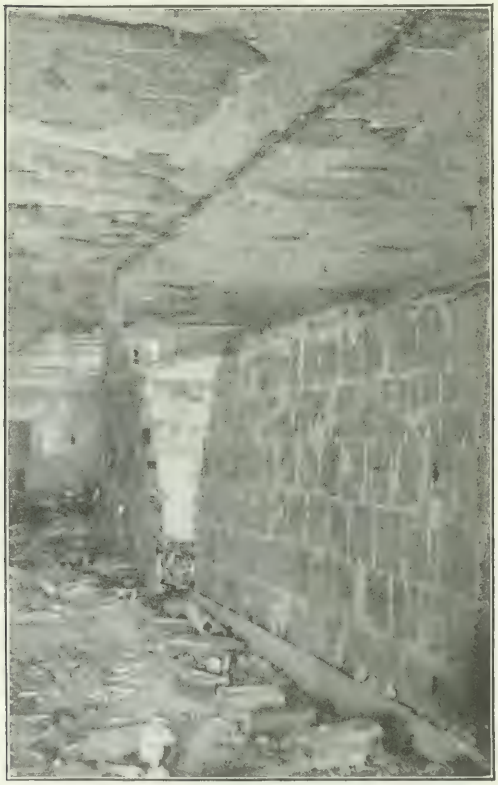


FIG. 3. TILE PARTITION AND CEILING DAMAGE

Expansion of floor tiles threw down plastering in patches. One two soffits spalled off.



FIG. 4. REMAINS OF FILING CASES ON FIFTH FLOOR

Damage to mullions and window frames. A short fire and little water indicated by condition of the ceiling plaster.

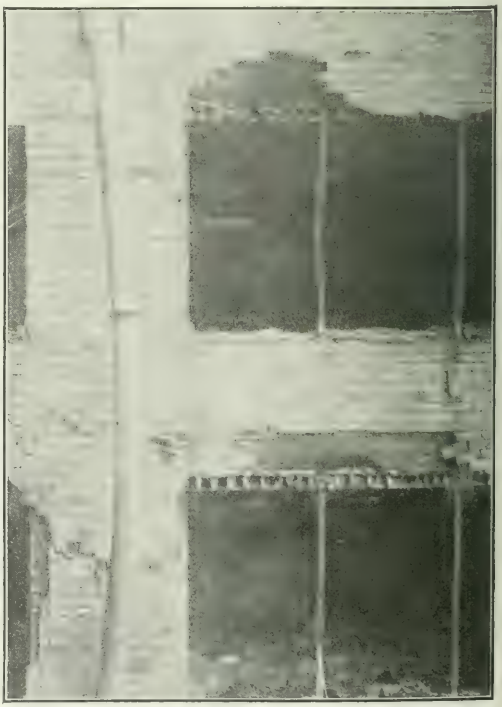


FIG. 5. BENT MULLION SUPPORT STRIPPED

Wire-glass sash and frames gone in court on fourteenth floor.

Inside Views of Burlington Building after Fire

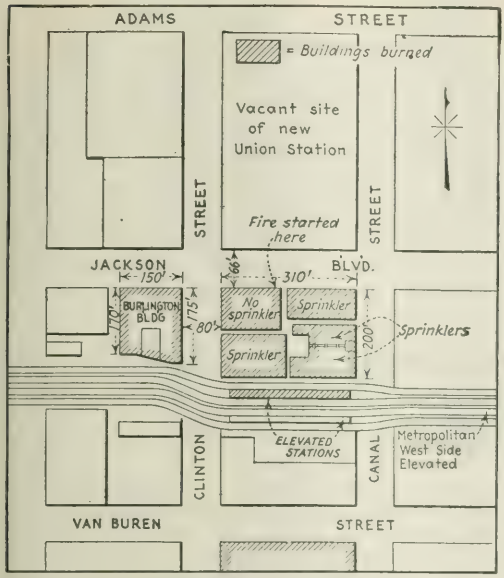


FIG. 6. LOCATION PLAN OF BURLINGTON AND ADJACENT BUILDINGS

March 14-15 by a severe exposure fire. The fire originated in the block directly east of the Burlington Building occupied largely by 2- and 7-story buildings. The flames swept across an 80-ft. street through the open floor areas of the Burlington Building above the eighth floor. The Burlington Building was of fireproof construction, but its unprotected street-front windows, plain glass and wood sash and frames, offered no resistance to the entrance of the furnace-like blast from the east. A light northeast wind prevailed. The steel elevated structure of the Metropolitan West Side Elevated Railway, extending along the south side of the burning buildings and the Burlington Building was much damaged by the heat, and a falling wall wrecked several girders, interrupting traffic for 15 hours.

So far as yet determined, the fire started in a 2-story building in the north side of the block bounded by Jackson Blvd., Canal, Van Buren and Clinton Sts. It spread rapidly southward through unprotected wall openings to the 7-story buildings, which were sprinklered. The engines were delayed some few minutes due to a false alarm. In the sprinklered buildings so many heads opened that the tanks were soon drained. The intensity of the heat generated in these buildings was exceptional, due to the character of the occupancy, light manufacturing, printing, book binderies and publishing. After the stream of fire gained entrance to the Burlington Building and melted out the wire-glass windows with which the openings in the rear were protected, it is reported that flames 30 ft. long shot out of the back windows. The Burlington Building was not sprinklered.

Interest from the engineer's viewpoint largely centers on the fireproof Burlington Building, where damage to structural members was little or none; the concrete and tile covering of the steel frame adequately protected the columns, beams and girders, but not without a certain amount of spalling. In spots the flat-arch tile floors lost the soffits of the tile.

The floor plan is open with the elevators grouped in a fireproof partition in a central location on either side of a corridor to the north of the court. The elevators were running up to the fifth floor the next day after the fire, no damage being done to the mechanism. The elevator inclosures were protected with wire-glass and are bulged outward several inches toward the corridor. There is no vent over the elevator shaft. Marble in the halls and elsewhere shows crumbling. The wood flooring and 2 x 3-in. sleepers in the cinder concrete were burned out clean. Steel filing cases and other steel equipment proved to be of little or no protection to their contents.

In general the fire damage was confined to the upper seven stories. The heat effects from the east are obvious on the spalled terra cotta work, of which perhaps half will have to be replaced. Large areas show where the glazing had been removed by the high temperature. The fire was intense and quick. Temperatures reached upward of 2,000 deg. F.; brass, which melts at 1,960 deg., is spattered around. The wire-glass windows melt at 1,700 deg. A clock hanging on the wall of an executive's office was found on the floor with the hands, after straightening, pointing to 1:45 p.m. The fire is reported as starting at 1:00 a.m. Other evidence of the short duration of the fire is the condition of plaster, which is practically intact in some of the top floors. Plaster calcines through in 30 to 40 minutes.

Losses of records by the Burlington are in many cases irreplaceable but G. A. Haggander, bridge engineer, states that most of the bridge plans were in fireproof vaults. On the other hand, many of the building plans and those of the signal department are gone. Valuation records are mostly gone and will have to be reassembled from Washington and points on the road. Most of the legal records are intact in the vaults. Steel office furniture and filing cabinets were of absolutely no protection to their contents.

Theories—The fire swept through the building horizontally. All evidence from several reliable sources indicates that the vertical stops at stairways were absolutely effective.

Charles Bostrom, city building commissioner, expressed the opinion that had all of the east windows been of wire-glass the first could have been kept out of the building. W. D. Matthews, chief engineer, Chicago Board of Underwriters, would not go so far concerning the effectiveness of wire-glass, but said that the firemen would have had a much better chance to save the building. The outside heat in his opinion prevented radiation from the fire caused by the ignition of office equipment within and this inside fire became so intense that it finally melted out the wire-glass windows in the rear.

Opinion, however, seems to be somewhat divided as to whether the wire-glass windows back of the fire escapes on the east face next to the fire were melted down from the fire inside or the heat from the outside. Employees of the elevated state that flames issued outward toward the east from some of the top floors. At any rate, the outside flames were not playing on the melted wire-glass windows on the rear of the building.

Dividing the destroyed block of buildings east and west is the elevated structure with the Canal St. sta-

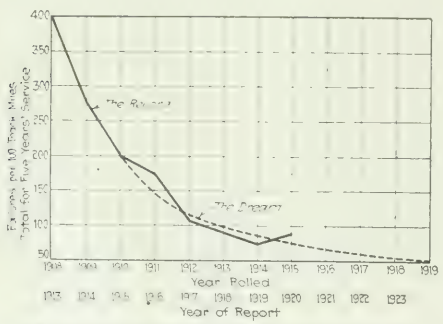
tion in the middle of the block. Brick walls and machinery falling on the north island station and three of the four tracks, put three tracks of the elevated service out of commission for 15 hours, when the plate girders under one of the tracks had been jacked back into place and rails relaid. The east track to the south was out of commission from the heat and hose lines only. The heaviest load dropped onto short, shallow box girders which carried the tracks over the under passage between the two island platforms. While the temperature of the girders was high, B. J. Fallon, general manager, Chicago Elevated Ry., is of the opinion that those which are in place can be used, although on the north track the damage from the falling walls twisted, bent and deformed six or seven girders, so badly that they must be replaced.

Reports on the effects of the fire and its lessons to the profession are being prepared under the direction of W. T. Krausch, engineer of buildings for the Burlington, who has called in Marshall & Fox, the original architects of the building, and their consulting engineer, L. E. Ritter. Under Mr. Krausch the bank offices on the first floor were made ready for occupancy the next day after the fire and so were five of the lower floors for the road's officials. By March 18 two more floors had been turned over and the eighth floor was ready by March 20. The damage on this floor was mostly from water. There was no delay to service or business.

American Railway Engineering Convention

Rail Committee Presents Experimental Rail Specification Based on Quiet-Setting Steel—Engineers and Labor Economics—Analysis of Warehouse and Freighthouse Design —Specifications for Movable Bridges Adopted

A DISTINCTLY progressive attitude in the work of the American Railway Engineering Association was evidenced in the committee reports presented at the annual convention held in Chicago, March 14-16. The most important action was the development of a new experimental rail specification, to which the manufacturers have agreed to roll rail. Four other important developments which mark departures from more or less



RAIL IMPROVEMENT INTERRUPTED IN 1915
Five-year performance of rails rolled in various years (full line), and predicted curve of M. H. Wickhorst (dash line).

routine investigations may be noted: (1) Application of economics to the labor situation, covering not only the selection and employment of common labor, but also the training of young engineers and of employees in the maintenance-of-way department; (2) Analysis of the main principles and factors in the design of railway warehouses and freighthouses, in order to insure efficient and economical operation; (3) Preparation of a system of records for unit costs in track work, so that there may be a definite knowledge and comparison of costs in various items of work; (4) Preparation of definite specifications for special classes of track work in view of the steady though as yet slight tendency toward the contract system in maintenance of way. Advance in the field of bridge design through the adoption of a specification for movable bridges was still another item of progress.

Following the disagreement of view between railway engineers and rail manufacturers which became evident during the past year or two, an intensive study of rail test data and mill practices was undertaken by the rail committee (chairman, George J. Ray, Lackawanna R.R.). This study led the committee to certain conclusions as to desirable qualities in rail steel, on the basis of which a trial specification was framed. The rail mills have agreed to roll rail to this specification. The committee states its conclusions thus:

> Probably the most important item of manufacture that affects the quality of the finished rail is the condition of the steel as it is poured into the molds. A well-made steel, thoroughly deoxidized with silicon or other deoxidizer, sets quietly in the molds with a flat top on the ingot. A steel not fully deoxidized, however, effervesces in the mold and sets with a "horney" top on the ingot. The upper third of an ingot cast with effervescing steel is spongy inside, with numerous small holes but with only a small central pipe. Such steel also shows considerable interior segregation of carbon, phosphorous, and sulphur, resulting in a brittleness in the interior of the head of the upper rail of the ingot. The quiet-setting steel is free from interior sponginess, the segregation is much lower, and the interior steel of the upper third of the ingot is denser and more ductile, but the ingot has a larger central pipe, which shows as a lamination in the web of the rail lower down from the top of the ingot than in rail made from effervescing steel.
>
> The work by Wickhorst in 1912 (see *Proceedings* American Railway Engineering Association, Vol. 14, 1913, p. 507), showed that about 0.25 per cent or more of silicon is required to obtain its full deoxidizing effect, and it would seem that specifications should require a minimum of 0.20 per cent silicon in rail steel. In this case the upper end of the *A* rail, with the usual discard of 10 or 12 per cent, may show a small vertical lamination in the web, but the metal in the head will be free from the sponginess and excessive segration present in rails made with effervescing steel.

These conclusions, and the expectation that with careful mill practice the normal amount of top discard will insure good rail steel, are reflected in the experimental specification which was submitted at the meeting for information. Some of its characteristic features are:

Chemistry—Carbon, from 0.53-0.68 per cent for 70-lb. rail to 0.67-0.80 for rail over 111 lb. Phosphorus, 0.04 maximum. Manganese, 0.60-0.90, with 0.50-0.80 optional for rail over 111 lb. Silicon, *not less than* 0.20 per cent.

Tests—Specimens *shall not fracture* in the drop test; ductility and deflection are to be measured for information only. Either one blow or two blows with reduced

height of drop may be demanded by the purchaser; with the standard 2,000-lb. tup and 3-ft. span (4 ft. for rails over 111 lb.), the two-blow drop is specified as 15, 15, 16 and 18 ft. for rails of 70-79, 80-90, 91-110, and 111-140 lb. weight. If one blow is used, the heights for 80-90, 91-110 and 111-140 lb. are to be 18, 20 and 23 ft. There are carefully guarded provisions for retest in certain cases. All tests are to be made *with head down.*

Desired Mill Practice—Fully deoxidized, quiet-setting steel is desired, teemed into the molds as cool as practicable. The ladle should be held as long as practicable, so that all reactions may become complete. Ladle additions should be made in liquid form. Aluminum addition in the mold is not permitted. Spattering in teeming, and disturbing the crystallization of the steel in the molds are to be avoided. The top discard must be such as to remove injurious segregation and pipe. Careful procedure on the hot beds and in the straightening press is demanded. As indicated, most of these provisions are informational and not mandatory.

Production of rails under these specifications during the next year is to be accompanied by thorough study of the mill practices actually realizable thereunder, and the results in rail quality obtained.

Other Points of Rail Study

Rail failure statistics for 1920 and their correlation with those of previous years confirm the indication obtained previously that the war-time rollings are decidedly inferior to those just preceding. The steady reduction in rail failures since 1908 was interrupted, beginning with the 1915 rollings, in the way brought out by the curve reproduced herewith, which reports the total failures in five years' service and shows their remarkable concordance with an improvement curve predicted six years ago by M. H. Wickhorst, engineer of tests to the committee. More light is thrown on the quality of the war-time rails by the record for shorter periods of service. Thus, the rails rolled in successive years from 1910 to 1917 gave, in three years' service, the following number of failures per 100 track-miles: 124, 104, 49, 45, 33, 34, 48, 86. The one- and two-year service records indicate an improvement in quality in the rollings subsequent to 1917.

Designs for rails weighing 150 lb. per yard have been considered, to supplement the series of sections up to 140 lb. heretofore designed. A memorandum on this subject by W. C. Cushing (Pennsylvania R.R.) stated that heavier sections than yet rolled are under consideration by various large railroad systems, that the relative importance of size of head (for wear under heavy traffic) and depth of section (for girder strength under lighter traffic) is the crucial point, and that the RE section, which appears to be most suitable for the heavy rails, is under study for the 150-lb. weight.

Discussion by Hunter McDonald (Nashville, Chattanooga & St. Louis Ry.) and J. L. Campbell (El Paso & Southwestern R.R.) proposed that the desirability of longer rails be restudied. The former said that 66-ft. rails seem desirable, while Mr. Campbell said that western roads are considering 39-ft. rails. Other work reported by the rail committee included a schedule of recommended practice for rail inspection, which was accepted. A formula by M. H. Wickhorst for elongation of rails in the drop test was presented. It is,

$$E = \frac{4.8\,h}{X\,(C + 0.30)}$$

where E is percent elongation in maximum inch on first blow for 3-ft. span, h is height of drop in feet of a 2,000-lb. tup, X is the section modulus of the rail, and C is the per cent carbon content.

Study of joint bars is still in progress. Investigation of the intensity of wheel pressure on rails has been deferred for the time being.

In a brief progress report the committee on Economics of Railway Location expressed the opinion that no information of value is obtainable concerning the effect of curvature on cost of maintenance of way and equipment. Although it would be possible to work out a number of factors by means of extended research and experiment, the practical value would be doubtful since it would be impossible to reconcile the test results with the practical conditions of operation. On the other hand the committee on Economics of Railway Operation discussed analytically the determination of traffic capacity of a railway, and proposes to extend this discussion to show the economic development through changes in motive power, additional tracks, grade revision, signals and other facilities.

Another important subject in close relation to that of traffic capacity is the economical operation of trains against the current of traffic on lines having multiple tracks. This includes the operation of a third track by trains in opposite directions according to traffic requirements, a practice followed by 14 roads having over 4,000 miles of multiple-track lines. Concerning the relation of speed to cost of maintenance of way, the conclusion was reached that this cost increases with speed but that no exact relation can be established.

Labor Economy Important

That labor economy is now fully as important as economics of materials, but has received much less attention and therefore affords a wide field of improvement, was emphasized in the report of the committee on Economics of Railway Labor. Two highly desirable lines of development are: (1) The establishment of a single central authority to supervise the selection and care of all employees on a railway system; (2) the establishment of units of measure of the work performed in track maintenance. At present the records of track work are mainly those of expenditures. The report submitted methods of establishing such units and of reporting such work so that its cost may be distributed in accordance with these units.

The disadvantage of the present employment system, which results in large labor turnover, was noted in the discussion. It was pointed out, also, that under the system of seniority rights of employees it is important in employing new men to select only those who appear to be adapted to railway service. Methods of training employees in order to promote efficiency were outlined.

Training Engineers—Technical employees were included in this report, one section of which deals with the training of young engineers in railway work. This does not include methods of obtaining engineers, though it pointed out that consideration should be given to the engineer who has not had a college training. The president, L. A. Downs (Central R.R. of Georgia), in his opening address, urged the necessity of greater co-operation with the engineering schools and a much more

liberal rate of pay to make railway service attractive to the young engineering graduate. According to the committee report, a fixed minimum engineering corps, giving greater promise of permanent employment and opportunity for promotion, is necessary in order to encourage men to remain with the company. It is of particular interest to note that the report and the discussion pointed out the desirability of railway engineers making themselves familiar with operation.

Animated discussion developed on the subject of the engineer's career in railway service. J. A. Stocker (Toledo & Ohio Central Ry.) expressed the view that the older engineers do not take a helpful attitude toward the beginners in the service, and that this has a discouraging effect. C. E. Lindsay (New York Central Lines) suggested that a well-defined line of advancement should be marked out in engineering service; others recommended that opportunities for engineers should be provided also in other departments. Prof. A. N. Talbot pointed out the great decrease in the attractiveness of the railway career to young civil engineers within the last generation, and expressed the hope that the condition may be improved in the interest of the railways themselves.

Track Ditching—Touching the question of labor economy was a brisk discussion of the economic aspect of railway ditching. In dealing with methods of ditching, the committee on Roadway was content to list and describe the various methods employed, no attempt being made to discuss their relative economy. Objection was made promptly to the action of the committee in recommending hand work under certain conditions. The point was made by R. H. Ford (C., R. I. & P. Ry.) that such action is fundamentally wrong, since hand labor is so expensive that although it may sometimes be used, it certainly should not be included by the association in its "recommended practice."

The report classified ditching according to varying depths of cut, but in discussion the argument was made that machine work is economical and practicable under all conditions, regardless of depth of cut and density of traffic. By a large vote it was decided to refer back to the committee all of its conclusions on ditching, with the exception of the opening statement: "Good roadbed drainage is the foundation of economical track maintenance; therefore, the ditching of cuts is of great importance and should be carried out currently with the regular yearly maintenance program."

Studies of time and cost of unloading and placing ballast, together with the force organization of the work, were the subject of a detailed report by the committee on Ballast. A proposed organization for a small ballasting gang was submitted and adopted.

Contract Work—Interest in the modern development of contract work for railway maintenance was indicated by a report of the committee on Track, which submitted complete specifications for contract work in relaying rails, renewing ties and ballasting. These specifications were proposed for the "Manual," but objection was made to this on the ground that they are new and untried and that in view of the very indefinite status of the contract system for track work it would be unwise to adopt such specifications. It was voted, therefore, to accept them as information.

Tie Records—Difficulties in comparing the life of ties due to uncertainties as to kind of wood and conditions of use, led the committee on ties to suggest that all test installations should include white oak ties of specified grade and size to serve as a basis of comparison. This recommendation was adopted after active discussion of the difficulty of fixing a standard of white-oak quality. The committee recommends that treated ties should have spike holes bored and tie-plate seats faced by machine, but that the expense of boring untreated ties for cut spikes is not warranted. As to cut and screw spikes, good track can be obtained with either, but there is no evidence as yet that the latter prolong the life of the tie.

The use of dating nails for treated ties was advocated by the committee on Wood Preservation, but F. J. Angier (B. & O. R.R.), a member of the committee, made strong objection to this. In his opinion the expense is too great to be justifiable, and dating nails should be used only in test ties. The chairman, C. M. Taylor (P. & R. R.R.), and other speakers took the position that without the nails there is no possibility of keeping reliable records of life of ties, while their presence warns the section foreman against premature removal, since he knows that his records of tie removal will be checked by superior officers. A vote on the question showed a large majority in favor of using the dating nails in all treated ties.

Considerable discussion attended the presentation of standard designs of track tools by the committee on Track, but it was voted to adopt them. As designs of shovels were submitted independently by the committees on Track and Ballast these committees are expected to get together and harmonize their plans. Designs for managanese-steel track crossings were adopted. Plans for location of track signs uniformly at 10 ft. 4 in. from center of track were adopted, as submitted by the committee on Signs, Fences and Crossings.

Analysis of Building Design

Two reports dealt with the operating factors affecting the design of railway warehouses and freighthouses. Such factors include length of trackage, tailboard space, elevator capacity, turnover of freight, etc., in relation to floor area and tonnage handled. Thus, with a knowledge of traffic conditions at any point, the engineer has a number of constants or ratios to guide him in designing an economical and adequate structure.

A study of the design of multiple-floor warehouses over railway freighthouses, in order to develop the air rights of the property site, was presented by the committee on Yards and Terminals. This is a subject on which very little information is available, but which has been given considerable attention in planning large new terminal developments at Chicago. A somewhat similar study of the design of L. C. L. freighthouses was presented by the committee on Buildings, which pointed out that too frequently the size of the freighthouse is determined arbitrarily and the design is based upon approximations and comparisons with existing freighthouses, whereas the traffic should be analyzed in regard to its character and extent and the building design then based upon these local conditions.

Of a more general and descriptive character was the matter submitted by the committee on Buildings in regard to ice houses and icing stations, and by the committee on Shops and Locomotive Terminals in regard to engine houses and car repair shops. This

latter committee pointed out that engine terminal development has lagged so far behind that of equipment that many terminals are inadequate for efficient service. In fact, in many cases improvements which will reduce the time required for turning and handling engines will be equivalent to the provision of additional power to the division. Other matters submitted by the committee on Buildings included specifications for structural steel and iron, stone masonry, tile, marble, plumbing, treating, painting and glazing. These were adopted, and will form part of a comprehensive set of specifications for railway buildings.

STANDARDS AND CONTRACTS

Waste due to useless diversity of types was urged by the special committee on Standardization (which is composed of the chairmen of the other committees) as indicating the great need for standardization. Several speakers suggested the desirability of closer relations with the American Engineering Standards Committee and it was voted to submit the following specifications to that committee: (1) Cast-iron pipe, valves and hydrants; (2) track tools; (3) railway lamps; (4) ties; (5) insulating tape, subject to approval of certain of these by the association.

A resolution was passed to the effect that within one year after the adoption by the Association of a "recommended practice," the Board of Direction may present such project to the American Engineering Standards Committee.

Discussion of specifications for movable bridges has been in progress for several years, after a first draft had been prepared by the committee. The final document was worked out during the past year, and was approved by the meeting as a standard. An important revision made by the committee at the meeting changed the tread pressure in rolling bridges from $125\,d$ to $3{,}200\,\sqrt{d}$ per linear inch, d being the diameter of the rolling segment in inches; it also changed the allowable web contact pressure under such treads (within 45-deg. planes) from 7,500 to 13,000 lb. per sq.in.

A short set of specifications governing the erection of steel fixed bridges (for spans less than 300 ft.) was also presented. These specifications were received as information, and are to be under study for a year before adoption. Comment was made on some of its clauses, chiefly with a view to securing more precise definition of work-train service and adequate clearance between track and piled material. The general criticism was made that the specifications largely cover matter forming part of the contract; but it was stated in reply that these particular elements of the contract need to be in the hands of the men on the work and should therefore be part of the specifications.

Several minor revisions were made in the specifications for fixed bridges adopted two years ago. The permissible compression in flanges of beams and girders was fixed at $16{,}000 - 150\,l/b$.

Classification of bridges, specifications for turntables, and specifications for highway bridges, are to be matters of study during the coming year. Work may also be done on column tests, on electrically welded connections, and on signaling and lighting drawbridges. It was stated that there is ground for believing that if uniform rules for lighting drawbridges are adopted they will be accepted by all government authorities having jurisdiction. A standard already exists in Canada.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Floating-Ginpole Method Patented

Sir—The writer was greatly interested in the very instructive article on the erection of 400-ft. radio towers which appeared in your issue of Feb. 9, 1922. He was somewhat surprised and disappointed to find that no mention was made of the fact that the Pittsburgh-Des Moines Steel Company developed the floating ginpole described and holds patent on the same. Permission was given to the American Bridge Co. to use this device on the Long Island job.

This invention was developed by members of our organization; U. S. patent 1,182,387 was granted to one of our employees on May 9, 1916, and was subsequently assigned to the Pittsburgh-Des Moines Steel Co. We have been using this device for the erection of steel towers for a number of years. It may be of interest to your readers to know that we shipped four of these poles to France and used them in erection of the eight 820-ft. towers of the Lafayette Radio Station at Bordeaux.

GEO. L. CHRISTY,
Chief Engineer,
Pittsburgh-Des Moines Steel Co.

Pittsburgh, Feb. 24.

Proposed Clauses for Structural Specifications

Sir—In applying to Bethlehem shapes the formula for buckling resistance of webs which is given in the Carnegie handbook, 19,000 — 100 d/2r; it seems to the writer that it would be better to go a step farther and add "= 19,000-173. 2 d/t" also giving a limit of 16,000.

In connection with web resistance to direct compression, are not our building codes conspicuously silent? This is one of the points which may well be covered in the proposed standard building code. Other matters which might be more satisfactorily specified are the spacing of plate-girder stiffeners, unit stresses for beams without lateral support, and unit stresses for threaded rods. On all of these questions there is a wide difference in practice and little that is definite in codes and specifications.

These latter points were covered in the following manner in the specifications for building work used by Westinghouse, Church, Kerr & Co. prior to their merger with Dwight P. Robinson & Co.

Plate-Girder Stiffeners—Web stiffeners shall be provided, generally in pairs, over bearings and under concentrated loads. They shall be proportioned for bearing at 24,000 lb. per sq.in. on the actual contact area and not over 16,000 lb. on the gross cross-section. There shall be a sufficient number of rivets to transmit the full load to the web. These stiffeners shall be placed on fillers, have an absolute end bearing on flange angles, and the outstanding legs shall be as wide as the flange angles will allow. Intermediate stiffeners shall be provided if the unsupported depth of web between flange angles is more than sixty times its thickness. The clear distance between stiffeners shall not exceed 72 in. or $t/40\ (12{,}000\text{-}s)$ where t is thickness of web in inches and s is shear in pounds per square inch.

Beams Laterally Unsupported—The compression flanges of beams and girders shall be stayed at intervals not exceeding fifteen times the width of flange, or else the unit stress in pounds per square inch shall not exceed 19,000-200 L/B, or, when cover is in the form of a channel or beam, $19{,}000 - 150\,L\,B$ with a maximum of 16,000, L being the unsupported length and B the width of flange, both in same units. In general, no beam or girder shall have a greater unsupported length than forty times the width of the compression flange.

Threaded Rods In Tension—One inch diameter and over 14,000 lb. per sq.in.; under 1 in. diameter, 11,200 lb. per sq.in.

A. W. A. EDEN,
Engineer, Paterson Bridge Co.

Paterson, N. J., March 1.

NEWS OF THE WEEK

New York, March 23, 1922

Indict Structural Details in Knickerbocker Reports

Associated General Contractors, and American Association of Engineers Make Findings Known

Two of the society committees appointed to investigate the failure of the Knickerbocker Theater in Washington on Jan. 28, have reported, and a third committee has made a report which is not in its final form. The reporting committees are those of the Associated General Contractors and of the American Association of Engineers. The government committee, representing the engineers of the United States Army and Navy, has not yet put in its final report.

Details of the two committee reports will appear in an early issue of *Engineering News-Record*. Meanwhile it may be stated that the Associated General Contractors committee, headed by Rudolph P. Miller, formerly superintendent of the Building Department of New York City, has confirmed the conclusions as to the failure reached by *Engineering News-Record*. The report says "Collapse of the roof was due to weaknesses in the design of the structural steel supporting the roof and of the Columbia Road wall. The direct cause is the unseating of the north end of the main truss principally through failure of the northernmost top gusset plate of that truss and the bottom chord where it rested on the Columbia Road wall.

Responsibility Placed

Responsibility for these weaknesses is placed upon the architect, who accepted the faulty design from the fabricator; the contractor is not held responsible by reason of the quality of his work or by any non-compliance with the design, specifications and contract, nor for the alternate design, but is held jointly responsible with the building department of the District for failure to apprehend the violations of the building code in detecting that the design did not provide for anchoring trusses to the walls to prevent their slipping from the bearings."

Full recommendations given for preventing a recurrence of the disaster are: (1) Charging sufficient fees for building permits to make possible an adequate force for checking and inspecting new construction; (2) provision by the owner for adequate plans and specifications and inspection on the part of the architect; (3) a revision of building codes standardizing them so that the average architect and contractor may become thoroughly conversant with their requirements; (4) registration of architects, engineers and contractors with the city building department in order to insure adequate skill and responsibility.

The report of the Associated General Contractors committee lists seven principal faults in design, which seem to be in accord with the nine principal faults noted by the report of the committee of the American Association of Engineers, which is headed by N. D. Mitchell. This latter committee, however, holds the contractor jointly responsible with the architect for the alternate design which was faulty. The principal faults noted by the A.A.E. committee are: Support of the main truss on a thin wall lacking solidity and mass; support of the main truss on a skew bearing combined with lack of stiffness in gusset between the end post and lower chord of truss; failure to anchor trusses and heavy beams into the walls; scant bearing at the walls; insufficient section areas and inadequate details of truss members; inadequate column bracing; absence of lateral support of the intermediate panels of the truss T-11; absence of diagonal bracing between the other trusses, and inadequate strength of the roof slab.

Finds Rate on Narrow-Gage Track High

In the complaint of the Lakewood Engineering Co., an I. C. C. examiner recommends that the rates on portable railway track in sections from Cleveland to New York and Baltimore for export are unreasonable because they exceed rates on fish-plates, switches, turntables and crossties.

$40,000,000 Highway Bond Issue for New Jersey

A $40,000,000 highway bond issue was approved by the New Jersey legislature March 17. The bill was passed over the veto of Governor Edwards.

Local Section Am. Soc. C. E. Discusses Theater Failures

At a technical sub-section group conference of the New York Section of the Am. Soc. C. E. held on Mar. 15, the subject for discussion was "The importance of the design of details as evidenced by recent theater failures." Although the conference considered the available evidence with regard to the theaters that failed recently in Washington and in Brooklyn, N. Y., and pointed out defective details of design and construction in those structures, the opinion prevailed that the problem of safe buildings goes far beyond the question of technical details and involves the provision of competent technical supervision from the beginning of design through to the completion of construction. Other conferences on similar subjects will be held by the sub-section in connection with the April and May meetings of the New York Section. James H. Edwards, Asst. Chief Engineer, American Bridge Co., who presided over the March 15 meeting, will be chairman of the April and May conferences.

Port Authority Officials Discuss Harbor Plan

New York Sections of Four National Societies Hear Chairman and Chief Engineer

At a joint meeting of the local sections of the four founder societies, held March 15, at the Engineering Societies' Building, New York City, E. H. Outerbridge, chairman, Port of New York Authority, B. F. Cresson, Jr., chief engineer of that body, and Morris Sherrerd, consulting engineer of Newark, N. J., reviewed the development of the Port Authority and discussed its plan for the organization of the port and its railroad terminal facilities.

Mr. Outerbridge reviewed the conditions and events that led to the formation of the Port Authority and declared its present task to be the adoption of those measures of relief that can be provided by a better and more economical use of existing facilities.

Mr. Cresson summed up briefly the benefits to be derived from closer cooperation between the railroads entering New York and developed at greater length the immediate advantages to be gained by more scientific and business-like handling of Manhattan railroad freight. He urged more team work between the rail service and the trucking service, in order to effect some form of direct delivery between the railroads and the merchants.

Mr. Sherrerd pointed out the advantages to the New Jersey communities that will result from the carrying out of the comprehensive plan of the Port Authority.

Motion pictures were shown in order to visualize the great scope of the Port Authority plan and the economies that will be effected in the handling of the food supply for the 8,000,000 people of the metropolitan port district.

Emergency Food-Distribution Plan

Mr. Outerbridge also described the plans that were laid by the Port Authority to insure a continued supply of food and other necessaries in the face of the threatened railroad strike of last autumn. These plans were based upon the co-ordination of the powers of the two states of New York and New Jersey and of the federal government. It involved the gathering of data as to the stocks and consumption of all supplies in the metropolitan district, the organization of some 200 wholesalers who dealt in necessities, and the provision of a motor-transport system with the necessary supervision of highways in order that the city might draw upon a territory included within a radius of some 200 miles, depending entirely upon the highways and waterways. This skeleton organization, Mr. Outerbridge said, was laid out in about ten days. A headquarters was established, and its various elements were all held in readiness to take up their parts on short notice.

A. R. E. A. Annual Meeting Breaks Records

Previous Meetings Surpassed in Work and Attendance—24 Reports Presented and Acted Upon

Breaking records appears to be a habit with the American Railway Engineering Association, for the attendance at the twenty-third annual convention, held in Chicago, March 14,-16, was again far in excess of previous high mark. The registration (evidently incomplete) showed 707 members and 178 visitors, as compared with 650 and 160 in 1921 and a total of 561 in 1920. Reports of all the 24 committees were presented and acted upon, the work being facilitated as usual by having all reports, with drawings and appendices, printed in advance. This printed matter aggregated about 1,000 pages, exclusive of a reprint of the voluminous report of the American Committee on Electrolysis.

PRESIDENT'S ADDRESS

In a brief opening address the president, L. A. Downs, referred to the movement for closer relations with the engineering schools, for which purpose a special committee has been appointed. Of 15 institutions only 9 per cent of the graduates in civil engineering are working for railroads. And of 350 engineers in railway service only about 50 per cent are graduates. The railways need more of these young men, but to obtain them the managements must offer a more attractive and reasonable wage. The graduate has a financial investment in his training and must capitalize it. But when a fireman is paid $170 a month at the start, a switchman $181, a flagman $141, and a technical graduate only $118, there is something wrong with the wage principle on the railways. Mr. Downs thought that a test of the value of the work of the association is in the use of its reports.

A net membership of 1,948 was shown by the secretary's report. There were 128 new members elected during the year and 16 losses by death. The financial statement was very satisfactory, showing receipts exceeding the high expenditures. Issue of the new *Manual* has been delayed but is expected to be made by June. During the past year the American Railway Association joined membership with the American Engineering Standards Committee and designated a representative of its engineering division (which is identical with the American Railway Engineering Association). This member is E. A. Frink, with J. R. W. Ambrose as alternate.

At a memorial meeting for the late John F. Wallace and Col. Geo. H. Webb, held during one session, brief addresses were made pointing out their high technical attainments, professional accomplishments and personal character. At the annual dinner the three principal addresses were as follows: "Needs of the Railways," R. C. Marshall, Jr., general manager of the Associated General Contractors of America; "The Basis of Patriotism," by Judge James A. Mulligan, of Ottawa, Canada, and "Government and Business," by Dr. Guy M. Dyer, professor of political economy at Vanderbilt University, Nashville, Tenn.

New Jersey Legislature Names New Tunnel Commission

Over the veto of the Governor, the New Jersey Legislature on March 17 passed the bill removing the chairman and certain other members of the Jersey Interstate Bridge and Tunnel Commission and naming new commissioners to take their places. T. Albeus Adams is ousted as chairman, together with Samuel Shay, Charles S. Stevens and Frank F. Gallagher. The New Jersey commission had been unable to agree with the New York commission on many important matters of administrative policy with the result that, except for the construction of ventilating shafts on the New York side of the Hudson, progress has been halted for practically a year.

With the advent of the new commission, headed by Theodore Boettger and the other candidates named in the news section of this journal March 16, p. 460, it is expected that the contract for constructing the twin tubes under the river, for which Booth & Flinn, Inc., were low bidders at last month's opening of bids, will be awarded.

Another tangle of long standing which was straightened out was the reinstatement of the board of consulting engineers which was summarily "dismissed" April 26, 1921, by the Jersey commission without concurrent action by the New York commission. At the same time the newly organized Jersey commission, at its meeting March 21, passed a resolution nullifying, on grounds of illegality, the appointment on May 10, 1921, of St. John Clarke and George M. Wells as "technical advisers" to supersede the consulting board. The Jersey commission further ordered the return and cancellation of the pay vouchers covering the salary of Mr. Clarke and Mr. Wells since last May which had been forwarded to Trenton by the old commission just before it was legislated out of existence. No money had ever been paid by the Jersey commission to Messrs. Clarke and Wells and the present action leaves these engineers without means of recovery unless they resort to legal proceedings.

The board of consulting engineers which now resumes its former status consists of Col. W. J. Wilgus, Major John A. Bensel, Prof. William H. Burr, E. A. Byrne, J. Vipond Davies, and Col. George L. Watson.

Officers elected for the year 1922-23 are as follows: President, James L. Campbell, chief engineer, El Paso Southwestern R.R.; vice presidents, E. H. Lee, vice president and chief engineer, Chicago & Western Indiana R.R., and G. J. Ray, chief engineer, Delaware, Lackawanna & Western R.R. The former holds over from 1921. Five new directors, including three regulars and two to fill vacancies in the list of nine directors, are: D. J. Brumley, chief engineer of Chicago terminal improvements, Illinois Central R.R.; Maurice Coburn, engineer of maintenance of way, Pennsylvania System; H. T. Douglas, Jr., chief engineer, Chicago & Alton R.R.; C. E. Lindsay, special engineer, New York Central Lines, and W. P. Wiltsee, assistant engineer, Norfolk & Western Ry treasurer, G. H. Bremner; secretary, E. H. Fritch.

Hearings Begun on New Road Legislation

Markham, Representing State Highway Officials Urges $75,000,000 for Three Years

(*Washington Correspondence*)

Active work on highway legislation, to become effective July 1, has started in the House of Representatives. Public hearings began March 15 before the Committee on Roads. It seems probable that the committee will recommend the plan contained in a bill, introduced by Representative Woodruff, of Michigan, providing an appropriation of $50,000,000 for the next fiscal year, $65,000,000 for the fiscal to end June 30, 1924, and $75,000,000 for the fiscal year to end June 30, 1925. W. C. Markham, representing the American Association of State Highway Officials, appeared before the committee and contended for appropriations of not less than $75,000,000 for each of the next three fiscal years.

The Woodruff bill, which seems to have the support of a majority of the House committee, provides in addition that not to exceed 3 per cent of the federal-aid appropriation may be expended for administering the act or for carrying on research and investigational studies. The bill also carries an appropriation of $6 500,000 for roads and trails in the national forests during the fiscal year to end June 30, 1924, and $7,500,000 for the fiscal year to end June 30, 1925.

MARKHAM'S ARGUMENT.

The more important points made by Mr. Markham on the occasion of his appearance before the committee may be summed up as follows:

"Approximately, the first 7 per cent system of the highways of this country [as provided for in the Federal Highway Act] is 186,700 miles. Of this mileage 69,090 miles have been improved or are in various stages of construction. That portion of this constructed mileage which has been paid for by the use of federal aid has been done at an average cost of $18,000 per mile. The federal government has contributed 42½ per cent and the states 57½ per cent. This leaves 117,610 of the first 7-per cent system to be built. Presuming that this mileage will be constructed at the same average cost as heretofore and that the federal government and the states will pay the cost in the same ratio, the time required to carry out this plan will be as follows: If you make an appropriation of $100,000,000 per year, it will take 10 years, an appropriation of $75,000,000 per year will take 15 years, and an appropriation of $50,000 000 will require 20 years to complete the system.

"To show you that this calculation is very liberal towards the completion of the work it should be borne in mind that no lag in completion of this system is allowed for reconstruction or surfacing of any part of the 69,090 miles now improved, although a part of this mileage will undoubtedly need a better type of construction due to the increased traffic requirements.

"Representing the States, which through their State Highway Departments, are responsible for co-operation

(Continued on p. 550)

France to Give Up State Railways

After fourteen years of government operation at heavy loss the French Government is now preparing to turn over the Etat railway system to a private corporation. A plan to embody this course, which has been decided on by a parliamentary commission, will soon be laid before the Chamber with the approval of the government.

Appropriation for Roads Bureau

In reporting to the House the agricultural appropriation bill the House Appropriations Committee recommends $483,320 for the U. S. Bureau of Public Roads for next year, which is $14,800 in excess of current appropriations but $19,700 less than the estimates.

Pittsburgh Highway Tunnel Holed Through

The west tube of the Liberty twin tunnels in Pittsburgh, Pa., was holed through March 11. When the two crews met in approximately the center of the tunnel it was found that there was a variation of but $\frac{3}{8}$ in. in line. A record of 12 ft. a day excavation and finished concrete lining has been attained. Three hundred and eighty-eight working days have been recorded on the tunnel construction to date and an average of 200 men per day have been employed. Approximately 300 000 cu.yd. of rock and earth have been moved to date. Details regarding the design and construction of these tunnels may be found in *Engineering News-Record*, Sept. 22, 1921, p. 478.

Move To Standardize Road-Material Specifications

Highway officials from Pennsylvania, New Jersey, Delaware, Maryland, Virginia, West Virginia, and Kentucky will meet with officials of the U. S. Bureau of Public Roads in Washington, March 23, to make such standardization of specification as will result in economy in construction in these States. The aim is to revise the specifications in such a manner that material from the same source may be used in all the states without difficulty.

At present a stone, gravel or sand plant may be supplying road jobs in two or three states. Due to variations in specifications the same sizes of material cannot be used on the different jobs for identical classes of work. The plant must use different screens and bins in supplying each job and the result is an increase in cost without a corresponding increase in the quality of the work.

Similar meetings will be held immediately between officials of the bureau and other groups of states with the same object in view. The movement has been initiated by the American Association of State Highway officials and is being worked out in groups of states so as to take into account conditions existing in each group. A committee composed of bureau and state highway bridge engineers has been working for some time on the standardization of bridge specifications.

Officials of the bureau say that since highway construction has grown to be one of the biggest industries in the country it must be organized and conducted with the efficiency characteristic of big business.

Unveil Bronze Tablet as Memorial to Alfred Noble

As a memorial to Alfred Noble in recognition of his distinguished achievements in the field of engineering, a bronze tablet, the gift of the American Institute of Consulting Engineers, was unveiled March 15 in the Engineering Societies' Building, New York. Charles W. Leavitt, consulting engineer, made the address of presentation and J. Vipond Davies, consulting engineer, accepted the memorial in behalf of the



ALFRED NOBLE MEMORIAL TABLET

United Engineering Society. The tablet, which has been placed on the wall to the left of the main entrance to the Engineering Societies' Building, was designed by Willard D. Pollock, New York sculptor.

The upper portion of the bronze carries the following inscription:

ALFRED NOBLE
1844-1914

An Upright Man, a Good Citizen, an Eminent Engineer Whose Life and Labors Contributed Greatly to the High Honor of His Profession and to the Success of Many Important Public Works. This Tribute by the American Institute of Consulting Engineers, 1922

Below the inscription there is shown, in relief, a river spanned by a bridge and in the central foreground two figures of structural workers. In decorative panels at each side of the tablet are references to the more important engineering works with which Mr. Noble was associated, including the East River tunnels of the Pennsylvania R.R., New York, the Nicaragua Canal Commission, the locks at Sault Ste. Marie, the Catskill Adqueduct, the Pearl Harbor dry dock in Hawaii, the Isthmian Canal Commission, and the Washington, Memphis and Cairo bridges.

Last week's ceremonies mark the first instance of the presentation of a memorial by an engineering society to one of its own members.

The meeting was attended by about thirty engineers including Allen Hazen, Col. W. J. Wilgus, George W. Fuller, J. Waldo Smith, Frank J. Sprague, Dr. Alexander C. Humphreys and Alfred D. Flinn.

Four Indicted as Result of Brooklyn Theater Failure

Manslaughter in First and Second Degrees Charged Against Each—Magistrate's Findings

Four persons were indicted March 18 as a result of evidence laid before the grand jury concerning the collapse of the American Theater in Brooklyn, N. Y., last November, which resulted in the death of seven men. Two indictments charging manslaughter in the first and second degrees were returned against each individual. The four men indicted are Joseph Gaydica, who furnished the steel for the structure; James M. Finlay, an inspector of the Building Department of the Borough of Brooklyn who had charge of the steelwork inspection; James Kavanaugh, the contractor who erected the steel for the building, and Samuel Moskowitz, one of the owners and builders of the theater. All four defendants were arraigned in the county court and entered pleas of not guilty. Bail was fixed at $10,000 in each case.

Chief Justice William McAdoo, before whom the Kings County district attorney has been conducting a John Doe investigation into the collapse of the theater, denounced the custom of "slip-shod, haphazard inspection" that was imputed to have been allowed in the Brooklyn Department of Buildings. The magistrate's findings of fact after a review of the situation included:

"There was no architect in charge of the work; there was no competent supervisor; there was no responsible engineer; there was no approved plan for the steelwork; and there was no official permit allowing its erection."

FINDINGS OF MAGISTRATE

Three things, the magistrates found, the builders had in mind: "to get the building as cheaply constructed as possible, to have an auditorium that would hold the largest number of people, and to hasten the time when they would be able to open the theater." The essential points in Magistrate McAdoo's review were that "a set of plans for the steel construction were drawn and approved by the Bureau of Buildings in the summer of 1921. The owners awarded the contract to the Gaydica Iron Works to furnish and put up the trusses and girders on which the roof was to rest. Subsequently, Gaydica, through his own engineer, filed an amendment to the original plan for the structural steel. These plans were filed Sept. 19. When they reached the official examiner attached to the Department of Buildings he made twenty-one objections and wrote out the same and attached them to the official papers. With these objections filed, the Gaydica plans were not approved until Nov. 2, 1921.

"In the meantime Gaydica furnished a working plan which he gave to Pluckham & Kavanaugh, the firm who had contracted to do the work of the erection of the steel structure to sustain the roof. Kavanaugh, a working erector of the firm, was the active man in control of the work. He followed the plan given him by Gaydica. This plan was never passed upon nor approved by the Building Department and differed from both the Kleinert plan (the plan that had been approved) and the plan subsequently approved as the Gaydica plan."

A. A. E. to Hold Annual Convention at Salt Lake City

The American Association of Engineers will hold its eighth annual convention at Salt Lake City, Utah, June 5-7. According to the tentative program just announced, the sessions on June 5 will be devoted to reports of officers and standing and special committees. At the morning meeting, June 6, the topic for discussion will be "Policies of Employment, Education and Other Departmental Service," while the afternoon will be given over to a chapter symposium. Amendments to the constitution and by-laws will be considered on the morning of June 7, while the remainder of that day will be occupied by a sight-seeing tour and the annual banquet.

Ball Engine Co. Changes Its Name

Because of the change in the character of its product from engines for power plant use to steam shovels and cranes, the Ball Engine Co. has changed its name to the Erie Steam Shovel Co. The company practically ceased the manufacture of engines about two years ago. Now it has sold its engine business. There has been no change in the personnel, assets or policies of the company since it has assumed a name more in keeping with its present activities. In six years the company has tripled its plant capacity to meet the demand for shovels and cranes.

Fire Protection Association at Atlantic City

The twenty-sixth annual meeting of the National Fire Protection Association will be held at Atlantic City, N. J., May 9-11, with headquarters at Chalfonte-Haddon Hall. The program for the meeting will be announced later. The secretary of the association is Franklin H. Wentworth, 87 Milk St., Boston, Mass.

Cleveland Gets Municipal Improvements Convention

The American Society for Municipal Improvements will hold its next annual convention at Cleveland, Oct. 9-13, according to an announcement made last week by Charles Carroll Brown, P. O. Box 34, St. Petersburg, Fla., secretary of the society.

Road Hearings Begun

(Continued from p. 503)

with the Federal government in this work, we are not disposed to ask the Congress for larger appropriations than can, recognizing economic conditions as well as traffic needs, be absorbed each year properly safeguarded in every particular. To this end, I wish to state that investigation shows that while a very few states, because of varied and peculiar conditions will need the next fiscal year to absorb the appropriations already made, two-thirds of the states can readily absorb all of their apportionment of a $100,000,000 appropriation. To cut this appropriation by two would mean to retard the work in many states to an extent that, in our judgment, would be an economic mistake. We therefore recommend that the Federal appropriation for the fiscal year 1922-23 should be $75,000,000.

Hydraulic Prime-Mover Makers Merge Interests

The plant and interests of the Pelton Water Wheel Co., San Francisco and New York, have been acquired by the William Cramp & Sons Ship & Engine Bldg. Co., Philadelphia. The Pelton Water Wheel Co. will continue under the old corporate name, but will be newly officered by H. B. Taylor (vice-president of the Cramp company), president; Ely C. Hutchinson (formerly chief engineer of the Pelton company), vice-president and general manager; William M. Moody, second vice-president.

This development combines two of the oldest companies in the United States manufacturing hydraulic prime movers. The I. P. Morris department of the William Cramp & Sons Ship & Engine Bldg. Co. is widely known as the builder of large reaction turbines. Among these are those of the Queenston-Chippawa development on the Canadian side of the Niagara Falls, having a capacity of 55,000 hp. each. The Pelton leads in high-head or impluse-wheel practice.

Morris Canal Abandonment Bill Approved by Governor

A bill naming a commission of three, with legislative powers, to negotiate with the owners of the Morris Canal for its abandonment has become a law. The commissioners are W. H. Spear, Judge of the U. S. Circuit Court, Jersey City; Frank H. Sommer, Newark; and Louis A. Focht, chief engineer of the State Board of Taxes and Assessments, Trenton. The canal extends from the Delaware River to tidewater in Jersey City. It was built under a charter granted in 1824 to the Morris Canal & Banking Co. In 1871 the property was leased to the Lehigh Valley Railroad Co.

For decades past, the water rights held and claimed under this charter have entered into the history of the water supply of Newark, Jersey City, Paterson and other municipalities in the New Jersey metropolitan district that have had or now have contractual relations with the East Jersey Water Co. and allied water companies and interests. (For an editorial review of this subject down to 1895, see *Engineering News*, April 25, 1895, p. 273; see also *Engineering News-Record*, March 16, 1922, p. 430, for a lengthy abstract of a report by Hazen, Whipple & Fuller on possible additional water supplies for the New Jersey district in question).

Reject Proposal to Use Ships' Hulls for Bridge

Rejection of the proposal to bridge Lake Washington by means of utilizing fifteen wooden hulls from the U. S. Shipping Board craft moored in Lake Union, has been announced by the King County (Washington) Commissioners, who refused to forward to the U. S. Shipping Board a bid for $1,500 for the hulls. This sum had been raised by business men and residents of Mercer Island, who are interested in the furthering of the project. The commissioners declared that construction of the bridge would cost $470,000 and would be necessary to open the bridge to travel, and that the annual upkeep would be $10,000 a year, with the life of the bridge a doubtful question.

Middle West Puts Up Candidate for Am. Soc. C. E. Presidency

The Illinois Section of the American Society of Civil Engineers has called a special meeting in Chicago, March 24, to consider the candidacy of Charles F. Loweth, chief engineer, Chicago, Milwaukee & St. Paul Ry., for president of the parent organization. The notice sent out states that it is time that the presidency be brought west and 150 members now favor Mr. Loweth.

Favors Paving Guaranty

John L. Elliott, city engineer of Indianapolis, has sent a letter to the Board of Public Works, advising that no steps be taken to eliminate from the specifications for permanently improved streets, the provision requiring the contractor to put up a maintenance guaranty. He said the elimination of this guaranty would cause trouble for the city in obtaining proper repair of streets. There has been no open discussion before the board of works of any plan of eliminating the guaranty provision from the street specifications, but the suggestion was made to the board that lower bids might be obtained on asphalt street contracts were the provision eliminated.

Fight To Lower Asphalt Prices in Indianapolis

A fight upon high prices of asphalt pavement in Indianapolis was begun by John L. Elliott, city engineer, who, in a letter to the Board of Public Works, recommended the rejection of several bids and urged that out-of-town contractors be invited to bid upon future work. The board had the letter read to about fifty contractors who were present at the opening of bids on a number of street and sidewalk improvements

Mr. Elliott presented a table showing, according to U. S. Labor Bureau figures, that the price of 200 commodities is only 48 per cent higher now than in 1915, while the price of asphalt paving as contained in bids of local contractors, is 125 per cent higher than in 1915. The board took under advisement Mr. Elliott's recommendation that proposed street improvements be held up until a square yardage of 50,000 accumulates so as to make it profitable for outside contractors to come into the field.

Steam Power Plant at St. Louis To Cost $6,000,000

Negotiations have been completed for the construction south of the city limits of East St. Louis, Mo., of a new steam power plant to cost $6,000,000. L. H. Egan, president of the Union Electric Light & Power Co. of St. Louis, has taken title to about 50 acres of land as a site for the plant and McClellan & Junkersfeld, Inc., of New York City, have been engaged as engineers and constructors.

The plant will supply the rapidly-increasing demand for electrical energy in St. Louis and vicinity. It will be named the Cahokia steam power plant and will have an initial capacity of 60,000 kw. and an ultimate capacity of probably 240,000 kw. The first two units will be of 30,000 kw. each, supplied with steam at 300 lb. pressure at the throttle and will deliver electrical energy at 50 cycles, 13,200 volts.

Hoover Favors Construction of Boulder Canyon Dam

Opinion Given After Hearings at Washington, Phoenix and Los Angeles

(Special to Engineering News-Record)

Secretary of Commerce Herbert Hoover, acting as chairman of the Colorado River Commission, has definitely committed himself as favorable to the immediate construction of the Boulder Canyon dam by the Federal Government and under government engineers in accordance with the plans proposed by A. P. Davis, director, U. S. Reclamation Service. This expression of his views followed hearings at Phoenix, Ariz., March 15-18, and at Los Angeles, Cal., March 20.

The Colorado River Commission was created by Congress to formulate an agreement or compact under which the distribution of the waters of the Colorado River could be made between the seven states lying wholly or in part within the drainage basin. The first hearing of the commission, held Jan. 26, in Washington, D. C. (see *Engineering News-Record*, Feb. 9, p. 255), lasted two weeks and reached no definite conclusions. The second hearing, at Phoenix, was given over largely to the presentation of the views of Arizona interests. Representatives from Southern California, including the Imperial Valley, presented a resolution urging the immediate construction of the Boulder Canyon dam as a flood-control measure pending the making by the commission of a permanent compact among the seven states, not without prejudice to the right of any state. The third hearing was held in Los Angeles, Cal. March 20.

Secretary Hoover announced that presentations to the commission should be confined to suggestions for the terms and form of compact to be entered into by the seven states. Presentations were made by Director Davis of the Reclamation Service relative to an adjustment of the sharply conflicting interests between the upper and lower basins over water rights growing out of the proposed developments.

Construction Industries Announce Convention Program

A three-days' program, with two days devoted to addresses and discussions, is planned by the National Federation of Construction Industries for the construction conference to be held in Chicago, April 3-5.

One session only will be held on the opening day, the address being: "How Trade Associations Can Be Made More Effective." On the second day the subjects for papers and discussions are: "Capital Must Be Economically Mobilized for Construction"; "Can Cost of Financing Construction be Further Reduced?" "Efficient Workers Needed to Meet Country's Construction Program" and "Handicaps to Reducing Construction Costs." On the last day some ten formal discussions are planned, on elimination of waste and better design, distribution, production, transportation and utilization of materials.

The convention proceedings will close with a banquet on the evening of April 5 and several luncheons and dinners are listed for the preceding days. The meetings will be held at the Drake Hotel.

Commerce Dept. Seeks Statistics from Trade Associations

The Secretary of Commerce will hold a conference in Washington with representatives of trade associations the activities of which are national or interstate in their scope, in Room 704, Department of Commerce Building, on April 12, at 10 a.m., for the following purposes:

1. Securing a list of trade associations that will furnish voluntarily to the Department of Commerce the classes of statistical information outlined in the correspondence between the Department of Commerce and the Department of Justice (See issue of Feb. 16, p. 294).

2. Discussing and considering means and methods that may be best adapted for collecting and forwarding to the Secretary of Commerce, for dissemination, the classes of statistical information outlined in the correspondence referred to.

3. Discussion of the manner in which such reports of the statistical officer of the associations are to be filed with the Department of Commerce, and the manner and method of distributing the information therein.

A. F. L. To Promote Reclamation and Mississippi Improvement

President Gompers of the American Federation of Labor has announced that bills for land reclamation and for Mississippi River improvement are to be drafted and introduced in Congress as the result of studies by a special committee of the A. F. of L. Joint Legislative Conference, composed of some forty representatives of labor. The reclamation bill will have as its main feature the development of the Colorado River for irrigation, but minor projects would be included. Mississippi River improvement would be designed to promote navigation throughout the entire river system, besides preventing floods, reclaiming land for agriculture, and preventing disease apparently by lessening mosquito breeding. Government bonds to finance these projects are proposed by the Committee already named, which includes, among others, C. M. Rosemund, president, International Federation of Technical Engineers, Architects and Draftsmen's Unions.

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Spring Society Meeting, Dayton, Ohio, April 5-6; Subject, "Flood Problems."

NATIONAL FIRE PROTECTION ASSOCIATION, Boston, Mass.; Annual Meeting, Atlantic City, May 9-11.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, Philadelphia, May 15-19.

The Connecticut Society of Civil Engineers at its recent annual meeting elected the following officers: President, Robert J. Ross, Hartford; first vice-president, Alfred H. Terry, former city engineer, Bridgeport; second vice-president, Clarence M. Blair, New Haven, secretary-treasurer, Henry J. Kellogg, New Haven.

The Pueblo (Col.) Engineers' Association at the recent annual meeting elected the following officers: President, H. K. Burton; vice president, D. J. Cox; secretary-treasurer, W. B. Curry. "Flood Prevention" and "Cheaper Power for Colorado" were discussed.

The Lincoln (Neb.) Chapter A. A. E. will have as its principal speaker at the meeting to be held April 10, Edwin S. Jarrett of Jarrett & Chambers, foundation engineers and designers of the foundations of the capitol building to be erected in Lincoln the coming year. This meeting will be a joint meeting of the Lincoln chapter of the A. A. E., the Nebraska chapter of the Am. Soc. C. E. and the student chapters of both organizations at the University of Nebraska.

The London, Ontario, Branch of the **Engineering Institute of Canada** at its annual meeting elected the following officers: Honorary chairman, J. Davis Barnett; chairman, Harry Brazier; vice-chairman, J. Forbes Mitchell; secretary-treasurer, George C. Wright.

The North Dakota Society of Engineers held its annual meeting at Jamestown, Feb. 8 and 9. The opening session was given over to a discussion of licensing. A series of professional sessions occupied the balance of the time, and at the business meeting which closed the activities E. R. Griffin of Mandan, N. D., was elected president.

The American Water Works Association will hold its forty-second annual convention in Philadelphia, May 15-19. J. M. Diven, 153 W. 71st St., New York City, is secretary.

Personal Notes

WILLIAM H. RHODES, Jr., who has been senior highway engineer, U.S. Bureau of Public Roads, has accepted the position of maintenance engineer with the Louisiana Highway Commission.

G. C. OMMANEY has been appointed development engineer of the Development Branch, Canadian Pacific R.R., department of colonization, with headquarters at Montreal. Mr. Ommaney has been with the C.P.R. since 1907.

FRANK C. LINGENFELTER, Indianapolis, formerly city civil engineer, has opened an office as a consulting engineer.

A. F. HARLEY has been appointed highway engineer for the Cocoa Beach special road and bridge district, and has opened an office at Cocoa, Florida.

THOMAS C. NORTH, borough engineer of DuBois, Penn., has been elected borough engineer and borough manager of Blairsville, Penn.

D. A. YOUNG, who had been with the New York State Highway Department since 1909, was recently appointed state engineer of Vermont.

JOSEPH JACOBS, of Seattle, has been appointed consulting engineer of the department of conservation and

development on plans for the greater Wenatchee and Quincy project. This project was recently surveyed by the state and involves the irrigation from Lake Wenatchee of about 50,000 acres in the Greater Wenatchee district and nearly 100,000 acres in the Quincy section. The districts are financing the investigation and development of the project.

W. C. BUETOW has been made bridge engineer of the Wisconsin Highway Commission succeeding M. W. TORKELSON. He has served with the commission in various capacities since 1911. At the time of his appointment as bridge engineer he held the title of assistant engineer, in charge of the day labor and material division. He is a graduate of the University of Wisconsin.

BUSINESS NOTES

ROBERT M. GATES, formerly a partner of the Herron Gates Co., Cleveland, Ohio, has become associated with Superheater Co., N. Y., handling power-plant equipment.

L. H. HART, formerly with the National Lime Association, has organized the L. H. Hart Building Lime Service, Buffalo, N. Y., which undertakes the solution of various problems concerned with the uses of lime.

D. B. FRISBIE of Atlanta, Ga., has been assigned the responsibility of developing a large selling organization throughout the south for the Barber-Greene Co., of Aurora, Ill. So far ten sales organizations have been put under his direction.

THE RITER-CONLEY CO., a Pennsylvania corporation, recently filed papers with the secretary of state at Indianapolis, qualifying them to do business in Indiana. The company was organized for the construction, erection and equipment of all buildings. Willard B. Van Horne will be the Indiana agent.

THE FOSTER ENGINEERING SERVICE CO. was recently organized at Indianapolis, Ind., for general engineering and construction work. C. B. Foster, T. A. Lavelle, T. D. McGee and W. B. Stern are directors of the company.

THE FEDERAL ROAD BUILDERS' MANUFACTURING CO. has been organized at Indianapolis for the erection of steel and concrete bridges, viaducts, etc. Leo Traugott, Louis Traugott and A. Joseph are directors of the company.

FRANK J. MCHUGH and G. A. FERGUSON of Seattle have consolidated under the name of the McHugh Construction Co. Officers of the company are Frank J. McHugh, President; P. J. McHugh, vice-president; and G. A. Ferguson, secretary-treasurer. Frank J. McHugh and Mr. Ferguson have each been in the road contracting business in Washington for more than 15 years.

WILLIAM J. CLEARY, recently general purchasing agent of the Willys Corp., with headquarters in Elizabeth, N. J., has been made assistant general sales manager of the Sharon Pressed Steel Co., with headquarters in Detroit, Mich. His new duties will cover the automotive industry in general.

OBITUARY

EDGAR T. WHEELER, manager of the Edgar T. Wheeler Co., contractors and engineers of Los Angeles, Cal., died recently at his home in Los Angeles.

JOHN H. FELTHAUSEN, chief engineer of S. Morgan Smith Co., York, Pa., died at his home in New York, March 5.

WILLIAM M. PHILLIPS, who supervised the construction of the New York Shipbuilding Corp. plant in Camden, N. J., died recently at his home in Torresdale, Penn. He was in charge of clearing up the wreckage of the Johnstown flood, and served for many years in the engineering department of the Pennsylvania R.R.

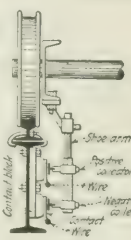
CHARLES R. ROCKWOOD, for more than thirty years identified with engineering construction in the West, died at his home in Los Angeles on March 4. Mr Rockwood was born in Michigan in 1860. He entered the University of Michigan but left in 1882 before finishing his course to go to California. His first work in California was with the engineering department of the Southern Pacific R.R. In 1889 he was employed by the U. S. Geological Survey. Subsequently he was in Oregon for some time on irrigation development and later went to the Imperial Valley. His leadership in the great Imperial Valley irrigation project, while it was still in the formative period, led to his becoming known as the "father of the valley" and he was the original of the character portrayed as Seer in Harold Bell Wright's book on the valley, "The Winning of Barbara Worth." Mr. Rockwood was the general manager and chief engineer of the California Development Co. (the predecessor of the present Imperial Irrigation District) from December 1914 to December 1916.

EQUIPMENT AND MATERIALS

Traveling Crane with Surface-Contact Collector

An electric surface-contact system for operating overhead traveling cranes, thus giving protected live spots instead of a bare trolley wire or third-rail conductor is being introduced by the Simplex Surface Contact System, Williamsport, Pa. In a recent installation a collector shoe 11 ft. long is carried by the crane and slides over insulated copper-faced contact blocks spaced 10 ft. apart and attached to the web of the runway girder. Spring pressure exerted by the shoe presses on the cap of the block, making electric connection between the feed wire and the wheels on the crane. The length of the collector shoe is such that before it leaves one block, it has engaged the next one.

For the feed and return wire circuits, the blocks are so made that the two insulator contact points are mounted on a single base which is bolted to the girder. The contacts are separately connected to their respective wires. The two shoes are also mounted on a single support and placed one above the other, as shown. These shoes are adjustable and are so constructed as to be easily bolted to the crane carriage. Only the face of the shoe is alive, as an insulating strip extends the entire length of the shoe and insulates the contact face from every other part. Copper contact of the fixed block has a surface of 2½ in. high and 1½ in. wide. The lower end is bent into a loop to support the feed wire, the insulation of which is removed at this point to permit the soldering of the wire to the copper strip.



Pressed-Lead Roofing

A lead sheet for roofing has been developed by the United Lead Co., New York, N. Y. The metal used is the "hardlead," which has been long used for downspouts, flashing, cornices, etc., and it is pressed into the form required for roofing.

Pressed roofing is made in flat sheets 24 x 24 x 1/8 in. Each square contains nine shingles. It is applied directly to



the roof slope without any mechanical preparation. The squares are laid diagonally on the slopes and secured by clips at the upper edges leaving free movement for each sheet. Each sheet interlocks with the adjoining ones and forms a complete waterproof joint. No soldering is necessary. Starting sheets have a lip to fit over the eaves board.

Sensitized Tracing Cloth

The New York Blue Print Paper Co. has put upon the market sensitized tracing cloth, by means of which reproductions of tracings may be easily made. The process involves making a negative with brown-print paper from which the tracings are reproduced upon the sensitized cloth, which, after proper exposure, is put into a bath and then a developer. After drying a lacquer coat is applied. The reproductions of original tracings are waterproof.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Rapid-Fire Survey of Business Conditions

"Suspended purchasing power," is what William T. Foster, in the Mar. 13 *Annalist*, calls money. He writes: "The owner of money, as the holder of such a convenient store of suspended purchasing power, virtually controls the production schedules of the world; and, in the very process of exercising this control—the spending of his money—he determines for the most part the prices at which goods are sold. For this reason, studies of the ups and downs of business may well begin with the changes in the volume and distribution of purchasing power relative to changes in available goods, and changes in the mental attitudes of the holders of purchasing power."

Money stocks in the United States on Mar. 1 are compared with stocks on Feb. 1, by the Treasury Department, as follows:

Total	decreased $3,002,692
Gold	increased 39,873,254
Silver dollars	increased 2,920,000
Federal Reserve notes	decreased 42,444,150

Changes during the twelve months ended Mar. 1 were as follows:

Total	decreased $8,713,031
Gold	increased 803,870,885
Silver dollars	increased 90,599,525
Federal Reserve notes	decreased 826,680,535

The highest point ever reached by the total stock of money was $8,372,959,004 on Jan. 1, 1921. The lowest last year was $7,942,675,633 on May 1. The present stock of gold is the highest ever reached in this country; the lowest last year was $2,784,834,427; the lowest since the war, $2,646,615,750, on May 1, 1920. In the armistice month the country's stock of gold was $3,079,784,766.

Japan's national wealth amounts to 86,077,000,000 yen, against 32,043,000,000 before the war, according to a report to the League of Nations. The yen has an exchange value of 47.375 cents; par is 49.8 cents.

French bank note circulation is 35,640,367,000 francs, against 38,245,393,370 francs one year ago. The highest point was 39,645,896,000 on Nov. 3, 1920.

Exports in February amounted to $251,000,000, a decrease of $28,000,000 from January. This is the lowest since August, 1915. Imports were valued at $217,000,000, which is an increase of $1,000,000 over January.

Wholesale prices advanced 3 points in February, Labor Statistics' index number for all commodities being 151, and 167 one year ago. The increase was most pronounced among farm products and foodstuffs.

Retail food prices were about the same in February as in January, 42 per cent higher than in 1913.

Highest priced commodities of fifty listed by the Harvard Economic Service, with their percentage increase over 1913 prices, are: tobacco, 225 per cent; brick and cotton-goods, 130; anthracite coal, 109; serge, 94; alcohol, 91; worsted yarn, 90. By groups the figures are as follows: grains and flour, 24; live stock, meats, hides and leather, 1; metals and metal products, 8; fibers and textiles, 71; fuels, 51; building materials, 59; miscellaneous, 41.

Steel production is at the rate of 29,000,000 gross tons of ingots a year, which is 25 per cent above the rate in October and November, and 15 per cent above the rate in 1910—the best year prior to 1912. In considering the current satisfactory demand for steel it must be borne in mind that an appreciable proportion is to replenish stocks rather than for immediate consumption.

Employees in 109 iron and steel establishments reporting to the Department of Labor numbered 124,932 in February, against 144,679 one year ago, and the payrolls were $5,306,863 and $9,393,391, respectively. But there was a gain in February over January, 1922, or 9.3 per cent in numbers of men and 15.7 in amount of payroll. Twelve mills reported wage cuts, but the per capita earnings of all the workers were 5.9 per cent higher than for January.

Freight loaded in the week ending Mar. 4 amounted to 803,255 cars, the record since November, 1921. All commodities except forest products show an increase over the preceding week. The principal increase is in merchandise, L.C.L., which shows a gain of 32,276 cars.

Surplus cars continue to decrease in number, the figures for Mar. 8 being 88,974 box, 86,464 coal and 223,846 all freight cars, representing reductions since the week before of 6,387 box, 11,170 coal and 21,254 total.

Earnings of Well-Known Companies in 1921 and 1920

The annual financial statements of several well-known American business organizations, as reported to the press, show an unusually large number of net losses, for the year 1921, suffered by certain companies as compared with substantial net gains realized by others. Despite the abnormal conditions under which these organizations have been operating during the past year the outlook for 1922, as depicted by various prominent officials, is very reassuring.

A. R. Erskine, president of the Studebaker Corporation, in addressing the stockholders, said: "The Management believes that business this year will show a substantial increase over that of last year."

George J. Baldwin, president of the Pacific Mail Steamship Co., speaking to the stockholders, made the following statement: "The year 1921 was a period of adjustment. Revenues decreased in marked degree, with reductions in expenses failing to keep pace with falling returns."

Charles A. Stone, president of the American International Corporation, in his remarks to stockholders said: "Toward the close of 1921 there was good reason to believe that the worst of the world depression had been seen. While no one will venture to predict the precise degree of improvement that may be expected this year there is warrant for believing that a process of recovery has begun."

Judge Gary stated that "the average production for the entire year (1921) in rolled and other finished products was 47.5 per cent, the lowest in any year since the organization of the corporation."

Following are net earnings or losses of well-known companies:

Company	Net Earnings or Losses (Deficits shown in italics) Total 1921	Total 1920	Per Share, Com 1921	Per Share, Com 1920
Alpha Portland Cement Co.	†$672,338			
American International Corp.	184,681	1,783,466		
American Steel Foundries Co.	675,009	4,496,442	0 13	6 37
American Surety Co.	1,022,295	600,000	20.00	12 00
American Telephone and Telegraph Company	54,002,703	51,821,215	11.10	11 70
American Tobacco Company	18,615,398	15,151,155	16.84	13 48
Bucyrus Company	145,905	530,984		
Columbia Gas Company	4,303,536	4,839,377	8 60	9 68
Corn Products Refining Company	6,326,358	12,469,626	9.21	21 53
Cumberland Telephone and Telegraph Company	*17,135*	145,589		
Fisk Rubber Company	3,336,467			
General Motors Corporation	*88,680,770*	37,750,375		1 56
Gulf States Steel Company	*591,915*	751,220		
Interborough Rapid Transit Company	*1,564,876*	*2,235,835*		
International Motor Truck Corporation	126,931	2,644,013		
Lehigh Coal & Navigation Company	5,394,224			
Middle States Oil Company	6,293,891	6,964,020	4 26	
New York Telephone Company	13,244,543	6,070,013	8 29	4 04
New York Air Brake Company	*178,699*	751,860		7 51
Otis Steel Company	*5,189,543*	1,141,088		1 48
Pacific Mail Steamship Company	*495,791*	*1,622,470		
Penn Seaboard Steel Corporation	*749,046*	*268,217*		
Pierce-Arrow Motor Car Company	*8,764,511*	1,769,915		
Pittsburgh Coal Company	*1,197,937*			
Pyrene Manufacturing Company	64,574			
Solar Refining Company	*503,638*	698,207		
Southern Bell Telephone and Telegraph Company	720,168	803,240	2 40	2 67
Standard Oil Company of Ind.	21,288,348	40,973,484	4 95	11 63
Studebaker Corporation	9,723,691	9,111,904	16 20	15 20
Texas Oil Company	9,286,129	31,089,372	1 41	5 98
United States Gypsum Company	2,247,326	2,126,778	6 48	6 52
U. S. Cast Iron Pipe & Foundry Company	100,841	851,592		
U. S. Steel Corporation	‡100,791,279	185,695,359	2 24	16 62
Westinghouse Air Brake Company	1,412,490		1 00	
White Motor Company	*4,857,319*	2,410,014		4 82
Worthington Pump & Machinery Corporation	*188,630*	2,030,923		7 85

* From this amount $345,000 had been reserved for income and excess profits taxes

† Capital stock (issued) preferred $2,000,000; common $15,800,000.

‡ Taxes deducted but including interest on bonds of subsidiary companies.

Who Gets Cement Contract When Bids Are Uniform?

Atlas Co. Says Determining Factors Are Salesmanship and Service—Personal and Institutional

Public interest in cement prices and their uniformity is so keen that *Engineering News-Record* asked the Atlas Cement Co. to state "the considerations aside from price that determine the award of a cement contract." L. R. Burch, assistant to the president, replies:

"The answer must be given in one phrase—salesmanship and service—personal and institutional. This is a very broad way of treating the matter, however, and in order to make clear just what cement salesmanship comprises and at the same time illustrate the keenness with which cement manufacturers follow up possible business, it might be well to note briefly the means employed in connection with a recent contract which is a typical case.

"Bids were submitted in the usual way and immediately the machinery of the sales department was set in motion long before the date on which the bids were to be opened.

"The purchasing agent was seen by the local salesman in charge of the territory in which the buying was to be done and an investigation was made of the prospective buyer with a view to discovering possible points of reciprocity and personal connections.

"Conditions of delivery were carefully looked into to see if more satisfactory shipments could be made by us than by a competing company. In this connection the matter of car supply, rail routing, junction points and time in transit play an important part.

"As a further service, the sales force, aided by the technical department lent valuable assistance to the purchaser in locating convenient sand and gravel deposits, and giving information on local storage and delivery facilities.

"An effort was made to locate the real buyer, for it frequently happens in the letting of large contracts that the purchasing agent does not have the final say and methods have to be employed which differ radically from those otherwise employed. As a matter of fact, each contract presents problems which are unlike any previously encountered; consequently there is no one method which will fit every case.

"The matter of storage and production capacity at the manufacturer's plant must also be considered and brought to the purchaser's attention, for with a heavy demand for cement for public work, the ability of the company to carry sufficient stock on hand to cover any call for deliveries, is of the greatest importance.

"The heads of the Sales Department naturally have knowledge of all bids and not only give their attention to the direction of the solicitation, but where they believe it will be to advantage to take up the matter personally, lending the prestige of their positions and ability to supplement the efforts of the local and general salesmen.

"The point I want to bring out is that in the efforts to make a sale in the face of such strong competition as prevails in the cement industry, nothing is left undone by a sales department costing more than a million dollars a year. That this is the case will be maintained by architects, engineers, contractors and dealers who have been in any way connected with cement jobs and who have had occasion to remark the active manner in which a prospective buyer is pursued by each bidder.

"Which gets us back to the short form of answer, that the consideration determining the award of a cement contract, where the quality is standard, the market highly competitive and the prices in consequence fairly uniform, are salesmanship and service of a highly developed character."

Cost To Test Cement and Inspect Fabricated Steel

Recent bids received by the Wisconsin Highway Commission for material testing in 1922 give a range of 1¾ to 2c. per bbl. of cement, and 20 to 75c. per ton of fabricated steel inspected in the shop. The seven bidders and their bids follow:

Cement: Bid Per Bbl.	Robt. W. Hunt Co., Chicago	Gulick-Henderson Co., Chicago	Pittsburg Test. Lab., Chicago	Amer. Bur. of Insp. & Tests, Chicago	Walter H. Flood, Chicago	Minnesota Test. Lab., Duluth	Transportation Rental Eng. Co., Chicago
1,200,000 bbl	$0.019	$0.0174	$0.02	$0.0165	$0.014	$0.0137	$0.0125
600,000 bbl	.02	.0178	.02	.017	.0165	.0144	.02
Shop inspection of steel fabrication							
At Decatur	$0.40 ton	.70	.40	.35	.30		.20
Waukegan	.90	.75	1.60	.45	.35		.25
Chicago	.40	.65	.40	.35	.30		.20
Minneapolis	.40	.75	.40	.35	.35		.20

"How High Are Cement Prices?"

Blaine S. Smith, general sales manager of the Universal Portland Cement Co., Chicago, contributes to the discussion, "How High Are Cement Prices?" which was published in this section, Feb. 23 issue:

"There is one point which we believe you should take into consideration in making comparisons between cement prices as of different dates, and that is the discount for cash in ten days from date of invoice in effect as the dates affected. This discount for prompt payment has varied from time to time. Prior to January, 1914, the discount was 1c. per bbl.; at the time of peak prices in 1920 it was 5c. a bbl.; it is now 10c.

"It is obvious that as the present discount is ten times the discount in effect in 1913, when present prices are compared with 1913 prices the discount is an important factor. For example: in Table I, p. 340, price on cement f.o.b. mill is shown as $1.70 to-day, as $2.10 at the peak in 1920, and the per cent decline since peak as 19 per cent. Applying the discounts, the present price becomes $1.70 less 10c. or $1.60, and the peak price becomes $2.10 less 5c. or $2.05. The per cent decline since peak therefore is 22 per cent instead of 19 per cent as shown in the table.

We note the following discrepancies in prices quoted in Table I, on p. 340: price of $1.70 f.o.b. mill, which you show as being in effect six months ago, should read $1.90; price of $1.80 f.o.b. mill, one year ago, should read $1.90; also price of $2.00 f.o.b. Chicago, one year ago, should read $2.17. With reference to Table II, on p. 341, you show the average price f.o.b. Chicago, for 1920 as $2.01, whereas in Table I, you show the peak price as being $2.37 for the same year. We have arrived at an average of $2.17.

"Again in Table II, p. 341, the average price at Mid-West mill is shown as $1.05 in 1913 and $1.70 in 1922, the per cent change being 62 per cent. Our average price at Buffington in 1913 was $1.07, but using the figure in your table of $1.05 and deducting 1c. discount, the 1913 price becomes $1.04; and deducting 10c. discount from $1.70 the 1922 price becomes $1.60. The increase from $1.04 in 1913 to $1.60 in 1922 is 54 per cent instead of 62 per cent as shown in the table.

"A gratifying feature of your article is that in Table II in showing prices f.o.b. Chicago you explain in footnote that these prices necessarily include freight between mill and Chicago and that the figures consequently are affected by the freight increases. A point that should be but unfortunately sometimes is not obvious to the reader is that an untrue relation is shown if delivered prices as of different dates are compared when there has been a change in the freight rate in the interval between the two dates."

Eight Cement Companies Receive Wisconsin Contracts

Contracts for 1,501,000 bbl. of cement to build the 1922 program of roads in Wisconsin have been apportioned as follows among eight different companies submitting bids on Feb. 28: Sandusky Cement Co., 75,000 bbl.; Lehigh Portland Cement Co., 197,000 bbl.; Alpha Portland Cement Co., 127,000 bbl; Petoskey Portland Cement Co., 16,000 bbl; Huron Portland Cement Co., 7,000 bbl; Northwestern States Portland Cement Co., 6,000 bbl.; Marquette Cement Manufacturing Co., 400,000 bbl; Universal Portland Cement Co., 673,000 bbl.

A. R. Hirst, state highway engineer, in a statement to the newspapers, says that at a conference March 7 with the representatives of the counties, the latter favored going ahead with the program. They urged that the differ[illegible] and actually received in the bids was so small as compared [illegible] that the employment situation justified proceeding with all [illegible]. The State Highway [illegible] opinion in the conference that the boycott had been carried as far as it was profitable to carry it. The price paid in 1922 averages $1.41 mill net per bbl. while the average mill net for [illegible] this year are lower than expected, averaging not more than $25,000, including grading and culverts, for 18 ft. concrete roads.

Work for 500 Men

The $2,500,000 O'Shaughnessy Dam to be constructed by the city of Columbus, north of Dublin, Ohio, on the Scioto River, is expected to furnish work for 500 men. Bids will be opened April 20 (see Construction News). The dam, of concrete, will be 1,400 ft. long by 70 ft. high, with a bridge on the top of the structure.

Unemployed Work Out Own Employment Service

Committees recently made up of unemployed engineers in Chicago to canvass the field and explain that the Western Society of Engineers maintained a free employment service accomplished little, says the *Journal* of the society. These members found employment so soon that they had little opportunity to accomplish results. The *Journal* concludes that unemployment conditions are undeniably improving, especially in the Western states.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted. Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section. The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of March 2; the next, on April 6.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$2.63	+$3.35	$4.00	$2.63	$2.66	$3.50	$3.10	$3.25	$3.75
Structural rivets, 100 lb	3.50	+3.90	5.50	3.43	3.90	+4.55	4.50	3.75	6.50
Reinforcing bars, ¾ in. and larger, 100 lb	2.53	+3.25	3.50	2.53	2.56	3.42½	2.75	3.25	2.75
Steel pipe, black, 2½ to 6 in. lap, discount	61%	68%	45%	59½%	61.9-5%	44%	58.8%	53%	35.10
Cast-iron pipe, 6in. and over, ton	47.30@48.30	+40.00	48.30	43.10@44.60	46.00	52.00	48.00	+52.00	55.00
Concreting Material:									
Cement without bags, bbl	2.40	2.39	2.25	1.94	2.24	2.90	2.73	2.94	2.40
Gravel, ¾ in., cu.yd	1.75	1.85	2.25	2.00	1.50	2.50	2.25	1.50	1.50
Sand, cu.yd	1.00	1.15	2.25	2.00	1.00	1.10	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd	1.75	1.90	2.73	1.60	2.25	3.50	2.25	3.00	2.00
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	49.00	37.00	−33.50	43.00	38.00	34.75	28.00	20.00	.....
Lime, finishing, hydrated, ton	15.80@16.80	18.00	25.00	18.00	29.00	24.00	22.00	27.00	21.00
Lime common, lump, per bbl	2.75@3.48	1.25	2.50	1.40	1.40	2.70	1.75	2.75	11.00
Common brick, delivered, 1,000	19.40@19.90	8.75	11.15	11.00	15.00	12.00	15.50	14.00	16.00
Hollow building tile, 4x12x12, block	Not used	.07975	.115	.0821	.0752	.08	....	.10	.20
Hollow partition tile 4x12x12, block	.11120	.06525	.115	.0657	....	.10	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal	−.84@.87	−.81	.109	.97	−.93	−1.08	1.04	.86	1.05
Common Labor:									
Common labor, union, hour	.60	.35	.....	.72½	.....	.50@.55	.56¼	.50@.60	.....
Common labor, non-union, hour	.....	.20	.25	.35@.40	.40@.50	.35@.40	.47½@.56	.50	.20@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or − signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations are delivered except tiles, which are "on trucks." Common lump lime per 280-lb. net; both lump and hydrated quoted f.o.b. cars New York. Sand gravel and crushed stone are quoted alongside dock. Cement and steel pipe delivered to contractors on job. Gravel ready mixed $2 per cu.yd.

Chicago quotes hydrated lime in 50-lb. bags; common lump line per 180-lb. net.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed store quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to contractors in yards at San Francisco. Lumber price is for No. 1 fir, common.

Seattle quotes on Douglas fir instead of pine. Common lump lime per 180-lb. net.

Montreal quotes sand, stone, gravel and lump lime per ton. Lime and tile are delivered; cement, sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 96.87 cents). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net.

Changes Since Last Week

The outstanding features of the week are centered in an advance in steel and cast-iron pipe prices at the warehouses and a general tendency downward in linseed-oil quotations throughout the country. An increased demand for finished steel products has characterized the market throughout the week. Pittsburgh mills, with few exceptions, are holding firmly to the asking price of $1.50 per 100 lb. on structural shapes, plates and reinforcing bars. Only in exceptional cases, involving large tonnages, is the quotation of $1.40 easily obtainable. Atlanta quotes advances of 10c. per 100 lb. on steel shapes, structural rivets and reinforcing bars. Denver quotes a rise of 30c. per 100 lb. on rivets. Structural steel, delivered by rail, is quoted at $63.30 f.o.b. Seattle; water deliveries at $52.60 per ton. Cast iron pipe is quoted at $52 as against $50 per ton with prices tending upward. Seattle also reports a falling off in demand for steel and cast-iron pipe but increasing lumber demand with prices holding firmly. Cast-iron pipe is quoted at $40 as against $37.63 in Atlanta and at $52 as compared with $50 per ton in Seattle one week ago.

A drop of 50c. per M. ft. is quoted in yellow pine lumber in Dallas. A total of 378 mills reporting to the National Lumber Manufacturers' Association for the week ending Mar. 11, show 179,779,597 ft. of lumber cut; 179,939,737 ft. shipped and orders for 168,851,556 ft. b.m. Production stands at 22.5 per cent; shipments at 23 per cent and orders at 28 per cent below normal.

Common brick prices remain firm in all important centers. The situation in New York has been improved by the arrival of seven more barge loads of Hudson River common brick, bringing the total up to 15,000,000 received from the Haverstraw district between Jan. 1 and Mar. 15.

Linseed oil, quoted at a drop of 13c. in Atlanta; 5c. in Minneapolis and 6c. per gal. (5 bbl. lots) in Denver.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, President

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren, Editor

Volume 88 — NEW YORK, MARCH 30, 1922 — Number 13

Wise Water-Supply Policy

IN GRANTING Bayonne the right to divert 50 m.g.d. from the Ramapo River for municipal water supply, the New Jersey Department of Conservation and Development, on March 23, made provisos (1) to guard the interests of other communities which have had an eye to this source of supply and (2) to facilitate the complete development of the Passaic and its tributaries under one of the projects outlined in the Hazen report abstracted in our issue of March 16. These provisos require Bayonne to develop not less than two-thirds the maximum yield of the stream by 1919 and all the yield when demanded by the department; the supply of Ramapo water by Bayonne to communities desiring it, after approval by the department, on terms to be agreed on mutually or, in default of agreement, to be fixed by the department; and the surrender by Bayonne, at a fair price, of the Ramapo grant to any board or commission having authority to acquire and consolidate existing public water supplies. These requirements, modified if and as needed to meet local conditions, might well be followed in other densely populated states where there is rivalry for sources of water supply and likelihood of a future need for a joint water undertaking for a water district, metropolitan or even less extensive.

France Gives Up Railroading

WORD has recently come from the other side announcing that after fourteen years' experience the French Government is planning to abandon the operation of the Etat Railway System and to turn over the property to a private corporation. Government operation of this line we learn has been not only bad business for the taxpayers but also quite unsatisfactory from the viewpoint of the railroad users. In view of our own national experiments, it is interesting to observe that after a long trial, part of which was under normal business conditions, France, too, has come to the conclusion that "government in business" is good neither for government nor for business.

Service to the Profession

A FINE service has been rendered to the engineering and architectural professions by the two investigating boards whose findings concerning the Knickerbocker Theater roof collapse are summarized in this issue. What they have accomplished in clearing up the disquieting puzzle will find acknowledgment, we think, in feelings of satisfaction and relief on the part of every one connected with the building art. Full appreciation of the service rendered may perhaps come only with time; the searching inquiries, going to the root of the evil of bad construction, will surely have a sanative effect, but one of gradual development rather than immediate. Every forward-looking member of either profession owes the men composing the two boards a tribute of thanks. They labored for him. The killing of a hundred citizens put a challenging question to us all, not merely to the small professional group in Washington. But because they were nearest to hand, they took up the burden of answering the question. Their self-assumed obligation—and we speak more particularly of the American Association of Engineers' committee— was discharged under great difficulties. Moreover, they brought to bear on their task a keenness of observation, a depth of insight, and a breadth and soundness of judgment that would themselves compel praise and warm appreciation. What was accomplished by the two investigating bodies sets a brilliant precedent for future professional service.

Results of Neglect

ALL mystery has been removed from the collapse by the studies of the investigating boards. There were no new agencies of danger, but only the old and too familiar one of bad work—the product of progressive neglect. The structure was not a building; architecturally it may claim the name, but never structurally. It was a reckless assemblage of building-code walls, unstable roof framing, and a concrete slab covering that was a credit to the materials of which it was made but not to the men who used them. Despite the wall and slab construction, however, it appears that the steel roof frame, after all, was the focal point of trouble. The steelwork was unsound in its general conception and inexcusably bad in its details. Important teachings are to be found in its individual defects: in the fatal weakness of the gusset plates, a subject demanding much more research study that it has yet received; in the equally fatal overloading of the thin and unstayed chord end, whose part in the outcome appears to be rather under-emphasized; in the absence of anchorage and bracing, and in the inadequacy and bad detailing of the columns, which yet by some miracle did not fail. However, the most significant feature of the case, as indeed of many prior failures, is that not one defect alone but half a dozen or more might and should have been the cause of destruction. The roof was condemned by all its parts rather than by a single one; and such a condition may be recognized as the product of thoroughgoing, cumulative neglect. Slighting one after another of the principles of sound practice, taking a chance with one bit of poor detailing and then with another, leaves in the end only a husk and shell of designing and detailing, a mockery of engineering.

Architectural Responsibility

ULTIMATELY a single brain and conscience, the personality of one man, stands back of any structure and guarantees its safety. The architect is that man in the case of buildings. Does he, in fact, assume and fully discharge this responsibility, or is it merely

a matter of form? That is the outstanding query resulting from the Knickerbocker disaster, and it is squarely up to the architectural profession to answer it. If the architect's creative responsibility, and the associated guarantee of adequate construction, is a mere historic form, without substance, it is time that the facts were known to all the world and time that other means to guard public safety be provided. If the responsibility is still to be regarded as real, it is time that steps were taken to make it real. The point at issue is a condition such as found in the Knickerbocker case—and such conditions, it must be admitted, are far from uncommon—where the architect gives careful attention to the externals, the appearance of his structure, but depends for the vital matter of making the structure safe upon an interested party, namely, a sub-contractor, without even an attempt to check the result. If the responsibility for the safety of a building may be thus divided and farmed out, what is left of the personal and competent answerability of the architect for his structure? What is left of the architect? The practices and laws requiring buildings to be planned by architects, and all plans to be duly accredited by his signature, have been regarded by the public as an assurance of safety. It is no assurance of any kind, however, unless the architect definitely assumes the responsibility implied, and shapes his practice so that his guarantee is real and not a sham.

Railroading as an Engineering Career

AT THE railway engineering meeting in Chicago week before last, there was discussion of the lack of attractiveness of a railroad career to young engineers. To impartial observers of railway engineering organizations nothing new developed in this discussion, other than the fact that ranking officials of these organizations have come to recognize, or at least to admit, what has long been generally appreciated. The wonder to the impartial observer is that as the key positions needed filling men of sufficient mold were available; in fact, despite the eminence displayed in the top ranks today, there has been a shortage of first-class men. Doubtless this shortage has impressed itself on the chiefs. However, the condition was plainly foretold years ago. The glamour of railroading began to fall off some fifteen years ago; at least, as far back as that the prospective graduates said that pay was poor and promotion in responsibility slow. They, therefore, began to avoid railroad work.

For this unfavorable attitude the engineering department heads have largely themselves to blame. Mr. Stocker, in saying that the older engineers do not take a helpful attitude toward the beginners in the service, voices the common impression of the young men. They have felt that the department heads were unappreciative of faithful service and hard work. There was neither commendation nor salary increases as evidence.

The cure is a more careful regard by the leaders for the upbuilding of their organization. Railroad careers must be made attractive if strong young men are to be invited and held.

All traces of the martinet influence of the days when a youngster was told that his time was the railroad's for 24 hours out of every day, and when the ordering of almost superhuman stunts was considered one of the necessities of railroading, have to go by the board. Not that young men need pampering. They do not. They will still give as loyally as their predecessors of a generation ago when occasion demands—even to nerve-racking vigils and superhuman efforts. But the opportunities have changed. Thirty years ago railroading was almost the dominant civil-engineering activity. Today it must compete with many attractive careers open to the young civil engineer.

For the sake of the transportation of the future railroading as a career must be rehabilitated in the minds of young engineers, and the rehabilitation rests upon the chiefs setting right standards of pay and so organizing that the strong men are discovered, recognized and rewarded.

An Opportunity for Trade Associations

THERE should be widespread response to the invitation of the Secretary of Commerce to trade associations to meet with him April 12 in order to arrange for the clearing of statistical material through the Department of Commerce. Such a conference is the inevitable result of the correspondence between the Secretary and the Attorney-General, in which the latter held that there was no violation of law if trade statistics gathered by associations were disseminated by the Department of Commerce and made available simultaneously to the members of the associations and to buyers. It should be noted that the essential feature of this method of dissemination is not the functioning of the Department of Commerce, but the simultaneous sharing in data by consumer and producer. The department merely furnishes an easy means for the accomplishing of the result.

It is going to take some wrenching of hitherto held notions for the trade associations to accept this simultaneous sharing of production, stock and shipment figures with the public. It is clearly indicated by the public temper, though, that this is the price which the public proposes to exact for the privilege of allowing the collection of statistics at all. As we have previously said in these columns, the confining of statistics to the membership may be legal, but certainly the easy way out, the way that will commend itself to the public, is through free publication of the association-gathered data.

Nor do we fear the dire results which some producers have predicted, such as unsettlement of the market and unintelligent buying due to the inability of the public to interpret the statistics properly. In the beginning there may be misinterpretation, but the public will soon learn how to translate them properly. Then there will ensue more intelligent buying, with consequent satisfaction.

Not to be neglected, either, will be the removal of the suspicions now entertained toward trade associations because of their statistical activities. As a corollary is the confidence that will ensue from the knowledge that the association has not available confidential information that may allow it to take advantage of the public.

As we see it, therefore, a good result from the meeting of April 12 will be of as great value to the associations as to the public. It is to be hoped that the associations will come there in large numbers impressed with that point of view and determined to square their functioning with the temper of the public.

Long-Term Road Bonds Again

SO OFTEN has the danger signal been raised against bonds whose terms extended beyond the life of the improvements for which they are issued that there is little excuse, at this date, for ignorance of the economic fallacies involved in such practice. It is a good many years since this journal published its first editorial condemnation of the long-term bond for the short-lived road. Competent banking authorities have gone so far as to oppose the general principle of bond issues for public improvements except in cases where they cannot be avoided, preference being given to the raising of money for such purposes by tax levies. Massachusetts began raising funds for road building by the issuance of 30-year bonds. This policy was pursued until 1913, when the 15-year serial bond was adopted. Beginning in 1919, however, the state ceased issuing bonds for highway purposes and the money has since been taken from current revenue.

If the financing is to be done by bond issues, two important factors to be considered are the character of the improvement and the total cost to state, county, or township. Sound policies of finance demand that indebtedness for road-building be liquidated at a rate at least equivalent to the depreciation of the improvement financed. In Florida, recently, certain county road work has been financed by the issue of 30-year serial bonds. While motor traffic in that section of the country may be lighter than elsewhere, it is fairly safe to assume that at the date of maturity of the 30-year bonds little, if anything, will remain of the pavements now being constructed. The long-term bond, while it involves lower yearly carrying charges, is, in the end, an expensive luxury. For the sake of comparison the following figures show the average annual cost and the total cost of a $100,000 serial-bond issue at 5 per cent.

Term in Years	Av. Annual Cost	Total Cost	Term in Years	Av. Annual Cost	Total Cost
5	$23,000	$115,000	20	7,625	152,500
10	12,750	127,500	25	6,800	170,000
15	9,333	140,000	30	5,917	177,500

These figures are well worth study. They show, for example, that with a 30-year bond issue as against one of 10 years, the saving in total cost amounts to exactly half the face value of the bonds.

Some of the states have recognized the fallacy of the long-term bond for road-building work. In New Jersey, for instance, specific limitations are placed on the terms of bonds according to the type of the improvement, as follows: Bridges, 30 years; concrete roads (6 in. thick), block pavements or asphalt on concrete foundations, 20 years; bituminous concrete, 15 years; macadam with bituminous surface, 10 years; gravel, 5 years.

It would be proper, of course, to consider that certain elements in a new road have a life much longer than that of the surfacing—the culverts for example—while certain other elements are almost permanent improvements. In the latter class come grading, new alignment, and the underdrainage. On these a longer bond term would be justified on the mere basis of the life of the improvement. Here, however, would properly enter considerations of higher total cost of the longer issues.

With public sentiment at present decidedly in favor of the good-roads movement it is not difficult to secure approval for ill-advised schemes of highway financing. Those in responsible charge of financing policies, however, have an obligation to protect the public against extravagant and uneconomic expenditures for bond issues extending beyond the life of the improvement which the obligations cover.

Self-Supported Arch Reinforcement

STRUCTURAL steel reinforcement for concrete bridges is not new. The earliest type of concrete arch introduced into this country was that devised by Melan, in which the steel was of small shapes framed and placed in vertical planes in a barrel arch. A self-supporting steel frame, erected as an arch and acting first to support the concrete of the arch without additional centering and later as a partner with the concrete to take the working stresses in the ribs—this is quite different from the Melan bridge, in which the steel served only as reinforcement. This self-supported type was early recognized as offering many advantages, notably in the reduction of centering costs, but it has never been very popular, probably because of the possible break in adhesion between concrete and the wide flat surfaces of structural steel and the doubtful distribution of the stresses between the proportionately large steel section and its enveloping concrete.

The former danger was quite clearly shown in the failure of the Third Street bridge at Dayton, an early Melan arch, which was found to have well defined cleavage planes along the rusting steel frames of the reinforcement. The latter doubt arises from the fact that in the usual reinforced-concrete arch, so called, the steel has little but an emergency value, to take care of the tension that may possibly develop from some unexpected loads which cause the line of thrust to fall outside the middle third. A composite concrete and steel structure with a complete interaction of both materials under all conditions presents quite a different problem, and one which has not been too well analyzed or subjected to test.

The Springfield bridge, described on another page, is the latest development of the self-supported steel type. In it the steel frame admirably serves as a centering, with consequent economy and safety in a river subject to rapid rises. But it is more than reinforcement; it is the major part of the arch section and its disposition and chronology of erection makes it possible to develop in the steel the full proportion of the ratio of elasticity of the two materials. The justification of such a type lies in comparative analysis of cost, assuming, of course, that considerations of appearance, maintenance and wear bar the uncovered steel arch or even the steel arch with a light covering of concrete not assumed to carry stress. Such an analysis governed the design of the Springfield bridge, but it was also considered to have superior qualities in the exact determination of the thrust line through the hinges and in ease of erection.

The possibility of a future reduction of adhesion still remains, but such a danger is much less in a rib arch than in a barrel arch cut at frequent intervals by the vertical planes of the ribs. Transverse or torsional action in an earth-loaded barrel might well set up strains between concrete and steel which would never occur in a comparatively narrow rib loaded from columns at intervals, and hinged at its abutments.

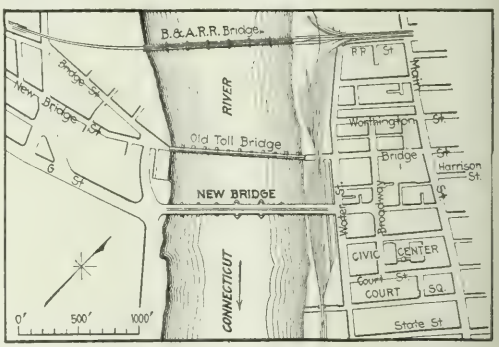
The Springfield bridge design is not unique but it is sufficiently novel to make it worthy of attention. Designers of similar large structures may well make the comparative analysis of the conventional type with this development before deciding upon their new bridges.

Steel Rib Reinforcement Used for Concrete Arch Centers

Monumental Concrete Bridge Across Connecticut River at Springfield, Mass.—Saves Cost of Falsework—How the Stresses are Figured

THERE is now being built across the Connecticut River between Springfield and West Springfield, Mass., a monumental concrete highway bridge of considerable architectural distinction and with some exceptional features of design, notably the use of structural steel arch-rib reinforcement which serves as centering for the arch ribs during placing. The bridge was authorized in 1915 to supersede a century-old wooden structure, and a board of commissioners made an exhaustive report soon after. Controversy as to width and location, however, postponed authorization until about two years ago. Work was started in the summer of 1920 and the bridge should be opened to traffic next July. Its total cost, exclusive of land damages, will amount to about $4,000,000.

As shown on the drawing, the bridge connects the two separate communities of Springfield and West Springfield. It crosses the river practically at right angles and reaches Springfield on a high grade street above the railroad tracks, two blocks away from the principal street of the city, Main St., and also two blocks from the civic center. On the West Springfield side a new set of earth-fill approaches will have to be built connecting the bridge to existing streets. Earlier layouts had the bridge crossing diagonally from Bridge St. in West Springfield, at the west end of the old toll bridge, and entering Springfield on the axis of the civic center, which is a well planned development in the business section of that city.



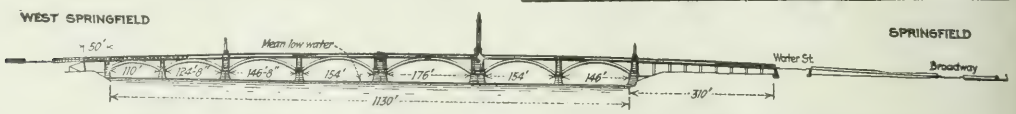


FIG. 1. PLAN AND ELEVATION OF NEW BRIDGE ACROSS CONNECTICUT RIVER AT SPRINGFIELD, MASS

The bridge consists of seven arch spans over the river, nine viaduct spans over the railroad tracks to the east, and earth-fill approaches extending about one-half mile to the west. The five easterly spans of the river bridge are symmetrical about the 176-ft. channel span, and the two westerly spans balance the viaduct spans at the easterly end. The total length of the bridge is 1,494 ft. and the length of the river bridge is 1,192 ft. The span lengths, as shown on the drawing, vary from 110 to 176 ft., and the rise of the arches from 19.1 to 29.7 ft. The bridge is 80 ft. between centers of concrete railings and carries a 60-ft. roadway and two 9½-ft. sidewalks. A clearance of over 40 ft. above mean low water for a width of 60 ft. was provided in the channel span, this clearance being in excess of that required by the War Department.

A requirement of the legislative act authorizing the bridge made it necessary to design and build the channel span so that it can be removed and a draw bridge substituted when and if required for navigation purposes. This latter condition required abutment piers for the center span and the architectural design was then centered around these piers, with the symmetrical spacing noted above, and furthermore with the embellishment of the large piers both by surface decoration and by the addition of high pylons. Smaller pylons were placed over the east abutment and the corresponding symmetrical pier. All the ornamental features of piers and superstructure, including all railing and coping courses, are of precast concrete, exposed surfaces being tooled. The concrete of the piers and abutments is protected against injury from floating objects and consequent deterioration by quarry-faced cut granite, which extends from a short distance below low water to the springing line of the arches.

Bedrock is not available at the site, so all foundations are on closely spaced wood piles. The piers, a section of a typical one of which is shown in Fig. 2, are of concrete placed inside cofferdams under water on top of the piles up to about 7 ft. below water, above which the concrete was placed in the dry. A feature of the design of the narrower piers is the use of 1-in. round rods extending from the top of the pier vertically down into the bottom section, where they are hooked for anchorage. These rods, which provide reinforcement for stresses caused by construction loadings, are shown in Fig. 2. The skewbacks on the piers are of cut granite placed on the piers to rough line and cut to the exact line after being set. It is stated that this special cutting required about 80 hours' work on each of the 70 skewbacks, but that it guaranteed an exact location of the steel arch ribs, and was therefore worth while. The channel piers shown in Fig. 2 have an open section in the middle for economy of weight and cost. This required a certain amount of reinforcing in the concrete over the opening. The piling and base of the east abutment are extended into the bank to carry two of the viaduct piers.

The arches themselves are made up of five ribs, three grouped near the middle and one at each side, as shown in the cross-section. This spacing is for equal distribution of loading, as described hereinafter. The reinforced-concrete roadway is carried on columns resting

on pedestals on the arch rib, with a solid concrete facing wall in the outer spandrel space. The arch ribs are parabolic, 4 ft. 6 in. wide, of constant depth in each span but varying in depth with the span lengths, and are when completed two-hinged, although they were built three hinged. They are reinforced with heavy structural steel lattice girders, erected as three-hinged arches with only a center support, except in four of the longer spans where supports at both center and quarter points were used. From the steelwork were then hung the forms in which the concrete of the arch ribs was placed, the hinges at the crown of the outside ribs being riveted before concrete was poured, and those at the springing line being left open. The adjustment of the steel ribs was secured by heavy screws through the cast-steel shoes, by which the distance between the face of the granite skewback and the base of the shoe could be varied. After adjustment, this space was filled with an alloy of antimony and lead which does not shrink on cooling.

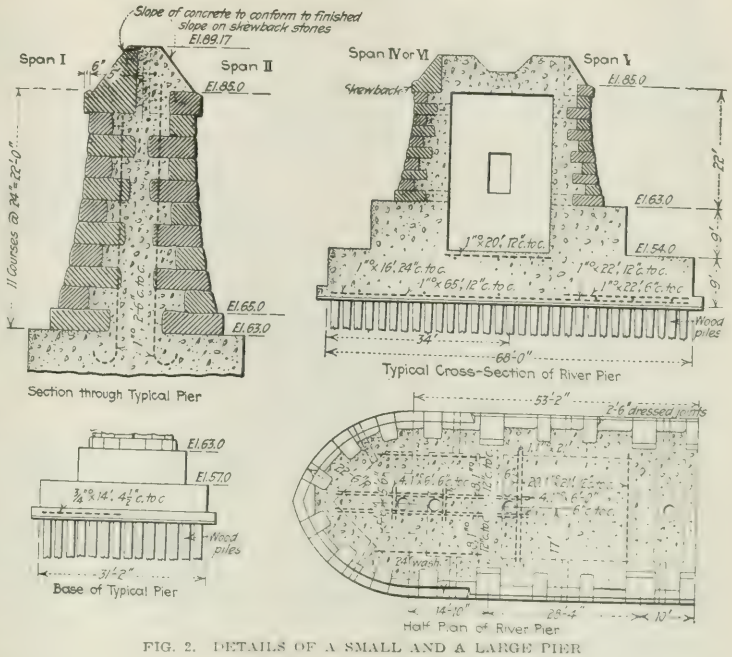
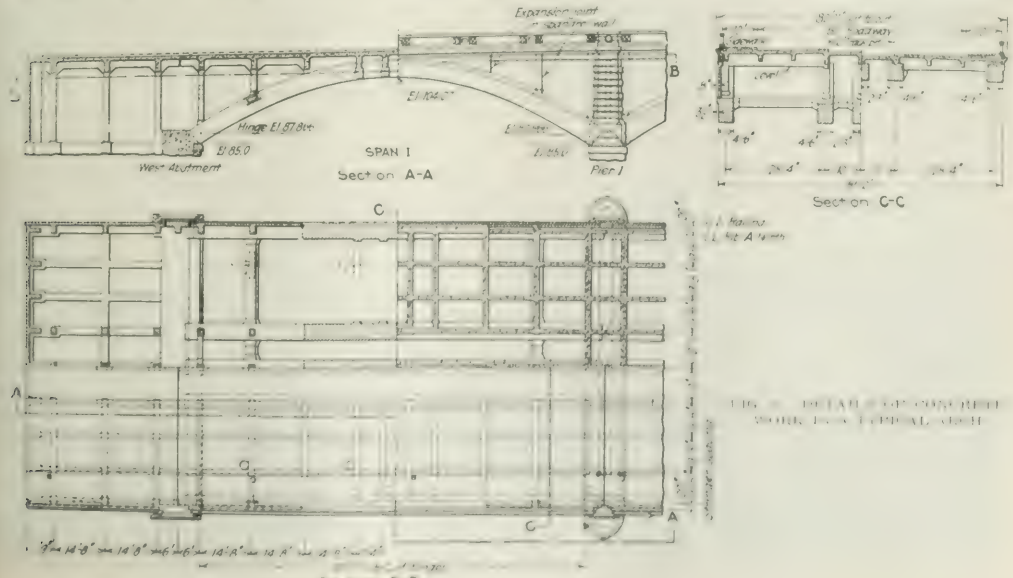


FIG. 2. DETAILS OF A SMALL AND A LARGE PIER

The concrete of each rib was poured in 20-ft. sections from each end alternately in order to avoid distortion, each rib being poured in one day's continuous pouring. The structural steel frame of the arch ribs supports the concrete until it becomes set, after which the steel acts as reinforcement. The behavior of this type of combined steel and concrete arch and the reason for its adoption are explained as follows by Prof. C. M. Spofford, of the firm of Fay, Spofford & Thorndike, who are designing and supervising engineers for the bridge.

Stresses in Steel Ribs.—The reinforcement of the arch ribs consists of riveted steel ribs with a limited amount of longitudinal rod reinforcement and with



hoops also formed of rods. The steel ribs were designed of sufficient strength to act as end-supported arches under not only their own weight, but also the weight of the rib concrete and the weight of the rib forms. These ribs were all erected as three-hinged arches, and were later spliced at the crown to act as two-hinged arches, the splice being made in the exterior ribs before the rib concrete was poured and in the interior ribs after the pouring of the floor. A limited amount of rib concrete at the crown in the interior ribs was temporarily omitted to permit the splicing of these ribs. This method of construction and erection obviates dead-load stresses due to rib shortening in the interior ribs which act as three-hinged arches under the dead-load; it also makes it possible to develop a considerable amount of initial stress in the steel in addition to its stress as reinforcement, a result which cannot be accomplished with rod reinforcement. In fact, the amount of initial stress per square inch thus obtained in the steel rib reinforcement is fully as great as the total stress per square inch which can be caused in rod reinforcement by the loading, and which cannot be greater than the unit stress in the concrete adjoining the rod multiplied by the ratio between the moduli of elasticity of the steel and of the concrete.

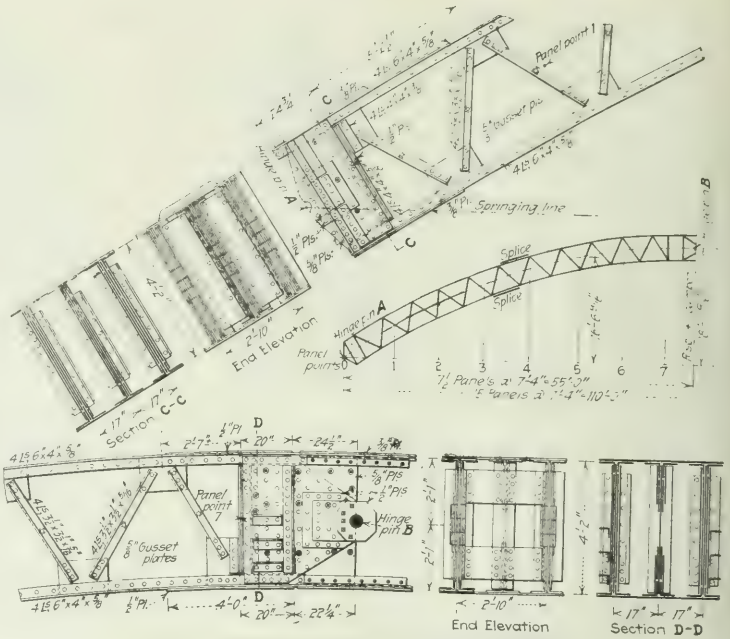


FIG. 4 DETAILS OF ARCH RIB REINFORCEMENT

The working stresses established for the design for live, dead, impact, and temperature stresses were 16,000 lb. per square inch in steel and 600 lb. per square inch in concrete. The actual maximum stresses in the various ribs were kept in close conformity with the above requirements. For example, in one of the ribs of the longest span the maximum stresses are as follows:

Steel.—Construction stresses due to weight of rib and forms	9,820 lb. per sq.in.
Stresses due to remaining dead load, live-loads and temperatures	7,570 lb. per sq.in.
Total maximum stress in steel	16,390 lb. per sq.in.
Concrete.—Maximum stress	593 lb. per sq.in.

The stress due to the loading in rod reinforcement at this particular section could not have exceeded 593 lb. multiplied by the ratio between the moduli of elasticity of steel and concrete, or say $12 \times 593 = 7{,}200$ lb. per sq.in. approximately. As a matter of fact, it would have been somewhat less than this owing to the reinforcement being located a short distance in from the extreme fiber. Hence the economy of material due to the use of the above type of structural steel rib is apparent.

Inasmuch as the steel ribs would cost more per pound than rod reinforcement, it was necessary in order to determine the relative economy of the two types of reinforcement to make comparative studies of the relative cost of ribs reinforced with rods and ribs reinforced with riveted members such as those used, due allowance being given not only to the additional cost per pound of steel ribs, but to the saving in falsework and the reduction in the cost of the piers due to the lesser weight of the ribs. These studies showed a marked saving for the steel rib type; they also showed it to be economical to make each rib in any one span constant in cross-section for its entire length, hence the maximum fiber stress at the different sections varies somewhat. An additional and important argument in favor of this type of ribs was the anticipated rapidity and easiness



FIG. 5 SPRINGFIELD BRIDGE DURING CONSTRUCTION

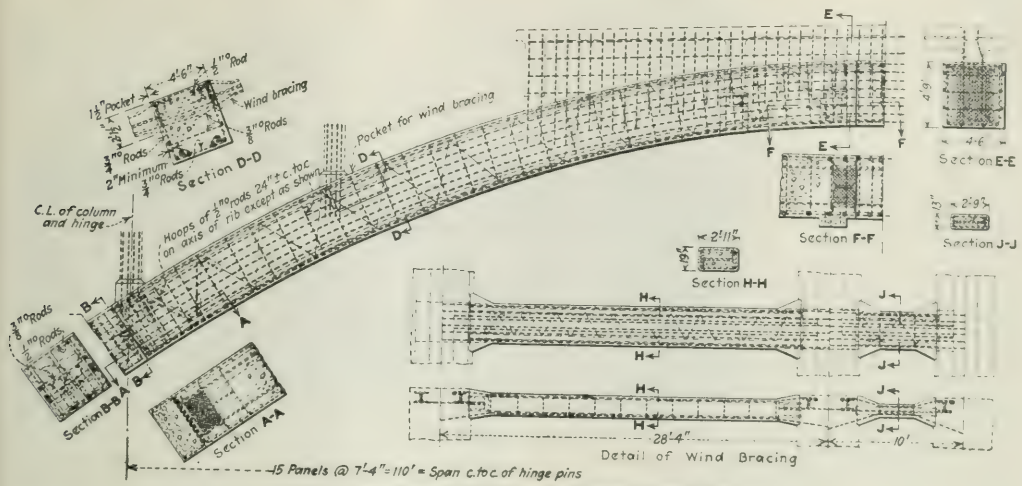


FIG. 6. CONCRETE COVERING TO STEEL AND RIBS

with which such ribs could be erected and the consequent lessening of danger to the permanent structure from floods and ice, an important factor in the Connecticut River. There was also the further advantage of simple connections to end hinges and of definite location of the reinforcement with respect to its position in the arch rib. These anticipations were fully realized during construction.

In determining upon the live-loads to be used in the design, the specifications of the Massachusetts Public Service Commission for bridges carrying electric railways were followed. The minimum requirements of the specifications provide a train of two 50-ton trolley cars coupled together, but they also provide that where steam road freight cars or express or other cars weighing more than 50 tons are to be operated, trains of two 75-ton cars shall be used in the design. In view of the permanent and substantial character of this bridge it was considered desirable to provide for the heavier cars, and these were used. Other provisions of the specification for live-load stipulate a uniform load of 100 lb. per square foot on roadway, or a 20-ton motor truck having 6 tons on one axle and 14 tons on the other axle; 100 lb. per square foot on sidewalks; and for the arch ribs 100 lb. per square foot for floor surface of spans 100 ft. or less and 80 lb. for spans of 200 ft. or over and proportionately for intermediate spans. Impact varying with the loaded lengths was also used. The temperature variation was assumed as plus or minus 40 deg. F.

Reinforced-concrete wind bracing was provided between the ribs in the form of horizontal struts but the wind stresses produced in the ribs were neglected in proportioning these members as these stresses were extremely small.

No direct allowance was made for stresses caused by shrinkage of the rib concrete during setting. Such shrinkage of the concrete would tend to bring it into tension and to cause some compression in the steel ribs, but this shrinkage would have no material effect upon the reactions since it would occur while the rib was acting as a three-hinged arch.

Since the rib axes are parabolas and the ribs are of constant cross-section, the rib stresses due to live- and dead-loads are practically constant throughout under full loading and while the maximum live stresses



FIG. 7. ARCHES BEFORE AND AFTER CONCRETING

do not occur under full live-load, the difference between the maximum live stresses and the live stresses under full load was not found sufficient to warrant the additional cost in labor in making the ribs of variable cross-sections. The application of partial dead-load to the rib during construction caused stresses in the diagonals which disappeared when the arch rib was completely poured. Consequently, except for the condition existing during construction, the steel rib flanges act in the same manner as longitudinal reinforcing bars in the ordinary reinforced-concrete member, the diagonals serving as shear reinforcement. In order to reduce the construction cost, all ribs throughout the bridge were made of equal width, the ribs in the various spans varying in depth in proportion to the span length. The size, number and proper lateral spacing of the ribs to permit conformity with these conditions and at the same time to secure approximately equal strength were carefully investigated and the ribs spaced accordingly.

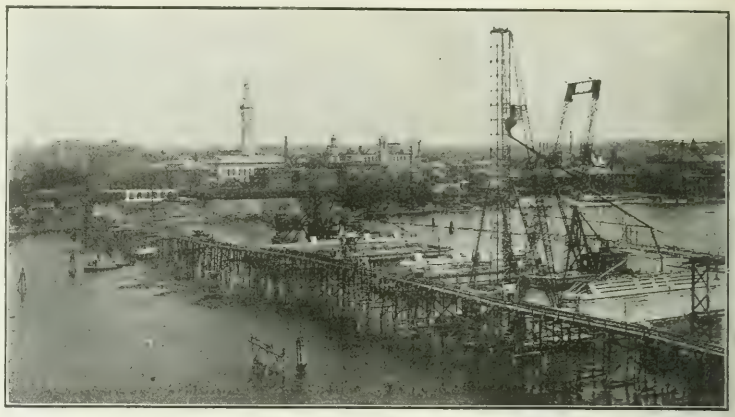


FIG. 8. CONSTRUCTION TRESTLE AND CHUTING TOWER BARGE AT WORK

The roadway is to be paved with granite block. The bridge provides for a double-track street railway and

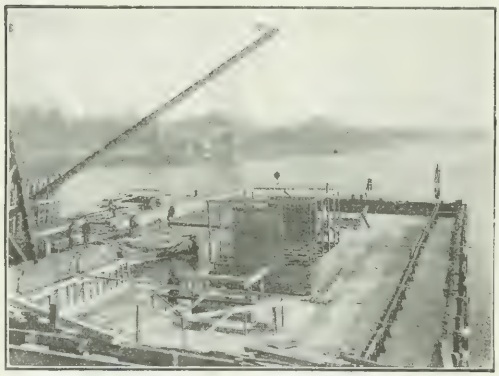


FIG. 9. BUILDING ONE OF THE RIVER PIERS

for sixty lines of ducts. Opportunity is provided for gas mains to be installed on the under side of the deck slab and for a water main when that may be required. The sidewalks are to have a granolithic finish and the curbs are to be of granite. A special feature is the provision of snow manholes near each end. These are in the roadway, easy of access for trucks, and are to be used in dumping snow taken from the city streets directly into the river beneath, thereby providing easy disposal.

Design of Viaduct Approach.—The viaduct over the railway yards at the east consists of nine spans 31 ft. long in the clear giving room for two tracks in each span. The piers in the bulk-freight portion of the yard are to be four-column bents permitting the passage of vehicles between the columns. Other piers are to be solid to a point above the tracks with small arches supporting the viaduct floor slabs.

Construction Plant and Methods.—For construction, a temporary trestle was driven just upstream of the bridge connecting with the concrete plant on the west shore. At this plant crushed stone and sand are delivered by trolley from a trap rock quarry 11 miles away, and some sand is obtained by dredging from the river at the site, this latter sand being screened just outside the concrete mixer plant. Concrete is mixed in a ¾-yd. batch mixer and carried across the trestle in a train of two or three cars of 50 cu.ft. capacity, which are dumped into the receiving hopper of a chuting plant mounted on a lighter. This tower chuting plant moves up and down alongside the trestle and serves as a flexible link between the trestle and any place where concrete is to be poured.

Concrete of variable composition is being used, the requirements being varied from 1:1 with ¼-in. aggregate which is used as a dry mixture for the surface finish to a 1:12 with a ½-in. aggregate used for filling around the conduits. The major part of the work is 1:6 mix with a ¾-in. maximum aggregate for superstructure work and 1:7½ with a 2½-in. maximum for substructure and piers. Tests showing a compressive strength of concrete at 28 days averaged about 2,260 lb. per square inch for the superstructure.

In the construction of the piers the piles were driven on 2-ft. centers with a steam hammer to such a penetration as to carry a load of about 16 tons. In all 10,500 piles were used, varying from 700 in pier 1 to 2,263 in each of the channel piers. The length of piles varies from 20 to 40 ft. and they bring up on a solid stratum. The cofferdams as shown in some of the views, were of 6-in. grooved and splined sheetpiling driven around each pier after the bearing piles were driven. This sheetpiling was of Douglas fir from Washington and was about 36 ft. long. Concrete was placed on top of the piles through the water by means of bottom-dump buckets up to about 7 ft. below water, when a cofferdam bracing of heavy timber was placed. The water was then pumped out from inside the cofferdam, the top of the concrete placed under water cleaned off, a leveling course of concrete placed, and the laying of granite facing started, the average head of water against the cofferdam being about 10 ft.

An important feature of the project was the program of erection and of concreting of the arch spans, which was incorporated in the specifications and rigidly adhered to during construction. This program was worked out with great care to prevent, during construction, the occurrence of unbalanced thrusts on the piers in excess of those contemplated in their design.

The bridge is being built by Hampden County, under the direction of the County Commissioners. The de-



FIG. 10. STEEL RIBS IN PLACE ON ONE ARCH

signing and supervising engineers are Fay, Spofford & Thorndike, of Boston, with George L. Mirick, construction engineer, and C. A. Farwell, as resident engineer, Haven & Hoyt of Boston, have served as advisory architects. The contract is held by H. P. Converse & Co. of Boston, with G. A. Follett as superintendent. The steelwork of the arch ribs was fabricated and erected by McClintic-Marshall Co., of Pittsburgh.

Wheel Hoists at English Engine Terminals

Hoists and drop-tables of types unusual in this country for the removal of wheels and axles from locomotives under repair are described in a recent number of the *Railway Gazette*, London, by W. Land, district locomotive superintendent of the Midland Ry. The hoists or sheer legs are three- or four-leg triangular steel towers spanning a track in the yard or engine-house and having a heavy tackle suspended from the apex. The hoist is operated either by hand or power. With the locomotive blocked in position, one end is raised until the frame pedestals are at sufficient height to enable the desired axle and pair of wheels to be run out. This method would not be applicable to very large or heavy engines. The other method consists in the use of a drop pit with platform elevator, the platform normally forming a part of the repair track and being suspended at the corners by cables from a rectangular frame or tower which is high enough to enable it to pass through it. The engine is placed on the track with the wheels to be removed standing on the elevator. When the pedestal connections are removed, the elevator is lowered, carrying the wheels with it. Two horizontally sliding platforms are then run out from the sides of the pit, so that the engine can be removed, either on its own wheels or on shop trucks. When these platforms have been returned to their recesses, the elevator brings up the wheels, which are then moved along the track to the machine shop.

How Grit Chambers Work at the Worcester Sewage Plant

By Ray S. Lamphear
Supervising Chemist, Sewage-Works, Worcester, Mass.

THE function of grit chambers at sewage-works is generally well known but data concerning their operation are meager. The grit chambers at Worcester consist of two units, each rectangular in section, 40 ft. long, 10 ft. wide, and 9 ft. deep to the normal water line. The pit section is 6 ft. deep and the normal flow channel 3 ft. deep, while the dividing wall is 10 ft. high, or 1 ft. above normal water level. The inlet and outlet channels are 3.5 ft. wide and 4.4 ft. deep; the gates are of approximately the same width and height, and are lifted by hand by using a lever in connection with a gear and rack at the center of each gate. A gravel drain, about 8 in. deep, was provided in the bottom of each pit to carry the water to an outlet gate, but proved impracticable in use so that dewatering of the deposit has been done by digging sump-holes in the deposit at the ends of the pits and using diaphragm pumps.

At the time of the construction of the chambers, in 1904, the outfall sewer was 42 in. in diameter; in 1915, the present 72-in. sewer was placed in operation without alteration of the chambers. Large storm flows result in an approximate water depth of 12 ft. in the chambers, the dividing wall and the gates being submerged.

Velocity of Flow. — The velocity of flow of sewage through the grit chambers should be about 1 ft. per second and slightly less when storm flows occur. A theoretical velocity of 1 ft. per second is attained when the rate of flow is 1,000,000 gal. per hour but the entrance velocity and the pit section tend to change this figure and observations indicate that the actual average velocity is greater than 1 ft. per second at this rate of flow, especially in the inlet half of the chamber.

Operation.—One chamber is generally used and the second placed in operation as the increasing rate of flow, due to storm water, approaches 1,000,000 gal. per hour, and both are continued in use until the flow decreases to nearly normal.

Operation as concerns period of service between cleanings has been influenced by two factors: Cleaning by hand labor and by the use of an auto-crane, generally used on sewer construction and moved to the chambers for the purpose of cleaning both chambers on successive days. In the first instance, the chamber must be entirely filled with grit material and in the second, while such condition is of advantage, it is not an absolute necessity.

Experience has shown that grit chambers should always be cleaned after sewage has been passed through them for some hours and not after the chamber has been cut out for some time. In the latter case, soft deposit, with rare exceptions, is found on top of the grit and interferes with dewatering and removal of the deposit.

Deposition of Material.—Deposition of some organic matter is bound to occur during the early morning hours and on Sundays, when the sewage flow is small. As grit accumulates, much of the softer material is displaced and, when the chambers are to be cleaned by hand labor, operation must be continued until practically all of the soft deposit is forced out by the

heavier material. Frequent measurements of the depth of deposit indicate the character of the deposit and the gradual accumulation of heavy deposit from the inlet to the outlet end of the chambers. The entire length of the chamber is used even though the entrance velocity is great, but on account of sudden changes of velocity there are so-called pockets in the deposit close to both gates.

Quantity of Deposit. — Previous to the use of the larger outfall sewer, the average quantity of deposit removed per million gallons of sewage passing was about 2.4 to 2.7 cu.ft. Since 1915, the average quantity of deposit has varied from 1.4 to 2.2 cubic feet per million gallons of sewage. The decrease is explained by the increased proportion of storm flow, carrying no grit, which now comes to the plant and formerly was discharged at an overflow located at the entrance to the smaller outfall sewer. A by-pass to the river is used when the rate of flow exceeds 54 m.g.d., and while some grit does not enter the chambers, all first flushes of storm-water flow pass through the chambers. The rate of accumulation of deposit necessarily varies with the number and character of the storms and the season of the year. During the spring of the present year, the deposit accumulated at a minimum rate of 1.5 cu.ft. per million gallons and during the past two months [written Nov. 16], it accumulated at a rate of 4 cu.ft. per million gallons of sewage.

Character of Deposit. — The proportion of mineral matter in the deposit is usually about 75 per cent; of volatile matter, 25 per cent. As dewatered for hand labor cleaning, the moisture content is about 35 per cent. The nitrogen content is usually about 0.5 per cent. Generally, a considerable quantity of rags, tin cans, balls and small metal pieces of various character are found. Purses containing money and a perfectly good Waterman Ideal fountain pen have been found, while rings have never been noticed although frequently being reported as lost.

Grit May Be Used for Dikes or Roads

When the chamber has been allowed to become entirely filled, the material is suitable for dikes or roads but its odor is somewhat offensive and prevents its general use for road purposes close to dwellings.

Method of Cleaning Chambers: As stated above, two methods have been used for removal of grit. Removal of approximately 90 cu.yd. of deposit, or the contents of one chamber as measured in place, by passing to two stagings, then to the ground, a distance of 16.5 ft., and then into carts, requires a gang of 10 men, including the one at the dump. A haul of about 900 ft. requires the use of two double carts. Considerable difficulty has been experienced with labor, especially during 1918 and 1919, on account of the heat and odor.

With the exception of one cleaning of each chamber, an auto-crane, having a ¾-cu.yd. clam-shell bucket, has been used for removal of the deposit since October, 1919. The labor, other than the two men with the machine, is reduced to four men. Three teams are used and the time required for cleaning one chamber is reduced from about 14 or 15 hours to 6 or 7 hours. This method is quicker and cheaper and indicates what permanent mechanical equipment would accomplish. The machine is not especially fitted to the present lay-out and shrubbery interferes with its proper location.

The objection to special mechanical equipment for cleaning grit chambers is the investment required for an installation which would be used comparatively little. The interest on the investment and the depreciation of value of the equipment tend to make the cost of cleaning fully as much as by hand labor. Where grit accumulation is rapid, and frequent cleaning is required, mechanical equipment would result in a decreased cost of cleaning grit chambers as compared with shoveling by hand.

Cost of Removal of Deposit. — In 1914, the cost of cleaning, based on 90 cu.yd. per chamber, varied from 45 to 55c. per cubic yard; in 1919, the same figure varied from $1.15 to $1.30. Later in the year, the chambers were cleaned with the auto-crane for approximately 60c. per cubic yard, including the charge of $1 per hour for the machine without operator and fireman.

COST PER CUBIC YARD OF CLEANING GRIT CHAMBERS AT WORCESTER SEWAGE-WORKS, 1920-1921

Date	Dec. 4-6	Jan. 31-Feb 1	Apr 27	May 14	July 21-22
Getting chambers ready	$0 07	$0 23	$0 26	$0 28	$0 05
Labor	27	20	1 23	1 15	26
Teams	28	35	46	50	31
Auto-crane and 2 men	19	23			22
Total	$0 80	$1 00	$1 95	$1 93	$0 86

The cost of cleaning may be divided into three or four parts, and those of the present fiscal year are given in the accompanying table on a cubic yard basis.

The cost of dewatering the grit deposit shows considerable variation, due principally to the available labor and time which can be given to it. In April and May, the chambers were cleaned without the auto-crane and the expenditure shown was none too great. The charge of 23c. in January as compared with 7 and 5c. in December and July is explained by the reason that the chambers were cleaned when not entirely filled with grit deposit. This was done to facilitate moving the auto-crane to the chambers during favorable traveling conditions. This charge accounts for the increased cost of cleaning as compared with the other two machine cleanings.

The data indicate the considerable reduction of cost of cleaning of grit chambers that can be effected with mechanical equipment. Provision of proper draining facilities, such as protected gates in the side walls, equipment especially suited for the work and a short haul to a point of disposal, would result in a further reduction in the cost of cleaning. It is known that the time consumed in cleaning a chamber with the auto-crane is excessive for it has been impossible to have carts always waiting to be filled. The cost per cubic yard of cleaning the chambers with proper facilities should be reduced fully 50 per cent.

A Large Rotary Sewage Sprinkler

An electric motor-driven rotary sewage sprinkler covering a bed of 200 ft. in diameter at Chichester, England, has been replaced with an automatic rotary distributor which covers 180 ft. of the diameter of the bed. The original sprinkler, according to a statement attributed to F. J. Lobley, city surveyor of Chichester, by London *Municipal Engineering*, was "not satisfactory and was worn out." The new distributor was installed by the Ames Crosta Sanitary Engineering Co. of Nottingham, England.

Notes on Canal Projects in Southwestern Germany

Status of Rhine-Danube Section of Baltic to Black Sea Route—Hydro-Electric Projects Linked with Canalization

By Karl Haller
Doctor of Engineering, Langenau in Wurttemberg, Germany

FOR SCORES OF years, there have been persistent endeavors in Southwestern Germany to effect a water connection between the Rhine and the Danube. At present, it is expected to achieve this purpose in a double manner. As the map in Fig. 1 shows, this can be partly done by the canalization of the Main between Frankfort and Werenfeld and also between Schweinfurt and Bamberg by the so-called Bavarian Line, and in the south, it can be done partly by the canalization of the Neckar through Baden and Wurttemberg.

This map shows that for large-vessel traffic along the Neckar Line, the original bed of the river may be used from Mannheim as far as Plochingen. From Plochingen to Ulm and from Ulm to Regensburg and Friedrichshafen, special canals have to be built to handle ships of 1,200 tons.

For the economic life of Baden and Wurttemberg, the Neckar-Danube Canal project is of the greatest importance as these two sections of southwestern Germany have no sources of supply of coal of their own. It is particularly because of the lack of coal in this section of the country that the utilization of the Neckar and the Danube for purposes of power generation forms the main purpose of consideration in connection with all these projects. The conditions for hydraulic power generation are here very favorable. According to the report made by Dr. Eng. Boehmler of the Gruen and Bilfinger Co., on the section of the Danube River between Ulm and Kehlheim, 800,000,000 kw.-hours can



FIG. 1. PROPOSED CANALIZATION, [illegible]

be developed. Equally favorable are the conditions on the Rhine-Neckar Canal route between Mannheim and Ulm. The Rhine at Mannheim is 90 m. and the Danube at Ulm, 464 m. above sea level. The mean flow of the Neckar between Mannheim and Plochingen of average water level is 58 cu.m. per second with a fall of 157 m. from one end to the other of that stretch of the river. If this fall be utilized fuller one may expect a development of 70,000 hp.

In designing the power-generating stations, the prevailing rule in Germany, which is to concentrate large heads of water at a few points rather than to utilize numerous small water falls, has been made use of.

An increase in the utilization of water power far above the usual amounts can be achieved by the following measures: (1) By making the head of water fall in each stage as high as possible. (2) By decreasing the head losses in the weir canals wherever these have to be put in. (3) By designing the power plants to handle larger amounts of water, even when these are available only for periods of 100 to 120 days during the year. (4) By inter-connecting the power plants. (5) By the installation of so-called "day reserve basins."

Arranging the water falls in high stages is desirable also from the shipping point of view as this makes for longer trips and fewer sluices as well as smaller losses of water and time at the locks. In order to reduce to the minimum the head losses in weir canals, an effort is made to make the canal walls smooth, and wherever possible, to cover them with concrete.

When large supplies of energy are concentrated in the hands of a single enterprise, considerable advantage is derived from the fact that the various power requirements by different consumers can be appropriately and

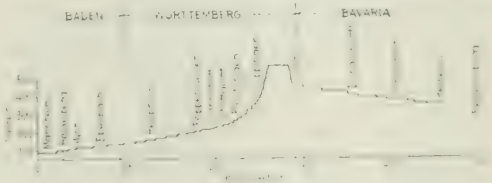


FIG. 2. CANAL PROFILE, MANNHEIM TO REGENSBURG

economically regulated from the point of view of time and volume of demand and also that the stand-by steam plants may be handled in the shape of a few big units.

In order to utilize fully the available water supply for purposes of power generation, it is desirable that as a rule the excessive night flow be utilized. The water that would otherwise run away at night is to be collected into a day reserve basin and be used as an additional supply to the general river flow during the day. Tests with such day reserve basins carried out at the Poppenweiller power plant near Stuttgart have shown entirely satisfactory results.

Fig. 2 shows the longitudinal profile of the Rhine-Neckar-Danube canal which brings out the very steep rise over the Swabian Alps, where it is intended to construct a canal 23 km. long, while another solution proposes the piercing of the Massive of the Alps by a ship tunnel 24.5 km. long. In order to overcome the head in the locks, which may be as high as 30 m., special "dividing sluices" have been provided. This type of sluice is not only easily adaptable to all kinds of terrain but can be applied to very bad underground conditions. The reduction of machine parts with this type of construction is of such material advantage that the new type becomes preferable to the old established chamber lock.

As regards the cost of construction of the Rhine-Neckar-Danube canal, it has been estimated at 2,000,000,000 marks for the stretch as far as Plochingen. It is a question yet whether the necessary means for building this canal may be secured owing to general economic conditions. So far, only 50,000,000 marks have been provided for its construction so that the first work, which will be undertaken this spring will be

in Wurttemberg where the construction of the power plant Horkhein at Heilbronn will be begun.

In view of the fact that the construction of the Neckar-Danube canal is of vital importance for the future development of the economic life of southwestern Germany it would appear that foreign capital would find in this enterprise a safe investment opportunity.

Main Project.—As the writer was in charge of construction of one of the sections of the Main canalization, something might be said here as to the execution of this engineering undertaking, carried out during the World War.

The damming works executed consist of a ship sluice to handle vessels up to 1,200 tons, a roller weir, a power plant and a raft chute 300 meters long and 12 meters wide. The latter was considered necessary because of the large amount of Bavarian timber rafted towards the Rhine. Besides the raft chute there are in the weir plant two more side openings each 30.61 m. wide and the ship passage, 40 m. wide. The left shore raft chute is closed by means of a rotary weir. Iron roller weirs have been adopted for the other weir locks.

The hydro-electric power plant, which contains four vertical Francis turbines, is set parallel to the river flow, to economize shore location. Each of these four turbines delivers 590 hp. at 30 r.p.m. with a head of 1.80 m. and a flow of 30 cu.m. per second.

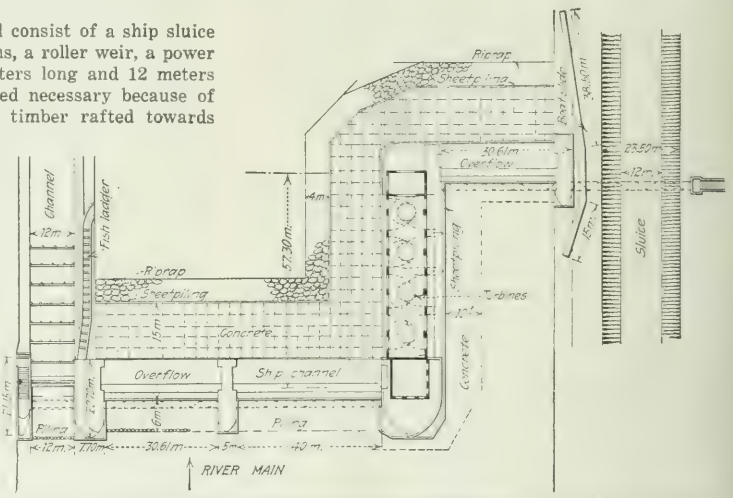


FIG. 3. PLAN OF ENTIRE INSTALLATION AT MAINKUR DAM—MAIN PROJECT

The sluice on the right-hand shore has a width at the bottom of 12 m. and is of the tug type. Into the sluice dam has also been built a "boat slide," through which the small boats are passed. Their construction is simple, being essentiaaly the placement of two oak beams held by bolts into a concrete foundation 50 cm. thick. As the end surface of the boat is kept smooth by the action of the water, the boat on the "boat slide" can be easily carried over by manual labor.

Both slopes of the dam are paved. The sluice walls are lined with smoothly worked stone squares and the sluice bottom is paved to the length of the lock heads. In order to provide for a certain amount of buoyancy there were used at the upper lock separate concrete prisms built in place. The individual prisms are held together by means of small iron plates that move vertically in slots, permitting a vertical freedom of motion to the concrete bodies themselves.

A plan of the entire installation of the works at Mainkur is given in Fig. 3. Both the forward walls (6 m. wide) ahead of the dam rollers, and the storm walls (15 m. wide) back of them, as well as all the single piles, etc., are all built between sheetpiling.

The proportions of the concrete were for the foundations of the turbine columns: 1 part cement, ½ part trass, 4 parts sand, 8 parts gravel; for reinforced concrete 1 part cement, 2.5 parts sand, 5 parts gravel; for packing, 1 part cement, 3 parts sand; for front and storm walls at the weir, 1 part cement, ½ part trass, 5 parts sand, 9 parts gravel; for all the other structures 1 part cement, ½ part trass, 4 parts sand and 8 to 10 parts gravel. All concrete was machine mixed and tamped with compressed air ramming machines. The paved bays of the front and storm walls were put up 3 x 3 m. wide; at the edges, strips of asphaltic roofing paper were set into the expansion joints. On the concrete foundations (50 cm. thick) of these weir walls was set a sandstone paving, 35 cm. thick, with here and there courses of headers. The paving was placed with a 1:4 cement-mortar mixture set into fresh concrete. The raft chute on the left shore had both the slopes and the bottom protected by paving, 35 cm. thick set on a 1:4 cement-mortar mix over a ballasting 25 cm. thick, in addition to which on the bottom, 12 m. wide, there were set, 5 m. apart, heavy wooden sills, attached by bolts to piles driven into the soil.

The construction was not free from unpleasant surprises. In December, 1916, as a result of sudden thaws in the Bavarian forests in the upper reaches of the river, the river rose with such rapidity that at the end of the fourth day the sheet piling located upstream was submerged. The water continued to rise until the pile planking with which the trenches were cut off from the stream was also broken through. What the high water did not destroy, was made away with by the following ice floe which enlarged the breach made by the water. The wooden framework inside of the steel piles prevented the complete destruction of the work. Only after numerous difficulties had been overcome, and six months of time lost, did it become possible to close up the trench, and start work anew. Though much of the work was done during the war, the power plants were not put into operation until 1921. The sluices have been in operation since 1917.

Health Investigations in French Cities

Under a recent order to the French Minister of Health sanitary assemblies of towns and communes in which the 1920 general death rate was in excess of 17.2 per 1,000 are required to make investigations designed to show the reasons for the excessive death rate and to report what steps have been taken for its reduction.

How Practising Engineers May Sell Their Services

Methods of Securing Clientele and Increasing Business Discussed in Two Papers (Abstracted Below) at the Conference of Practising Engineers, Held in Chicago Feb. 22, under the Auspices of the American Association of Engineers

Reaching the Prospective Client

By Paul E. Green
Consulting Engineer, Chicago

MOST of a practising engineer's success is due to his ability to sell his services. Quite frequently the men who decide to enter private practice have no experience in selling their services and have inadequate capital. It is my opinion that a two-man engineering firm needs a cash capital of not less than $15,000 to handle $25,000 to $30,000 of professional work per year.

Sources through which professional work may be secured may be classified as follows: (1) Other engineers; (2) municipal, state, county and other political subdivisions; (3) private corporations; (4) individuals. From other engineers work is secured because of a good reputation with them. This is a most satisfactory way in which to receive work. It comes only from extensive acquaintance secured by joining technical societies and taking active part in them, by contibuting articles to the technical press on the specialities with which the engineer is best acquainted, and by personal acquaintance socially or through common employment.

Municipalities, which are probably the most prolific source of work, are approached in various ways. Even in the large city the city engineer often has little to say as to the selection of a consulting engineer, who may be employed by a council committee or a lay commission. Frequently this work is secured by direct solicitation.

Direct Solicitation Necessary—Even a prominent engineer often is unknown to the public. In spite of the fact that he has been active in a technical society, has contributed to the technical press and is well known to the men of his profession, it is necessary in two cases out of three for the firm and individual to solicit directly, even in large cities. Certainly it is true with the smaller municipalities. Circular letters and similar advertising appeals are sent out by the thousands by various engineers. Every mayor and city clerk receives dozens of them each year. The percentage of replies is small. We have found that circular letters sent out in lots of 2,000 and 3,000 brought less than 0.5 per cent of replies. When accompanied by self-addressed envelopes and in normal times, the replies were about 10 per cent, of which 90 per cent stated that there was nothing doing. However, some direct results are obtainable and it is an important method of securing advance tips on work.

Clipping bureaus, advance reports and similar methods of getting information as to prospective work, we have found, do not pay for their cost, since the items were too late for the engineer. Articles contributed to the technical press form one of the most valuable means of reaching the prospective client, both city officials and employing concerns.

Work for private corporations is a highly desirable field and often requires solicitation, though not to the same extent or of the same character as is required with municipalities. Once secured as a client, the corporation seldom looks elsewhere. It is, however, more difficult to get advance information from private corporations and much of the work is given out as the result of acquaintanceship and technical reputation. Private individuals from time to time have considerable work, but not much of this can be secured by solicitation. It comes largely because of acquaintanceship and a considerable amount of this work is secured through the friendship of the higher class of contracting supply men.

No tip should be ignored. Nine out of ten are worthless but the tenth may be very much worth while. A source of work which is quite valuable as the age of a firm grows is from previous employees. If they have departed in good feeling and have a respect for the firm they are a valuable source of information. This illustrates the fact that a successful organization is successful partly because it treats its employees in the highest and best manner.

One of the most important points in selling engineering services is the character of the work performed. At least 50 per cent of the firm's clients will have additional work to do after a season or two. In the municipal field this does not mean that the old firm will always be re-engaged but if your work is well and conscientiously done, when the time comes around for additional work you will get it often without competition. If friendly relations are maintained with municipal officials they frequently will tell of other work. Various state departments from time to time have employment for the consulting engineer in water supply, highway and paving work, sewage disposal, drainage and hydraulic developments. They also, because of their activities, recommend considerable work of this kind to other political sub-divisions of the state. By keeping in touch with these departments a line is frequently had on prospective work.

One difficulty which the engineer in private practice meets is the general confusion in the public mind as to what "engineer" means. Very frequently the layman considers that an engineer is a builder or contractor. The same confusion does not exist with the word "architect." It would seem as if a campaign to educate the public along this line would tend largely to increase the field for the practising engineer.

Personal Contact—No campaign for professional work will be of any great benefit if it is not followed up by close personal contact. Very little work which is not the result of recommendation by another engineer or another client can be secured purely through correspondence. I lay this down as a fundamental principle based on the result of years of experience. From time to time there enters the unexpected employer, such as the attorney who wishes expert services for court work, the promoter who wishes to develop some idea along engineering lines or the club member who is confronted by a problem. Most of these come without solicitation and as a result of personal contact which had nothing to do with engineering. Work from such sources increases as years go on and much of it comes from a genial interest in the other man's affairs.

A final source of employment, not unimportant, is that which may be developed through political activity in its better sense. Other professional men have done much of this, with an increase in prestige. It would be well for engineers to take an active personal interest in politics, as members of party organizations.

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Advertising for the Practising Engineer

By Morris W. Lee
Vice-President, Frank B. Chase, Inc., Chicago

IN THE first place, what is advertising? Where does personal solicitation leave off and advertising begin? How can the practising engineer get business unless he goes after it in some way? Then what does he do to get business? He starts in by telling his friends and acquaintances that he has an office, is qualified to do certain work and would like some work to do. If he has a little nerve he takes a card or small space in an engineering paper. Advertising

in its best sense is disseminating by the printed word information about an article or service which is calculated to affect favorably the sale of that article or service. It is a tool, and its effectiveness depends upon the way it is used.

Should the practising engineer advertise; and if not, why not? Outworn codes of ethics, timidity, custom and the popular opinion gradually formed from these, seem to have set a limit to those who may advertise. But it is a wholly artificial limit. In discussions with engineers regarding advertising I have found no logical objection to it. Some of them say that strictly professional advertising becomes self-praise if carried beyond a simple statement of the service offered for performance. Some engineers say they prefer to let their works speak for them, but the same engineers countenance and even promote the publication of articles descriptive of their works, in order that they may be more widely known. Then why the great distinction between the text pages and the advertising pages of a publication? Doubtless it is because the text pages are supposed to be what others say of one, and the advertising pages what one says of himself.

The best test of whether advertising is ethical is the test of its truthfulness. If it states the truth, there is no justifiable objection to it. Only the statement of untruth is to be condemned, and this will fail of its own weakness in due course without other condemnation. It would seem logical therefore to agree that there is no sound reason from an ethical, moral or business standpoint why the engineer should not advertise.

Does Advertising Pay?—The proposition then narrows down to will it pay? That is a far more difficult question to answer. For many engineers it doubtless would not pay. For some who exercised the necessary skill, care and perseverance, it unquestionably would pay well. Some engineers can afford to continue in business until they can build up a reputation by word of mouth. But is it the best plan? Advertising is not merely buying space and filling it with type matter or sending out circular matter. It requires judgment, and there are far less specific data upon which to form that judgment than exist in engineering practice. First there is judgment required as to the proper monthly or yearly appropriations. Then the local, national or trade mediums to be employed; the method of approach, the selection of the ideas best calculated to produce the desired end, the choice of advertising agency, the style and wording of copy and use of illustrations.

In his advertising the engineer should start with a publication which he believes will reach most effectively his particular clientele. Let him use that publication intensively. For example, a paper mill engineer should start out in a publication reaching paper mill owners. The foundry engineer and the designer of textile plants should use appropriate mediums. The temptations will be great to spread out with small cards or small spaces in a large list of papers or directories, but this temptation should be resisted.

There is a great deal of direct-mail advertising being done nowadays, and much of it is productive. But this method of advertising has increased greatly in volume, so that to be effective it must be high class in character and distributed with discretion. This is only another illustration of the judgment required in advertising. Of course this judgment is developed, as in other fields, by the practical use of advertising and the observation of results secured.

Follow up Inquiries—So let the practising engineer or firm of engineers start out on a moderate scale. Let them state clearly the work they are prepared to do and why they are qualified to do it. Let them show specific examples of work well done and favorable comment on their accomplishments. If they place these announcements in reputable papers circulating among buyers of such engineering services as they supply they will get inquiries. Then let them go out on those inquiries and work like beavers to sell their services.

Popular opinion or custom seems at present to set curious limits as to who may or may not properly advertise; but as this becomes less arbitrary there will be more opportunity for the practising engineer to advertise himself. There is also a reticence among engineers about putting themselves forward and making their achievements known. Consequently the public at large talks loosely about "great engineering feats" as if they were merely manifestations destined to appear in the natural order of things and not the result of conscientious and often self-sacrificing application by many engineers to problems affecting the community or the race. Effective advertising by straight-thinking engineers would do much to remedy this and bring about a due recognition of engineering ability and value. It would thus be of substantial service to the individual engineer as well as to the profession.

Steel Rails Embrittled by Welding Bonds

DECIDED weakening of steel T-rails by attaching electric rail bonds by welding has been found, through tests carried out in connection with the development of a theft-proof rail bond for the Mexico City street-railway system. The tests were made by the Pittsburgh Testing Laboratory for the Canadian Engineering Agency, Inc., of New York, and indicate that drop-test results on rails with welded-on bonds are less than one-half as good as the results obtained with corresponding pieces of rail having no bonds attached.

Loss of exposed copper bonds by theft became serious enough on some lines of the Mexico system to make a concealed bond desirable. C. E. Winblad, of the

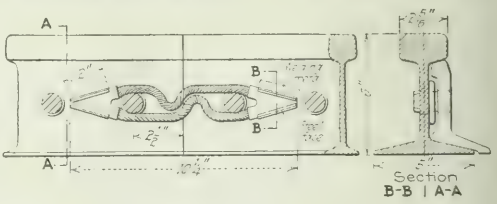


FIG. 1. STEEL-FACED RAIL BOND

Canadian Engineering Agency, engineer for the system, devised a bond of the form sketched in Fig. 1 herewith, comprising two strands of No. 0 copper cable connected at the ends by spear-shaped cast copper terminals faced along the outer edge with ⅛ in. of steel. The bond was designed to fit under the standard splice bar, passing around the bolts, and was to be attached to the rail web by means of electric arc welding of the steel facing to the rail metal. To determine whether this method of attaching a bond affected the strength of the rail, comparative drop tests were made on 4½-ft. lengths of the rail (70-lb. T-rail, 6 in. deep), under the standard drop-test machine of the American Railway Engineering Association specification (2,000-lb. ram with 15-ft. drop). Bonds were attached to about half the number of test-pieces, in some cases with one of the terminals at mid-length of the specimen, in other cases with the two terminals symmetrically placed with respect to the mid-length of the rail. No more welding material was used than would be considered good practice, the test report states, and the welding process did not heat the rail to a noticeable degree.

In the tests, the unbonded rail specimens broke on the third to fifth blow, while the bonded specimens broke on the first blow. In a second series of tests the height of drop was reduced to 10 ft.; the unbonded specimens broke on the fourth to fifth blow, while the bonded rails broke on the first or second blow.

Quite abnormal shapes of fracture resulted in the case of the bonded specimens, moreover. Fig. 2 here-

with, showing two unbonded and four bonded specimens, illustrates this point.

It was concluded from these tests that "serious injury is done to a rail by the welding process applied to its web," and the welded bonds therefore were not adopted

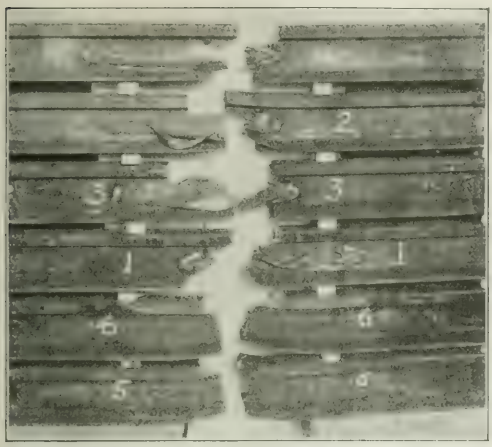


FIG. 2. DROP-TEST FRACTURES OF BONDED AND UNBONDED RAIL

for use. A form of bond passing under the splice and attached to head or base of the rail by welding may be adopted, however, as welding to the more massive parts of the section is not believed to injure the rail.

Rights of Trucks To Main Streets Upheld

An opinion was recently submitted by the Town Counsel of Milton, Mass., suburban to Boston on the direct line between that city and points north, and Brockton, New Bedford, Providence to the south. Certain citizens of Milton were much disturbed by the noise of big trucks which ran almost continuously through the night, using the streets of Milton simply as a thoroughfare. The selectmen of the town received a petition in which these citizens asked that the trucks be declared a nuisance and that the streets be closed to them, at least during the night hours. The jar and the noise were said to be so unpleasant as to interfere seriously with the rest of those who lived on these main highways.

The selectmen referred the matter to their counsel. He quoted a section of the general laws in which the selectmen of the town are given power "to make specific regulations as to the speed of motor vehicles and as to the use of such vehicles on particular ways, and may prohibit the use of such vehicles altogether on certain ways . . . provided . . . no regulation shall be valid which excludes motor vehicles from any state highway or from any main highway leading from any town to another."

The opinion went on to state that the clause last quoted would prevent the exclusion of motor trucks from this particular highway, since it was a main highway leading from one town to another. He stated also that although the statute is not express in the matter, an exclusion for a part of the day would be held to be prohibited by this clause.

Fast Loading of Motor Trucks Speeds Road Work

Moving Trucks Trip Measuring Box Gates Sand Washer Pump Operated by Fordson Tractor—Truck Turntables Used

AUTOMATIC charging of motor trucks while in motion cut down the hauling time on concrete road construction last season in Susquehanna County, Pennsylvania. One-batch trucks, serving a 21-cu.ft. mixer, were charged with sand and stone invariably in 10 to 12 seconds and on occasions were charged in 6 seconds. The average loading time was 8 seconds. With this quick loading outfit and a well organized gang at the mixer, over 500 ft. of road per working day was built.

Six miles of 18 ft. reinforced concrete pavement from New Medford to Hallstead were being constructed, according to the standards of the Pennsylvania highway department. Stone had to come in by railway but a pit about ½ mile from the New Medford end was developed for the sand. With a sand washer at the pit and the unloading plant and switch about a mile further



FIG. 1. PLANT LAYOUT AND PAVING SEQUENCE

on, as indicated by Fig. 1, the maximum haul was 4½ miles. With dry batch haulage by Ford trucks planned, it was decided to pave first the section from A to B, 2 miles, then the 1½-mile section from C to B and finally the 2½-mile section from D to A. This gave, for the long haul, two miles of paved road.

Loading and Hauling.—Particular effort was made to eliminate delays in loading and hauling. Ford 1-ton trucks with Lee bodies were chosen to haul the dry batch, 15 cu.ft. of stone and 10 cu.ft. of sand, to a 21-cu.ft. paving mixer. To load these trucks without backing and without stopping was the object sought, and measuring hoppers, one for sand and one for stone, which would be discharged automatically by the truck were the means adopted. One partitioned bin, 10 x 10 x 20 ft., at the railroad siding held 40 cu.yd. in the proportions of three stone and two sand. As shown by Fig. 2, hinged chutes from the bins discharge into two measuring hoppers with swinging gates. A sketch of one of these hoppers is shown by Fig. 3. The only unusual detail is the lever arm, rivetted to the gate, which the passing truck body engages as shown by Fig. 2, and swings the gate open. The truck did not stop moving when taking a load but of course it moved very slowly, tripping the gates in succession. Trucks brought the sand from the washer and the stone came

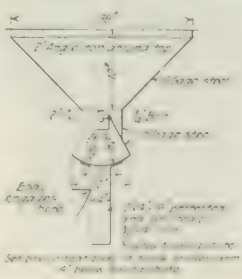


FIG. 3. SKETCH OF MEASURING BOX GATE TRIP

in by rail and both materials were handled at the bin by a locomotive crane and a ¾-cu.yd. clamshell. The operating force was a craneman and one man operating each of the bin chutes and two men in the cars.

On the long haul 16 trucks were operated; this number was gradually cut down to 3 trucks on the extreme short haul. One mechanic and assistant kept the cars in order, including tire repairs. One piece of equipment found very useful, was a Westinghouse locomotive type air pump and receiver installed at the bins to inflate the truck tires. It required an average of eight minutes from the time the truck entered the yard until it hauled out loaded. The trucks made over 20 miles an hour running light and about 15 miles an hour loaded. The grades were mostly 3 and 4 per cent with a maximum grade of 7 per cent. At the mixer it took a truck 30 seconds to turn on the turntable and 20 seconds to back up to the mixer and dump its load.

Sand Plant.—To wash the sand a portable crusher plant was remodeled by replacing the continuous bucket elevator with an intermittent bucket line and by installing a sand washer box of 200 tons capacity. Wash water was pumped from a brook 1,000 ft. away by a centrifugal pump, with 4 in. suction and 3 in. discharge, operated by belt from a Fordson tractor as shown by Fig. 4. The 3 in. line gave plenty of water for the required output of 150 tons a day. The sand was brought from the pit to the elevator by teams and slip scrapers because this outfit was available and unoccupied, but a drag line scraper outfit would, the contractor states, have been less expensive. The operating force was one foreman, one fireman, four laborers, one pump runner and three teams.

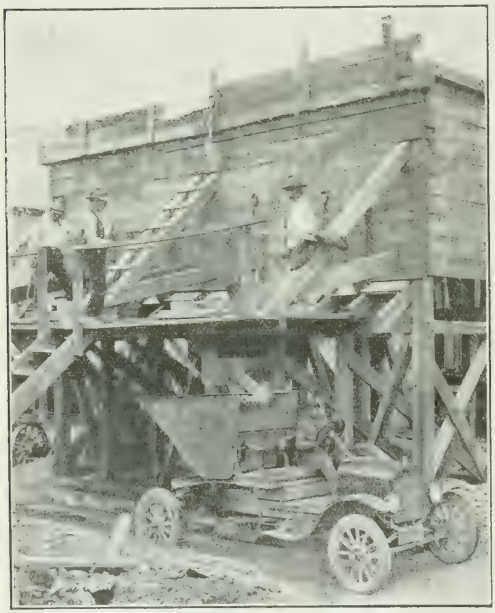


FIG. 2. MOVING TRUCK TRIPS HOPPER GATE

Paving Outfit.—A 21-cu.ft paving mixer, finishing machine, truck turntable and steel forms constituted the equipment on the grade. With the 21-cu.ft paver the output averaged 500 lin. ft. of 18 ft. 6-8-6-in. reinforced concrete pavement a day and reached a maximum of 561 ft. Cement was received in sacks and dumped directly into the mixer, using a five-bag batch.



FIG. 4. TRACTOR OPERATES CENTRIFUGAL PUMP

As the mix was 1:2:3, this gave five bags of cement, ten cubic feet of sand and fifteen cubic feet of stone to a batch. The cement was drawn to the road on a flat bottom truck and distributed in piles ahead of the mixer. The mixer crew consisted of two men handling the cement; one man handling the cement and dumping the trucks; a mixer operator and a fireman, and three men spreading concrete behind the mixer and placing steel reinforcing and expansion joints. The finisher required one operator, and there were two laborers to finish off the joints and the edge of the pavement. One man was used continuously to sprinkle water and in real hot weather two were required, one foreman and six men took care of the subgrade ahead of the mixer, while one foreman and ten men were required behind the mixer to move up the canvas, move up the forms and cover the concrete with dirt. The water for the concrete was furnished by two 3½-hp. engines; the supply was ample at all times.

The contractors were the H. B. Sproul Construction Co., Inc., Peekskill, N. Y., with H. M. Unangst as superintendent. H. D. Stoll, Scranton, Pa., was district engineer for the Pennsylvania Highway Department.

Road Building in Argentina

It is very probable that extensive road building will be undertaken in Argentina within the next two or three years, according to Commercial Attaché Edward F. Feely, at Buenos Aires. The Argentine Road Congress, to be held in Buenos Aires next May, will undoubtedly stimulate much interest, and it will be of advantage to American manufacturers of road-making machinery to watch closely the developments in Argentine road building.—*Commerce Reports.*

Second Railway Cantilever Bridge Over "Reversing Falls"

Canadian Pacific Completes New Crossing Alongside First Cantilever, Built 37 Years Ago—450-ft. Main Span

A NEW crossing over St. John River, St. John, N. B., has been completed by the Canadian Pacific Ry. It lies directly to the north of the first crossing, built in 1885, and like it is a cantilever bridge. These two structures, with the 565-ft. arch highway bridge built by the provincial government in 1915, form a cluster of three bridges spanning the St. John River at the narrowest portion of the gorge, close to the well known "Reversing Falls."

The older railway cantilever, at the rear in the accompanying view, originally was part of the undertaking of the St. John Bridge & Railway Extension, formed to connect the Inter-Colonial Ry. at St. John with the St. John & Maine Ry. at Fairville. In 1905 this connecting line was incorporated in the Canadian Pacific Ry. system.

The new cantilever has a main span of 450 ft. (as against 477 ft. for the old bridge); its underclearance is 2 ft. 7 in. greater than that of the old, on the length of the suspended span. As may be seen from the photograph its design differs from that of the old in having a horizontal top chord throughout, and parabolic curves for the bottom chords of the anchor and cantilever arms, while the old bridge has a horizontal bottom chord and inclined rectilinear top chords. The old bridge is now connected while the new one is riveted.

The main or cantilever portion of the new crossing is 700 ft. long, comprising two anchor arms of 125 ft., cantilever arms of 150 ft. each and a suspended span of 150 ft. Its steel weight is 2,000 tons. On the west or Fairville side is an approach consisting of eight plate-girder deck spans, each 70 ft. long out to out of steel.

Heavy steel members of I-section with enlarged bases resting on grillages, all imbedded in concrete, form the anchors of the cantilever. At the east end, excavation in solid rock was required for the anchorage, while at the west end a concrete pier was built. The anchor members were placed in shafts molded in this pier and subsequently embedded in concrete.



NEW AND OLD CANTILEVER BRIDGES OVER REVERSING FALLS, ST. JOHN, N. B.; CANADIAN PACIFIC RY.
Although of almost the same span, (450 ft. as against 477 ft., the two structures are markedly different each in outline and in make-up of members, the differences reflect the advance of bridge engineering skill in 37 years.

Solid rock projects below low water level from the river banks and forms shelves on which the main piers were founded. The piers, of concrete, are faced with granite up to high water elevation. The finish about 43 ft. above the surface of slack water.

Construction work was begun in April, 1920. By the following December the substructure was completed. Steel erection began in June, 1921 and was completed in October. On November 23 the bridge was opened to traffic. All the work was done under the general supervision of J. M. R. Fairbairn, chief engineer of the Canadian Pacific Ry. Co., P. B. Motley being engineer of bridges and C. F. Draper resident engineer on the work. The Foundation Co., Ltd., was contractor for the substructure, and the Dominion Bridge Co., Ltd., was contractor for the fabrication and erection of the steelwork.

Effects of Moisture on Behavior of Concrete

Tests Show How Plain and Reinforced Concrete Change in Volume Under Varying Conditions of Wetness

UNDER the title "A Study of the Effect of Moisture Content Upon the Expansion and Contraction of Plain and Reinforced Concrete" by Torata Matsumoto, the Department of Theoretical and Applied Mechanics of the University of Illinois has published a bulletin (Bulletin No. 126, Engineering Experiment Station) giving mainly the results of a series of experiments by Mr. Matsumoto, a Japanese engineer with some experience in harbor construction in Japan and later a graduate student at the University of Illinois, together with the deductions from these experiments and from experience, all setting forth some conclusions on the volume changes in concrete due mainly to moisture.

The purpose of the bulletin is well stated in the preliminary paragraph as follows:

To Investigate Internal Stresses

Purposes of Tests.—While the properties of concrete have been investigated for many years, attention has largely been given to considerations of strength alone. Studies of the less important properties, however, are also needed to explain phenomena that are observed in reinforced-concrete structures, and to give information on questions relating to the appearance and durability of the material.

Aside from the action of direct load, deformations are produced in concrete by changes in temperature and in moisture content. With reference to temperature changes in reinforced concrete, it is well known that, regardless of differences in the mixture, concrete has practically the same co-efficient of expansion as steel, so that the two materials contract or expand together. Moisture content, on the other hand, has the undesirable property of affecting concrete alone. Concrete, like wood, clay, and some other materials, expands when it absorbs moisture and contracts when it is dried; steel has no such action. After the concrete is poured the steel remains unchanged with changes in moisture conditions, while concrete ordinarily shrinks a considerable amount. Aside from the stresses set up in steel and concrete by the shrinkage of the latter, the resulting formation of cracks large or small will produce a condition which may be favorable to the corrosion of the steel or the disintegration of the concrete after repeated changes from dry to wet condition.

The tests which are described were made to investigate the amount of shrinkage which may be expected in a mortar or a concrete, the relation between the change of moisture content and the change of length of these materials, the difference in shrinkage of plain and reinforced concrete, and the internal stresses set up in the latter.

Tests were made on mortar and plain and reinforced-concrete pieces of acceptable material in different mixes and under different conditions of service.

The coefficient of expansion of mortar and concrete was measured for use in making a temperature correction of measurements. It was obtained from perfectly dried specimens only, so that there was no error due to the change in length with a change in moisture content of a specimen. The results obtained indicate that the coefficient of expansion of mortar and concrete is practically the same for different proportions and ages, provided that the same materials are used in all mixtures. The average values of the coefficient of expansion of 1:1, 1:2, and 1:3 mortar, and 1:1:2, 1:2:4, and 1:3:6 concrete, varied from 0.0000050 to 0.0000058 for one degree Fahrenheit, with no particular variation with the age or with the richness of the mixture.

Effect on Length of Specimen.—In investigating the effect of moisture content on the length of specimens, pieces 2 x 3 x 24 in. containing gaged steel plugs were made of different mixtures and subjected to different conditions of moisture storage. The deductions are as follows:

The amounts of change of moisture and length during the test are shown in the accompanying table. 1:1 mortar at seventy days contracted 0.025 per cent, notwithstanding the fact that it contained more moisture than its initial amount. From this phenomenon it can be concluded that the water which goes into the concrete may exist in two different ways, either combined with cement in a chemical compound or remaining in a state which affects the volume of the concrete. It also appears that concrete in which the total moisture content is kept constant for some length of time is liable to contract slightly. This slight contraction was observed on several occasions during the test. It follows that the absolute amount of contraction of concrete due to drying is indeterminate, because it depends upon the age of the concrete and the duration of the drying period. In general these specimens of mortar and concrete expanded when they were kept wet. The richer mixtures absorb more water and consequently expand more than the leaner ones. Mortar and concrete lose moisture rapidly when placed in dry air and the loss is more rapid in lean mixtures than in rich ones. In air storage the shrinkage is greater for mortar than for concrete, and with artificial drying the shrinkage is greater for the richer mixtures.

For the specimens tested, the contraction of mortar and concrete at a temperature of 150 deg. F., was 0.12 per cent for 1:1 mortar, 0.10 per cent for 1:2 mortar, 0.09 per cent for 1:3 mortar, 0.07 per cent for 1:1:2 concrete, 0.06 per cent for 1:2:4 concrete, and 0.06 per cent for 1:3:6 concrete. The amount of expansion when specimens were kept wet reached 0.012 per cent in 1:1 mortar, and 0.002 per cent in 1:3:6 concrete, at the end of 60 days. Judging from these tests, shrinkage of concrete in a structure freely exposed to the air may be as much as 0.05 per cent in a 1:2:4 concrete. In a structure such as a retaining wall or a road pavement, where one side of the structure is against a mass of earth, the shrinkage should be considerably less.

Rates of Absorption and Expansion

Phenomena of Volume Change.—From a further test the following deductions were made:

(a) Dry mortar and concrete expand as soon as they absorb water.

(b) The rate of absorption upon immersion is much less for the older specimens during the first two or three days of immersion, although the total amount of absorption does not change very greatly for specimens of different ages.

(c) The rate of expansion due to immersion is also less for the older specimens during the first two or three days of immersion. For longer periods of time the amount of expansion is nearly the same for all ages of each material; but in every case the expansion is considerably greater for mortar than it is for concrete.

(d) The amount of the expansion of mortar and concrete is small until an absorption of nearly 2 per cent is reached. After this point the expansion becomes nearly proportional to the addtional absorption of moisture. This holds true until a sudden decrease in the absorption occurs after one day's immersion, beyond which point additional absorption gives a greatly increased expansion.

(e) The absorption of moisture by mortar or concrete is much more rapid than the drying out of moisture from the same material. As a result, the expansion due to wetting is more rapid than the contraction produced by drying. For example, a mortar 7 days old gained as much moisture in 2 hours' immersion as could be dried out by heating to 150 deg F. for 24 hours.

Another experiment on the relation between absorption of moisture and expansion of concrete was made upon two specimens of 1:2:4 gravel concrete taken from a floor of the Western Newspaper Union Building in Chicago. The concrete was 9 years old. The sizes of the test pieces were 3.5 x 5 x 21 in., and 3.5 x 5 x 26 in. The specimens were dried for 13 days in an oven at a temperature of 150 deg. F. In drying, the average contraction of the concrete was 0.016 per cent for the two specimens. After immersion in water for 15 days the average absorption was 5.09 per cent and the resulting expansion 0.042 per cent.

Final Conclusions.—The bulletin then gives an analysis of the shrinkage stresses in reinforced concrete and a comparison of the calculated and measures stresses in some test pieces based on the experiments

TABLE SHOWING CHANGE IN MOISTURE CONTENT AND CORRESPONDING CHANGES IN LENGTH

Expansion and Contraction are given in Per Cent of Gage Length

	Kept in Wet Condition 60 Days		Kept in Air of Room 58 Days		Kept in Oven at 150 Deg. F 14 Days		Dried in Oven at 200 Deg. F 15 Days	
Proportion	Gain of Moisture Per Cent	Expansion Per Cent	Loss of Moisture Per Cent	Contraction Per Cent	Loss of Moisture Per Cent	Contraction Per Cent	Loss of Moisture Per Cent	Contraction Per Cent
1:1	1.46	0.0124	0.26	0.0460	3.92	0.1204	4.54	0.1570
1:2	1.14	0.0100	0.71	0.0488	3.51	0.1241	5.97	0.1237
1:3	1.05	0.0101	0.57	0.0503	4.04	0.0944	4.18	0.1077
1:1:2	0.85	0.0091	0.68	0.0358	2.86	0.0673	3.33	0.0807
1:2:4	0.89	0.0055	1.25	0.0333	2.80	0.0605	2.82	0.0636
1:3:6	0.64	0.0019	1.91	0.0362	3.21	0.0576	3.17	0.0622

and the theoretical deductions. As a general conclusion to the whole bulletin these comments are offered:

1. Concrete expands when it absorbs moisture and contracts when it is dried. Concrete of a 1:2:4 mixture is likely to contract during hardening as much as 0.05 per cent in an ordinary structure.

2. Contraction of concrete by the loss of moisture causes stress in the concrete when it is restrained by an external force. The amount of this stress is not as small as it is generally supposed.

3. The shrinkage stress caused in the steel in reinforced concrete may reach the usually accepted working stress of steel when the amount of reinforcement is less than 1.5 per cent.

4. The shrinkage stress developed in 1:2:4 concrete may reach the ultimate tensile strength of the concrete when the amount of reinforcement is greater than 1.5 per cent. With richer mixtures the increase in shrinkage stress may be relatively greater than the increase in ultimate strength.

5. The greater the percentage of reinforcement the greater the tensile stress that may develop in the concrete and concrete having a higher percentage of reinforcement than 1.5 per cent is likely to have cracks formed unless proper provision is made.

6. In reinforced concrete out of doors, subject to alternate wet and dry conditions, cracks may [illegible] be formed under the repeated stress which is nearly equal to the tensile strength of the concrete.

7. Reinforced concrete does not appear likely to be a durable material in a place where a corrosive influence on steel, such as sea air, is active, unless [illegible] protection against the formation of shrinkage cracks is made.

8. It is suggested that the prevention of shrinkage stress in concrete might be accomplished in two ways, either by finding a cement giving less expansion and contraction, or by the use of a perfect waterproofing [illegible].

9. It may be expected that an integral waterproofing compound might lessen the change of volume for a short time, but it would not prevent the final difference of moisture with consequent change in volume.

Reciprocity in State Licensing Laws

Arbitrary boundaries restricting the activities of practising engineers have been established, though largely without intent, by the utter lack of uniformity in state laws for the licensing or registration of engineers. This aspect of the licensing problem was presented at the recent A. A. E. conference of practising engineers in a paper by C. S. Hammatt, secretary of the Florida board of engineering examiners and chairman of the National Council of State Boards of Engineering Examiners; an abstract follows:

No Reciprocity Now—State reciprocity for practising engineers with licenses does not exist at the present time, although the various states in passing their registration laws have aimed to provide for it. Every state has legislated differently in the matter of registration, yet each asserts that reciprocity for engineers is to be effective providing the standard is not lower in the other states. Such a provision is not practically in force, even in those ten states which have become members of the National Council of State Boards of Engineering Examiners, and such a condition cannot exist until this council can agree upon a uniform standard of requirements, which as yet has not been done. After such a standard has been agreed upon, those states which adopt it may reap the benefit of the intention of the laws. We will thus have two classifications of registered engineers: Those who practise within their own states and those who can practise in any state, upon paying the fee and filing their papers.

To Unify Procedure—Since all the states have different laws, it is difficult to see how the several state boards of engineering examiners can administer the clause for reciprocity without some change in the laws upon a uniform basis, or by an interpretation guided by a standard agreed to by the several boards. This problem resulted in the organization of the Council of State Boards of Engineering Examiners in the hope that it would be able to unify a procedure that would accomplish the aim of the several laws which provide for reciprocal relation. It is useless to expect the passing of a uniform code by the several state legislatures, but as the standard of requirement for registration is left largely to the discretion of the several boards, it would seem feasible for those boards to unite upon a common level and provide for a standard that would be acceptable to all for the reciprocal interchange of registration. A qualification for reciprocal registration that would be accepted by all the states must start with a standard as high as that prescribed by the most exacting of all the laws, and it should be such as would command the respect and approval of all skilled and educated men in the profession. To bring this about appears to be an easy matter through the council. It can provide a uniform code, which, if agreed to by the various state boards, can become operative by the attachment to certificates issued by the state boards of an additional seal bearing the words "reciprocal registration."

Some states require two, four or six years' experience; others exact ten years. The uniform code should call for the maximum time exacted by any of the states and should commence the calculation of that period with duties above those of apprenticeship, foremanship or inspector, and with those of civil engineers whose experience is not less than that of actual instrumentman, unless such duties were shown to be of a very responsible character. The showing of work performed, under what authority vested, for whom and when, in the statement of experience should be carefully scrutinized and only such credit given for reciprocal registration as would be, beyond question, fully qualifying. This would provide requirements of sufficiently high character and reliability that no question might be raised as to the integrity of the statement. The National Council of State Boards of Engineering Examiners, next October, will no doubt provide a basis such as the one outlined to those engineers coming from other states whose boards have put their stamp of approval upon their qualifications.

Field Experiments on a Practical Irrigation Rating Box

By C. C. Jacob
Federal Court Commissioner for the Uintah Basin, Utah, and
H. R. Leach
Junior Engineer, U. S. Irrigation Service (Resigned)

THE disadvantages of a standard weir for measuring irrigation water are well known. In silt laden waters the rapidity with which such a weir silts up renders it useless as a practical device for the measurement of water. Various modifications of the standard rectangular weir have been proposed from time to time with the idea of avoiding these disadvantages and obtaining a measuring device simple of construction and operation and sufficiently accurate for practical work. The most promising of these modified weirs thus far suggested is that described by V. M. Cone as "A New Irrigation Weir" (*Journal of Agricultural Research*, March 13, 1916, and *Engineering News*, Aug. 3, 1916) which, in its elemental form, is a rectangular weir with the bottom contraction suppressed. Among the advantages claimed from this modification are: (1) it is simpler of construction and of smaller dimension than the standard weir; (2) it is self cleaning; (3) it can be installed where the available head is less than required for the installation of a standard weir.

In connection with their work of distributing water under the various canal systems of the Uintah Basin the writers found it necessary to modify some of the rating flumes on certain of the main canals to prevent the continuous shifting of their ratings due to the accumulation of sand and gravel above or below the flumes. This was accomplished by throttling the flow through the flume at the lower end by means of wings projecting into the flume at right angles to the sides, the opening between the wings being in general one-half of the original width of the flume. The results obtained from these modified flumes were very satisfactory. The shape of the rating curves was much improved and the ratings were apparently permanent. These results, together with the Cone experiments referred to, indicated that a simple and cheap measuring box designed on this principle could be constructed of native lumber and operated successfully in the silt laden canals of the Uintah Basin. A number of small boxes were installed on various laterals and the field ratings verified these conclusions, for, while the boxes were installed under various conditions of velocity of approach, the ratings consistently showed a definite law of flow.

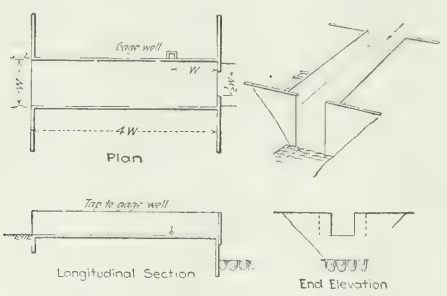


FIG. 1. RELATIVE DIMENSIONS OF RATING BOX

These results led to the permanent adoption of the box in the form shown in Fig. 1. It is a simple rectangular flume of a length four times its width, contracted at its lower end to 50 per cent of its width. It is designed to have a free overfall at this end similar to an irrigation drop, but experiment shows that a slight submergence of the notch does not affect the head discharge relation. Rough lumber was used for all boxes owing to the excessive cost of any other available material. The floor of the box is level and the head is measured a distance equal to the width of the box upstream from the notch.

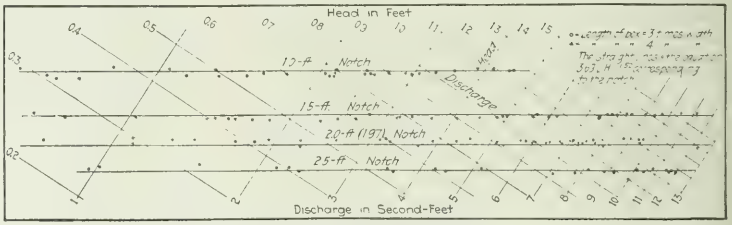


FIG. 2. COMPARISON OF OBSERVED VALUES, RATING BOX EXPERIMENTS: $Q = 3.69\ LH^{1.52}$

In order to accurately rate the box and determine the formula for discharge through it, a field laboratory was set up under authorization of A. J. Charles, project engineer, Uintah Irrigation Project. This consisted of a 90-deg. V-notch weir by which the discharge could be measured, a flume with a 2-ft. drop near its lower end in which the experimental boxes could be built, and a gate below this drop by means of which the notch could be submerged and the effects of submergence studied. Heads were measured in stilling wells with hook gages. Four different boxes were rated whose nominal widths were 2, 3, 4 and 5 ft. respectively, the width of the notch or opening being one half the width of the box in each case. The boxes were constructed of unfinished lumber, the notches being formed at the 2-ft. drop by nailing 2-in. planks on the end of the box, edges vertical, each overlapping the end of the box one-fourth the box width. The floor of the box was level and the sides vertical. The notches were square-edged but not bevelled.

The head on the V-notch was measured on a hook gage and the discharge of the notch computed by King's formula. Simultaneous readings of the gages were made for each observation and the flow through the set-up kept constant during the interval. The observed data are given in the accompanying table.

For the determination of the formula of flow the data were plotted by logarithmic co-ordinates, Fig. 2, straight-line graphs resulting. Each size of box gave a different slope and intercept, showing the discharge to be not strictly proportional to the width of the notch. It was found possible, however, to adjust a single line to all experiments and still keep within the practical limit of error. This line is represented by the equation, $Q = 3.69\ LH,^{1.52}$ in which Q is the discharge in second-feet, L, the width of the notch in feet, and H, the head on the notch measured a distance equal to the width of the box above the notch. A rough equation for field use,

easy to remember and also to compute is $Q = 3.7\ LH^{3/2}$.

Observations were also made to study the effect of various modifications of the standard entrance condition on the rating of the box, and to determine the effect of submergence of the notch by tail-water. The results show that considerable interference with the free entrance of water into the box is permissible with only a slight error in the discharge. A submergence of the notch up to 0.2 ft. has no practical effect on the box rating. Conclusions drawn from all of the experiments may be summarized as follows:

1. The formula, $Q = 3.69\ LH,^{1.02}$ gives the discharge of the box up to a head equal to the width of the notch.

2. In only 5 of the 134 observations made under standard conditions, do the discharges computed by the formula differ from the observed discharges by more than 0.10 second-feet.

3. Metal and wood contractions give the same rating.

4. No difference in the rating of boxes of a length either 3 or 4 times the width could be detected in the cases of the 2- and 3-ft. boxes. In the case of the 4-ft. box the discharge was somewhat lower for the short box.

5. A slight change in the ratio of notch width to box width does not materially affect the rating.

6. Submergence decreases the discharge but it requires a submergence of 25 per cent of the head to decrease the apparent discharge 5 per cent.

7. It requires material obstruction at the entrance to appreciably change the rating.

A great many of these boxes have been installed in the Uintah Basin during the past three seasons, replacing, in many instances, Cippoletti weirs which it was impossible to maintain, and their use has solved a troublesome problem in the task of distribution of water.

OBSERVED HEADS AND COMPUTED DISCHARGES, RATING BOX EXPERIMENTS.

2-Ft. Box (Notch 1 ft.)			3-Ft. Box (Notch 1.50-ft.)			4-Ft. Box (Notch 1.97-ft.)			5-Ft Box (Notch 2.50-ft.)		
H_g	Q	H	H_g	Q	H	H_g	Q	H	H_g	Q	H
Length 6.0-ft.			Length 12.0-ft.			Length 12.0-ft.			Length 16.0-ft.		
0.28	0.11	0.105	1.70	9.35	1.41	1.575	7.74	1.07	1.775	10.46	1.08
0.54	0.55	0.29	1.63	8.41	1.32	1.52	7.09	1.01	1.85	11.09	1.16
0.58	0.66	0.31	1.595	7.98	1.27	1.45	6.31	0.96	1.86	11.68	1.17
0.57	0.63	0.305	1.57	7.68	1.24	1.40	5.79	0.88	1.88	11.90	1.18
0.725	1.12	0.45	1.55	7.44	1.21	1.27	4.55	0.76	1.85	11.49	1.16
0.805	1.48	0.65	1.51	6.97	1.165	1.10	3.19	0.60	1.80	10.72	1.12
0.93	2.11	0.675	1.39	5.68	1.02	0.88	1.84	0.41	1.75	10.03	1.065
0.935	2.14	0.70	1.32	5.00	0.93	0.85	1.69	0.39	1.69	9.21	0.99
0.995	2.49	0.76	1.26	4.46	0.855	0.61	0.74	0.23	1.66	8.79	0.97
0.985	2.43	0.75	1.21	4.04	0.80	1.645	8.61	1.16	1.61	8.16	0.93
1.07	2.98	0.85	1.16	3.64	0.74	1.70	9.35	1.22	1.58	7.80	0.885
1.145	3.52	0.97	1.095	3.15	0.68	1.71	9.49	1.23	1.52	7.09	0.83
1.225	4.16	1.09	1.04	2.78	0.635	1.655	8.75	1.17	1.34	5.19	0.69
1.26	4.46	1.13	0.99	2.46	0.60	Length 16.0-ft			1.26	4.46	0.62
1.11	3.26	0.915	0.88	1.84	0.47	1.71	9.49	1.20	1.235	4.25	0.605
1.025	2.68	0.80	0.80	1.45	0.41	1.61	8.16	1.10	1.15	3.56	0.535
0.92	2.05	0.67	0.79	1.41	0.40	1.555	7.50	1.04	1.14	3.48	0.530
0.825	1.57	0.565	0.695	1.03	0.33	1.55	7.44	1.02	0.98	2.40	0.41
0.76	1.28	0.50	0.58	0.66	0.25	1.495	6.80	0.965	0.96	2.28	0.405
0.635	0.82	0.38	0.485	0.42	1.195	1.425	6.04	0.90	0.94	2.16	0.39
0.525	0.51	0.27	0.445	0.3	0.17	1.42	5.99	0.89	0.82	1.54	0.32
Length 8.0-ft.			0.83	1.58	0.43	1.335	5.15	0.805	0.69	1.01	0.24
0.405	0.27	0.18	0.96	2.28	0.54	1.245	4.3	0.72	0.68	0.97	0.23
0.605	0.73	0.33	1.10	3.17	0.685	1.195	3.91	0.675	0.55	0.58	0.17
0.77	1.32	0.495	1.21	4.03	0.80	1.09	3.12	0.59	1.55	2.44	0.87
0.86	1.74	0.60	1.30	4.82	0.90	1.01	2.58	0.52	1.40	5.79	0.74
0.935	2.14	0.68	1.38	5.58	1.00	0.90	1.94	0.43	1.11	3.26	0.51
0.94	2.16	0.69	1.44	6.20	1.07	0.79	1.41	0.35			
1.00	2.52	0.76	1.55	7.44	1.20	0.715	1.10	0.29			
1.08	3.05	0.87	1.45	6.31	1.08	0.595	0.70	0.23			
1.19	3.87	1.04	0.885	1.86	0.485	1.17	3.71	0.64			
1.265	4.50	1.14	Length 9.0-ft			0.955	2.25	0.46			
1.055	2.88	0.84	1.83	11.20	1.60	1.35	5.29	0.81			
0.94	2.16	0.70	1.78	10.47	1.53	Metal Contractions					
0.70	1.04	0.44	1.725	9.68	1.445	1.695	9.28	1.20			
			1.675	9.01	.38	1.61	8.16	1.10			
			1.62	8.28	1.31	1.58	7.80	1.06			
			1.58	7.80	1.255	1.54	7.34	1.01			
			1.42	5.99	1.04	1.455	6.37	0.925			
			1.31	4.91	0.92	1.49	6.75	0.96			
			1.12	3.34	0.71	1.46	6.42	0.945			
			0.99	2.46	0.57	1.39	5.68	0.87			
			0.82	1.54	0.42	1.27	4.55	0.76			
			0.615	0.76	0.27	1.11	3.26	0.60			
			0.855	1.71	0.45	0.95	2.22	0.47			
			1.02	2.65	0.60	0.76	1.28	0.33			
						0.71	1.08	0.30			

H_g = Head on V-notch weir
Q = Discharge over V-notch by King's formula $Q = 2.52\ H_g^{2.47}$
H = Observed Head on rating box

New Department of Surveying at University of Michigan

A separate diploma department of geodesy and surveying, distinct from but connected with the engineering department, was authorized in December, 1921, by the engineering college of the University of Michigan. This action was based on the conclusion that the proper schooling of the surveyor requires much more time than that allotted to surveying in the regular civil engineering course. This new system was described at the recent annual meeting of the Illinois Society of Engineers, by Thomas J. Mitchell, assistant professor of surveying at the University of Michigan, who stated that the definite field of surveying has been almost entirely neglected by engineering schools. The following is a brief abstract of Mr. Mitchell's paper:

When we compare American with European practice, we become impressed with the gap that our universities have allowed to develop. In almost every civilized country, surveying in its broadest significance is considered an important and high class profession interested in the application of science to its problems. In many places in Europe separate schools are maintained for the study and research of geodesy, a branch of surveying. Apparently the European idea is that surveying is a separate profession not intimately connected with engineering, but that its practitioners rank equal to or higher than engineers.

The present demands for men with such a training as it is purposed to give, are many and definite. Massachusetts is engaged in a resurvey and some counties in Michigan are planning resurveys. The work of the General Land Office has been completely reformed. There is a demand for men qualified by training to assume leadership. The science of geodesy has been largely confined to such federal departments as were able to train their own men. Now many of our cities have reached such a size that surveys on plane co-ordinates are inadequate and misleading. Business interests are yearly becoming more insistent in their demands for complete topographic maps of the nation. It will be necessary to train men to occupy this field and the training seems to be a public service obligatory on the universities. Already demands for special short courses have been made by practicing surveyors.

Two Committees Charge Knickerbocker Collapse To Twisting Failure Of Truss End

Substantially identical conclusions as to the cause of the great Washington theater disaster of Jan. 28 have been reached by two independent investigating bodies: a committee of the Washington chapter of the American Association of Engineers, and a board appointed by the Associated General Contractors. The reports submitted by these committees are summarized below, in greatly condensed form. The results of the official investigation, carried out for the District Attorney by a board of engineers of the War and Navy departments, have not yet been made public, but it is known that the board attributed the roof collapse to the failure of a minor beam support—the wall bearing of purlin 21. In disagreement with this view, the two reports here presented find that the north end of the main truss failed by twisting due to defective design. This part of the truss was on the verge of failure before the collapse; the added snow load in the heavy storm of Jan. 28 was the last straw.

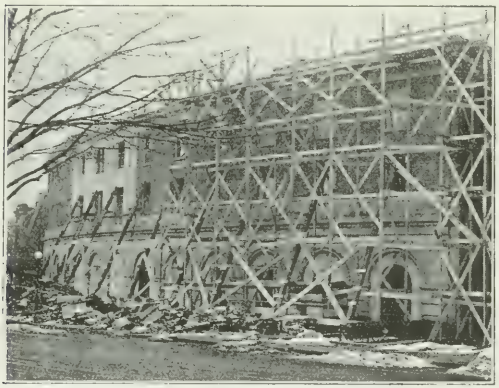
Discussing the question of responsibility for this vital defect and others almost as serious, the two reports place the blame on the architect and the steel fabricator, the latter having prepared the design of the framework. Emphasis is placed on the fact that municipal approval of plans and inspection of work does not relieve the architect of full responsibility for adequacy and safety of his structures.

TWO organizations, the Washington chapter of the American Association of Engineers and the Associated General Contractors, have been at work for six weeks past investigating the Knickerbocker moving-picture theater roof collapse in Washington on Jan. 28. The investigations were completed and reports presented within the past two weeks. While they diverge considerably in detail, their findings of cause are substantially identical: twisting failure of the north end of the main truss, due to defective design. The A. G. C. committee shows, moreover, that other explanations or findings of cause are untenable and in conflict with fact.

Looking aside from the immediate cause and the events during the collapse, the A. A. E. committee also presents the results of an analysis of the structure, listing the defects of design and the numerous divergences from building law requirements. The conditions found are such, according to both reports, as to have made failure of the structure almost inevitable at some time, by reason of some combination of the defects, even if the particular failure of Jan. 28 had not then occurred.

Both reports take up quite specifically the question of professional responsibility. They place primary blame on the architect. The A. G. C. board exculpates the contractor, while the A. A. E. committee holds that he might have been expected to discover the faults of the structure. Both indicate that building supervision and inspection should not be expected to discover and prevent all the faults or remedy the defects in design resulting from inadequate performance of the architect's function. Registration of architects, engineers, and builders with the local building department, with penalty of suspension or revocation, is recommended by the A. G. C. committee, in line with recommendations made some years ago by the New York Building Department.

The investigation for the Associated General Contractors was carried on by Rudolph P. Miller, former superintendent of the Building Department of Manhattan,



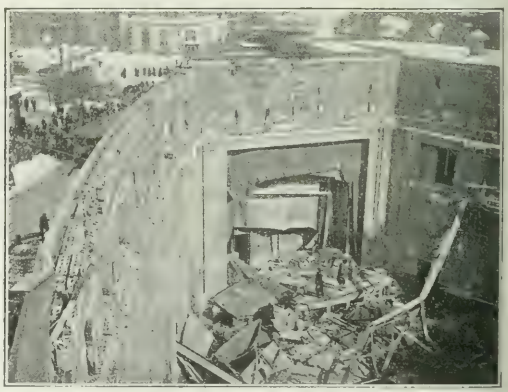


FIG. 1. KNICKERBOCKER THEATER: WALL CONSTRUCTION CRITICISED BY CONTRACTORS' COMMITTEE

Curved bearing wall on Columbia Road side of auditorium. This wall was cut up by many window openings, intended for exterior effect. At the heat colored portion of the wall the main roof truss was seated, bringing to bear a concentrated load of more than 50 tons. The wall at this point was found 5 in. out of plumb after the accident

Interior view. The 55-ton truss load was carried on the hollow-tile wall at the left. The proscenium wall in the background contains at the top the seats of three roof beams, 22, 23 and 24, the first of which was charged in the expert testimony at the inquest with being one of the first members of the roof to fail.

New York City; James Baird, vice-president of George A. Fuller Co., Washington; Guy Mason, attorney, Washington; W. P. Christie, research engineer of the A. G. C. The committee of the Washington Chapter of the American Association of Engineers consisted of Nolan D. Mitchell, W. G. Noll, L. M. Neel, W. A. Slater, J. A. Cliff.

General Facts—For the general facts of the construction of the building and of its collapse reference may be made to *Engineering News-Record* of Feb. 2 and Feb. 9. Briefly stated, the theater, which was built in the early part of 1917 and was opened in the summer of that year, was of roughly triangular shape and was roofed with a 3-in. concrete slab carried by I-beams spaced 9½ ft. apart and resting on a framework of trusses. The main supports were two interior columns (there were also two short balcony columns) and the walls themselves (see plan, Fig. 2). The truss supports on the walls were nearly 40 ft. above ground. The walls themselves were of hollow tile (with vertical cells), except the south wall, which was of brick. The curved wall along Columbia Road, which is of primary interest, was 22 in. thick, composed of 18 in. of tile and 4 in. of facing brick and limestone. The entire roof of the seating space fell during a performance on Jan. 28, when a heavy snowstorm was raging and some 24 in. of snow had already fallen. While the seating capacity was over 1,800, only about 300 spectators were in the theater; of these 97 were killed and more than 100 were injured.

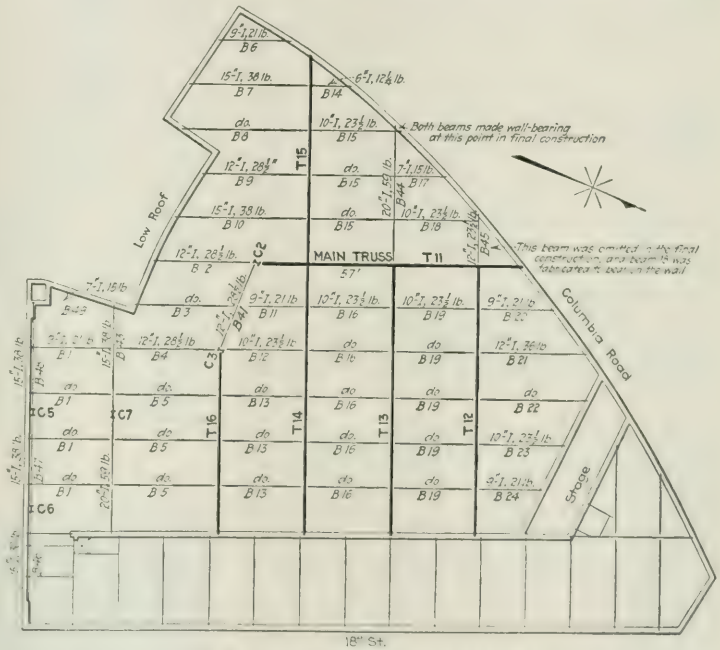


FIG. 2. KNICKERBOCKER ROOF FRAMING

Various engineers have charged the failure to bending or breaking of beam 11, between column C2 and C3, as feature of the wall seat of beam 21 pulling beam 22 off its seat with the result that truss T11 broke in two due to breaking of the roof slab between beams 21 and 22 with the same result. The A. A. E. and A. G. C. reports find that the main truss, T11, failed at its wall end and twisted off its seat, due to defective design.

How the Roof Failed—From study of the wreckage, the American Association of Engineers' committee finds the explanation of the collapse in the following sequence of events:

Under the normal loading of truss T11, there would have been sufficient deflection to cause the lower chord of the truss to twist slightly at its point of support in order that a bearing be secured by both channels of the lower chord. This twist would put a bend in the ½-in. gusset plate which formed the only connection between the lower chord and the end post. The eccentricity thus set up may have been increased by contraction of the truss due to changes in temperature, or by any tendency of the wall support to move outward. It is not only possible but very probable that such a tendency existed. Any local settlement of the footings under the points where the loads were concentrated would, on account of the curvature of the wall, have the effect of throwing the top of the wall outward. Another possible factor may have been the inclination of the roof near the support of truss T11, which would cause a large outward thrust of the wall when either the main truss or purlins 20 and 21 deflected.

With the gusset plate between the end post and the lower chord of truss T11 already stressed nearly to its yield point, the very slight additional load of snow probably was sufficient to bend it to such an extent that the end of the truss was thrown completely off its seat, not by slipping but by the buckling of the gusset plate and the twisting of the lower chord of the truss until it rolled off the I-beam seat, thus precipitating the failure of the entire roof by dragging all the other trusses with it.

As the roof started to fall at the north end, it apparently pivoted about a horizontal axis approximately east and west through the top of the angle strut over column C2, while the top of the column moved toward the south as the north end of the truss fell. At the same time a southerly motion was given to all parts of the roof as it fell. That the roof had such a motion during its fall is evident from the scoring of most of the seat beams supporting trusses T12, T13, T14 and T16 at the east (18th St.) wall and from the diagonal abrasion marks indicating where the walls were scraped by the ends of the falling trusses and purlins. This southerly motion was no doubt aided by an initial inclination of column C2, but the amount of this inclination (1 in. in the height of the column) could not have been sufficient to start the collapse.

End of Truss Crippled—The committee sketches the distortion of the end portion of the main truss, T11, prior to and during its unseating (Fig. 3). It explains the distorting effects thus:

On account of its skew bearing, it will be seen that the slope of the bottom chord (exaggerated in the sketch) due to the center deflection of the truss, caused an inclination of the top of the bottom chord toward the east, in order to bring the east channel of the two forming this chord into bearing upon the I-beam seat. As the actual deflection of truss T11 is not known, it is not possible to determine

just how great was the inclination of the channels. However, with a deflection of the truss of 1 in., the inclination of the bottom chord channels would cause a bending of the gusset plate producing an eccentricity e of nearly 0.1 in., under which the sum of the computed direct and bending stresses would be close to the yield of the steel. From independent sources, statements from workmen have been reported that after erection there was a deflection of the truss T11 of 3 or 4 in. The eccentricity e presumably would be proportional to the deflection of the truss, and the significance of such a deflection will be apparent. Under such critical conditions any other influence tending to increase the eccentricity would be almost certain to result in crippling of the gusset and lower chord of the truss. As it

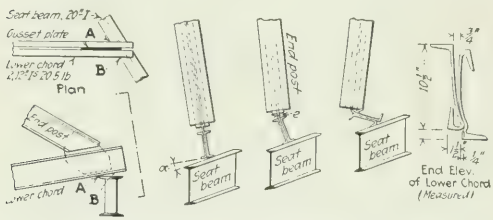


FIG. 3. DISTORTION CONDITIONS AT COLUMBIA ROAD (NORTH) END OF MAIN TRUSS T11

Sketched by A. A. E. Committee. The deflected position of the truss on its seating beam in the wall is sketched at the left to exaggerated scale. Following this, the deduced sequence of distortion is indicated. Sketch at right shows the present condition of the north end of the bottom chord.

actually occurred, the east flange on the bottom of the lower chord was bent upward against the web of the channel, while the west flange was not bent upward at all at the end. The upper flange on the west side was bent down nearly against the web. The corner of the cover plate was bent upward. If the truss had slipped off its seat it would be expected that the east flange would be undisturbed and the west flange would be bent upward.

All the phenomena together are almost positive evidence that in falling the lower chord of truss T11 rolled and did not slip (at least until the later stages) off its seat. Not only is this true, but an upward crimping of about ½ in. which occurred in the west flange of the lower chord at approximately the edge of the bearing shows that there must have been an extremely heavy pressure at the point where the west channel bore upon the edge of the I-beam. This evidence of pressure is exactly what would be called for by the behavior just described, and is a strong indication that it occurred at the beginning of the failure and not as an aftereffect. It is not improbable, however, that the final stages of the crippling may have been completed only when the end of the truss struck the floor.

The evidence seems clear that truss T11 started to fall before beam 21 fell. At the point at which beam 21 framed into the top chord of truss T12, the north flange of that chord is buckled upward. Careful examination shows the marks of the web of beam 21 on the bottom of the flange, indicating quite clearly that as truss T11 fell, beam 21 acted as a lever prying the north flange of the top chord of the truss upward. Additional evidence is found in the fact that the gouge caused by the bearing of the web of the beam extends around the edge of the flange of the north angle and a short distance back from the edge on the top; this latter gouge apparently was caused by a small piece of metal which in coping beam 21 was left directly above the web of the beam. This gouging of the flange could have been caused only by truss T11 falling before purlin 21 fell.

Further evidence that the north end of the purlin did not fall before the south end fell is afforded by the movement of the proscenium wall to the north, due apparently to the thrust of the inclined purlins. This movement of the walls as measured under the roof slab over the stage was ¾ in. at the junction of the proscenium wall with the Columbia Road wall, 1½ in. at the beam seat for purlin 22, and ½ in. at the seat for purlin 23. No movement was found at the seat for beam 24.

The committee concludes that the failure started at the north end of truss T11, from the causes set forth in the preceding paragraphs.

A. G. C. Board's Finding of Cause—Substantially the same sequence of events is found by the investigating board of the Associated General Contractors. This board states that the ½-in. gusset plate between end post and upper chord of the main truss, which furnished the only lateral stiffness of the heavy upper chord, buckled to the west, and the lower chord where it rested on the wall without reinforcement for bearing stresses and eccentricity was crushed and tilted under a combination of tension, compression and twisting stress. More specifically, the committee recites the conditions and actions thus:

The actual roof load greatly exceeded the design load; the main truss was reduced about 9 in. in depth from the original design, and its moment plates were neither butted together nor spliced. These factors all produced excessive downward deflection of that truss. This deflection, acting on the skew bearing, created a thrust at the Columbia Road wall which tended to push the wall outwardly and to twist the bottom chord of the truss. Either of these movements, occurring in but a small degree, was capable of unseating the truss, as its bearing perpendicular to the wall was only 6 in. and parallel to the bottom chord 8 in.

To resist this twisting force the only stiffness provided was that of a ½-in. gusset plate and of the bottom chord in the first panel. The batter post could contribute nothing, as its rigidity was in turn limited by a ½-in. gusset at its upper end. Thus, the bottom chord from the twisting force alone was probably in a hazardous condition. Furthermore, the two 12-in. channels forming this member extended beyond the gusset plate with their webs unsupported, forming an eccentric bearing. These webs therefore took practically the full bearing load of the truss and the stress from its eccentric bearing as well as the twisting force. Under such a combination of stresses, failure in the bottom chord or bearing was at some time almost inevitable. A condition existed that would have been dangerous with a thoroughly adequate wall, and when with this was combined a thin wall badly cut up by openings, a condition must have existed which awaited but an

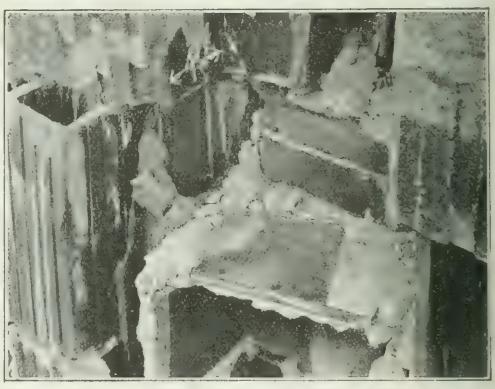


FIG. 4 WALL PLATE ON WHICH BEAM 22 WAS SEATED

Expert testimony at the inquest attributed the collapse to beam 22 being pulled off its wall seat laterally (to the left). According to the A. G. C. board the spilled cement which outlines the original position of the beam on the steel wall plate fails to show marks such as lateral sliding of the beam would have caused.

additional load, a measure of vibration, or fatigue of the overstressed metal, to result in a collapse.

The additional load and probably the vibration and fatigue were present when the roof gave way. A snow load of some 12 or 13 lb. per sq.ft., or about 16 per cent of the dead load (computed from precipitation recorded by the U. S. Weather Bureau), exclusive of possible drifting, and the heaviest since completion of the building, was on the

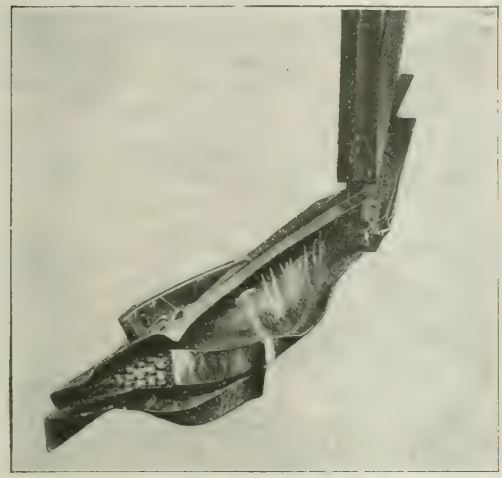


FIG. 5. TWISTED NORTH END OF BOTTOM CHORD OF MAIN TRUSS

The end piece of the truss has been placed in a vertical position, bolstered by the web members at the first paired joint. The end of the chord in the foreground is twisted more than 90 degrees, with its top flange forced down eastward. The ends of the 12-in. channels, which had no connection or stiffening for x in from the end, carried a load of 55 tons when the truss was in service.

roof. Vibration from passing street cars had been noted on the structure and was doubtless accentuated at times by a double 8-ft. ventilating fan carried on the roof. The snow load which increased the dead load at the north end of the main truss some 15,000 lb. was, so to speak, the last straw in destroying equilibrium at the support. It undoubtedly provided the additional stress necessary either to buckle and twist the member resting on this bearing, or to buckle the gusset plate above.

When the web of the east channel of the bottom chord buckled, the top of that member (not the whole truss) was twisted eastward, thus unlining the batter post, and moving the center of stresses off the bearing. With the bottom chord in his condition only the lateral stiffness of the wall could prevent the truss from sliding off. This stiffness the wall did not have. It was pushed outward about 5 in.—sufficient to break both its bond with the stage wall, to break the stage wall itself, and to allow the truss to drop.

Whether the gusset plate or the bottom chord channel failed first is immaterial, as either action would have brought about the other and would have thrown the batter post out of line. Once this member was displaced, collapse readily followed.

No failure of an auxiliary truss was essential to unseat the main truss, and no failure of a beam as they were actually erected, as believed to have been supposed assuming a failure in the auxiliary truss T12. In connection with the steel, except the bottom chord mentioned, [illegible] evidence of failure between supports was found. Collapse [illegible] appearance of preliminary failure seems highly improbable in view of the difficulty experienced in efforts to cause collapse when demolishing structures.

Official Explanations Untenable—A careful analysis of other theories of the failure is presented by the A. G. C. board. The first of these is the explanation offered by a board of army and navy engineers which served as investigating authority to the district attorney. This report attributed the failure to primary failure of the wall bearing under beam 21, by a combination of slipping off (after outward movement of the wall) and crushing of the tile. According to this theory this beam in falling pulled beam 22 sideways, westward, off its wall bearing; the two beams in falling broke the bolts by which they were fastened to the top chord of truss T12, and, this truss being thereby freed also from the opposite purlin beams, it buckled and fell, pulling the main truss off its wall support and dropping the entire roof.

The A. G. C. board finds this explanation incompatible with the facts. At wall bearing 22, cement which was spilled on the bearing plate at the time of construction was not disturbed along the west side of the beam, and a piece of tile projecting from the wall could not have remained in place had the beam moved westward. The sharp upward buckling of the top-chord flanges of truss T12 where the beams framed into it, and marks made on the under side of the top chord by these beams, "could have been made only by a scissors action from each pair of beams as the truss preceded them in its fall." A break in one flange of the top chord of T12 is described as a clear tension failure resulting from this scissors action. Moreover, "if beams 21 and 22 had dropped from their wall supports and broken their truss connections, the first sign of collapse should have been the appearance of their north ends as they broke through the ceiling. This, according to eye witnesses, did not take place."

Slab Failure Theory—A somewhat similar explanation by one army officer goes farther back and assumes that a breaking of the roof slab pulled beams 21 and 22 towards each other and off their supports. The board, however, finds that at this point the slab was probably stronger than elsewhere; that breaking of the

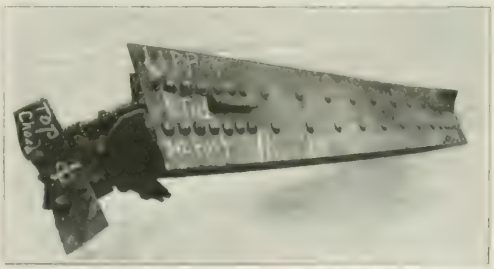


FIG. 6. NORTH BATTLE FLOOR OF MAIN TRUSS

[illegible] of the gusset and the [illegible] truss T12. [illegible]

slab could not have pulled the beams toward each other; and that since in the southeast corner of the building a large slab of the roof is still holding together unsupported, the suggested action appears unlikely.

Column Failure Theory—A published article by a structural engineer charged the failure to bending of purlin 41 and crippling of the main roof column (C2). The column failing, presumably through overloading, it allowed the south end of the main truss to drop, pulling the north end from the wall. This explanation is rendered untenable by the fact, among others, that the

column underwent no distortion through the collapse.

Architect's Theory—According to the architect of the theater, a weakness in the steel of the top chord of truss T12, just where beam 22 was attached, caused the truss to buckle here, pushing the beams north of it into the stage wall, and thus allowing truss T12 to pull the main truss from its bearing. However, the stage wall shows no evidence of the beam having punched through the hollow tile at the beam end.

Gusset-Plate Failure Theory—One theory advanced places the origin of failure in the gusset plate connecting the top chord of the main truss with the north batter post. Buckling of the truss at this point caused the top of the post to move westward, thus throwing the main truss out of line and pulling truss T12 from its bearing in the east wall. The board finds that truss T12 did not fall early in the collapse, however.

Structure Had Many Weaknesses—A full review of the many weaknesses and defects of the structure is given by the A. A. E. committee. It finds that the roof slab, with a working stress of 16,000 lb. per sq.in. (the reinforcement had a yield-point of 73,000), had a total capacity, dead and live load, of only 23 lb. per sq.ft., while the actual load was about 75 lb. But no evidence was found in the wreckage that the slab failed until after the failure had started elsewhere.

Steelwork Overstressed and Unbraced—Inadequate proportioning, bad details and lack of bracing characterized the steel roof structure, the A. A. E. committee reports. The main roof truss was actually made 9 in. less in depth than the stress sheet shows, as the 6½-ft. designed depth was actually made the overall depth of the truss. The cover plates of its chords were not spliced or even butted, and as a result there was pronounced weakness with respect to buckling between the points where the lateral trusses were attached. Assuming no support of the top chord of the main truss by the roof slab, the slenderness ratio of the chord channels between these points was 184, and the allowable unit stress 4,510 lb. per sq.in., whereas the actual compression in the chord reached 20,000 lb. per sq.in., an overstress of 345 per cent. The lateral staying of the chord by the auxiliary trusses, moreover, depended entirely on the friction of these trusses on their wall bearings.

Other characteristic elements of weakness in the steel structure are described:

The gage lines of the inclined and the vertical web members always intersected at the inner flanges instead of at the center-of-gravity line of the chord channels. At each end of the main truss the first two diagonals were designed to carry the same total stresses, yet at their intersection with the bottom chord one of them was provided with twenty rivets and the other with only seven. The principal feature disclosed by the computations of the secondary trusses is that the rivets were apparently figured in double shear, regardless of the fact that their capacity was limited by their bearing value on the ⅞-in. gussets. Compression members of these trusses overstressed as much as 78 per cent had only one stitch rivet in panel lengths of 10 ft. The bracing of columns C2 and C3, which supported trusses T11 and T16, was very defective. Column C2 according to the original plan was entirely without bracing from the east or the west. This lack is reported to have been recognized by the architect during the erection of the roof, and a 10-in. 23⅔-lb. I-beam extending horizontally from the bottom chord of the main truss T11 to column C3 was added. Its connection to column C3 was by means of not more than two ¾-in. bolts, and that to column C2 was not more substantial. That the end connections of this strut were of little value in indicated by the fact that column C3 bent, with curvature sharply convex toward column C2, at the point at which the I-beam strut had been attached, completely breaking the connections without crippling the strut.

Examination of the wreckage showed that the thickness of the plaster on column C2 was 1 in. greater on the north side at the top than at the bottom on the same side. This indicates that the column must have been out of plumb by about 1 in. at the time of plastering, and the difference was taken up in the plaster. This inclination of that column toward the south at the top, while assisting in a general southerly movement of the roof during its fall, would not be sufficient to start the movement.

The committee concludes that in spite of the defective conditions at the columns there is no evidence that the failure started in that vicinity.

List of Principal Defects—The A. A. E. committee lists the following features of the building as most deserving criticism:

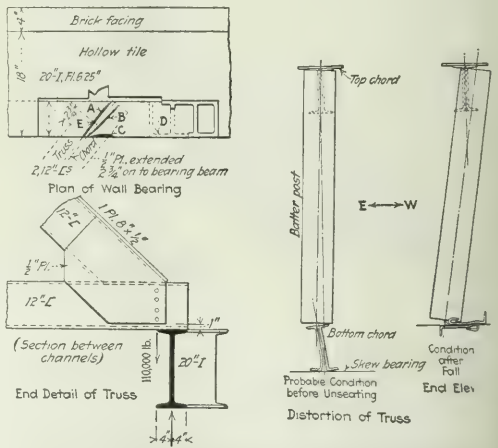


FIG. 7. WALL BEARING AND DISTORTION OF MAIN TRUSS (A. G. C. REPORT)

The weakness of the upper gusset, connecting the batter post to top chord, is strongly emphasized by the contractors' committee.

Support of main truss on a thin wall lacking solidity and mass.

Support of main truss on a skew bearing, combined with lack of stiffness in the gusset between the end post and the lower chord of the truss.

Failure to anchor trusses and heavy beams into walls.

Scant bearing at walls.

Insufficient section area and inadequate details of truss members.

Inadequate column bracing.

Absence of lateral support at intermediate panels of truss T11.

Absence of diagonal bracing between other trusses.

Inadequate strength of roof slab.

Some of these defects are not believed to have been immediately contributory to the event of the collapse, but "it would require the correction of all those listed to convert the building into a safe structure."

All these defects represented direct violations of the District of Columbia building law. Fifteen violations are found by the committee. Besides those indicated in the preceding comments there are such as the following: Concrete reinforcement left to the judgment of the contractor; plans filed with inspector of buildings not adhered to; purlin 41 overstressed 54 per cent, namely to 24,500 lb. per sq.in.; bolts instead of rivets

used for field connections for trusses; and building not fireproof.

The Question of Responsibility; A. G. C. Findings—Discussions of the professional and public responsibility for the conditions disclosed in the Knickerbocker collapse are presented by both reports.

The board of the A. G. C. places responsibility very definitely upon the architect and the steel contractor, but exculpates the building department and the contractor. It presents noteworthy suggestions for improvement of building supervision. Essential extracts are quoted here:

Contractors' Views as to Responsibility

In the erection of a building, particularly a building to be used as a public gathering place, all persons engaged in designing and erecting the structure, like the operators of public utilities, are jointly and severally responsible for its safety. The highest degree of responsibility undoubtedly rests upon the architect, as it is upon him that an owner relies for a properly constructed building; but every other agency involved in the project has an individual responsibility for the character of its work.

Municipal approval and inspection may include, in some instances, investigation into features of design, but to completely check the design of each structure erected would exceed the working capacity of a municipal building department. It would require a staff of experts almost equal to the combined forces of private designers and would entail an expense and duplication of work too great for a municipality to bear. Field inspection also is limited by a like consideration of expense.

In the case of the Knickerbocker, responsibility for the disaster cannot be justly laid to employees in the department of building inspection, except in so far as it may be shown that an official or employee has failed in his duty of apprehending any violation of the building code. But even if this is finally shown to have occurred, it would in no sense relieve the other agencies of construction from their respective responsibilities.

If any parts of the building, built in accordance with plans and specifications as either drawn or accepted by the architect, are found to be inadequate or improper, then he cannot avoid responsibility for the condition of such parts. Neither can he disclaim responsibility for violation of the plans and specifications, if laxity in supervision has made such violation possible; though in the latter case the agent of the violation should be held fully responsible for his own acts. The fabricator, on account of difficulty in securing certain material, submitted an alternate design of his own, and this, it appears, was approved by the building department and accepted by the architect upon their approval. Adoption of this design obviously entailed responsibility to the owner for its safety, but, on the other hand, did not in any sense release the fabricator from responsibility for departures from safe practice.

The steel design of the Knickerbocker contained serious departures from established practice, which are believed to have been a vital factor in the collapse, and while the architect may be culpable for not checking it, the fabricator, in whom he relied, cannot escape his moral responsibility for these departures. In such instances the subcontractor obviously becomes an agent of the architect in supplying a design, as well as an agent of the general contractor in executing the work.

No responsibility appears to rest upon the contractor by reason of the quality of his work or any non-compliance with the plans and specifications; but in conforming to these instruments, as required in his contract, which did not provide for anchoring trusses to the walls, he was made a party to infraction of the building code.

It is the duty of ownership to insist upon adequate inspection and to pay a fee for architectural service sufficient to provide such inspection. If the owner presses his architect to reduce this fee below that commonly recognized as necessary to give adequate inspection he should not expect the building department to relieve him of responsibility for such action. Should the owner induce his architect to reduce the cost of structural design at the risk of endangering its safety, he jointly with the architect should share responsibility for the results.

In the case of the Knickerbocker, the architectural fee, as shown by evidence at the coroner's inquest, was lower than that advised by representative architects, and an examination of the building indicates that while the decorative features were elaborately executed, structural features were inadequately provided for. Whether any action of the owners resulted in this condition has not been determined, but, if so, the ownership should share the responsibility.

A. G. C. Recommendations—Several specific suggestions and recommendations are made by the A. G. C. board for prevention of the conditions responsible for the Knickerbocker disaster. One of these is the suggestion that, as thorough examination of plans and inspection of building work cannot be provided by cities with general funds, building departments might make a charge for each permit depending on the value of the structure, sufficient to pay for checking the design and for inspection. Improvement in building codes is advocated, as "many codes are deficient in vital particulars, to such an extent that an unsafe structure can be built."

Licensing is not believed by the board to be a remedy for bad architectural and engineering practice, but compulsory registration of designers and constructors with local building authorities is recommended.

On the subject of adequate fees and adequate work, the board says:

In the case of the Knickerbocker the plans and specifications were not complete, and testimony before the coroner showed that the inspection was inadequate. In any building there are items of construction unforeseen by the designer which must later be added, but when, on a structure like the Knickerbocker, costing about $77,000, there are more than fifty such items, there would appear to have been incompetence, indifference, or both.

The committee recommends that the fees of architects and engineers be made sufficient to enable them to give competent and complete service. Fees recommended by the American Institute of Architects nad the American Institute of Consulting Engineers are reasonable and proper and have had recognition by the courts.

What Engineers' Committee Recommends

Conclusions of A. A. E. Committee—Diverging from the views just quoted, the committee of the American Association of Engineers does place a measure of responsibility on the contractor. It further demands critical checking, by a duly qualified structural engineer, of all structural features of public buildings, and suggests that thorough inspection of plans and rigid field inspection by the public building officials are in the interest of conscientious builders. It makes no reference to licensing or registration. The conclusions are as follows:

In the opinion of the committee this disaster was the result of bad practice on the part of the architect and the contractor.

The testimony offered at the coroner's inquest showed that the architect allowed the contractor to change the design of the roof framing and that he did not check the sufficiency of the new design but instead relied on the check of the computer in the office of the building inspector. No check on the subcontractor's draftsman was required for detail of construction.

The contractor because of the substitution of a new design was placed in the position of being directly re-

sponsible for the design, but that did not relieve the architect of his responsibility to the owner.

From the number of violations of the building code it is evident that the designing was carelessly done or else, what is worse, the violations were deliberate.

To have the inspector of buildings assume the responsibility for the sufficiency of the details of the design of buildings would be beyond the intent of the law. It would virtually put the work of designing buildings in the hands of the inspector and relieve the architect from that function almost altogether.

Critical checking by a duly qualified structural engineer should be required for the structural details involved in the construction of every public building of importance, and drawings bearing the signature of the engineer as a guarantee of the adequacy of the design and details should be filed with the inspector of buildings.

When an architect accepts a fee for plans, specifications, and superintendence, the owner has a right to expect a building conforming to all the building regulations and the function of an inspection department should not be to relieve the architect from the responsibilities which are his.

At the same time the best interests of conscientious contractors, engineers, architects, and owners, as well as those of the public, would be served by an exacting and thorough examination of general plans by municipal officials, followed by rigid field inspection.

Since this catastrophe, there has been much agitation advocating a new set of building laws, but it is here emphasized that such laws will not insure against failures of this kind if their enforcement is not insured. Valuable as a simplification of the code would be, the first need is for the enforcement of the law.

Exposure Fire Hazards and Protection in the Burlington Building Fire

(Extracts from a preliminary report issued by the Chicago Board of Fire Underwriters)

IMPORTANT teachings concerning exposure-fire hazards and means of protection are brought out in a preliminary report on the Burlington Building fire of March 15, prepared by W. D. Matthews, chief engineer of the Chicago Board of Fire Underwriters. The report covers the major phases of the fire (see *Engineering News-Record,* March 23, p. 495), but states that other phases are still under investigation.

Reviewing the origin of the fire, the report describes its rapid spread through the block of printing-house and factory buildings between Canal and Clinton Sts., Van Buren to Jackson, in one of which it started. Delay in either discovery of the fire or response to the alarm was a factor in the early stages. Then the fire spread from building to building through unprotected (and some wire-glass-protected) windows. Thus, as to the fully-sprinklered Atlantic Building, which was in the block destroyed, the report refers to the entry of fire through wire-glass windows thus:

The condition of greatest exposure to the Atlantic Building was an 8-story building 138 ft. long, 102 ft. high, burning fiercely and shooting flames and heat into a court only 5 ft. wide against wired glass. Here was a building protected against the worst exposure by wired glass, but with a condition existing which wired glass is not expected successfully to resist. In the case of the Burlington Building, the exposed window openings (east wall) were glazed with ordinary glass in woden frames, except that the fire-escape windows were wired glass. Distance (80 ft.) alone was all the protection this building possessed, and distance was insufficient with the very high temperatures prevailing.

The spread of the fire to the Burlington Building occurred very soon after the beginning. The alarm was given at 12.50 a.m., the first engine company arrived at 12.52. Soon afterward nearly the whole printing-house block was on fire, and by 1.20 the Atlantic Building and the Burlington Building were on fire.

The Burlington Building had no automatic interior protection. It had a fair supply of hand fire extinguishers; also two 4-in. standpipes with 100-ft. lengths of 1½-in. linen hose and 2½-in. outlets each floor supplied by three 800-gallon steam pumps, two of which were automatic. Employees used the small hose and the fire department used the large hose as well as leads that were brought up the front stairway and the fire escape. The fire was fought by the department working upward from the 9th floor.

This building is not by any means so badly damaged as some reports have stated. Present indications are that the structural steel is intact and that few of the floor arches will need to be replaced. Much of the terra-cotta trim on the exterior walls is damaged. A very large percentage of the wired-glass windows on the south, west, and court walls was destroyed. Beginning at the 9th floor and going upward, it appears that the loss is total on wooden top flooring and its nailing strips, all wooden trim and combustible contents, plastering, marble and tile dividing partitions. The tile partitions (with metal and wired-glass doors) enclosing stair and elevator openings are damaged to some extent, but apparently most severely in the warping of metal and fusing of glass, although instances were noted where the tile was bulged and spalled. The tiles protecting the interior columns were calcined and spalled in many cases and will have to be replaced, but in no case was the steelwork exposed by action of the fire. Needless to say, records and papers exposed in the open or filed in steel sectional cabinets were destroyed. Records in the vaults are reported to be intact.

The Burlington Building was much more worthy of the descriptive misnomer "fireproof" than many buildings advertised as such. It was, comparatively speaking, a well constructed building and it had what many office buildings in this, as well as other cities have not, viz., enclosures around all floor openings sufficiently substantial probably to have stopped a fire originating on any one floor, from spreading to another floor. Taking it as it was and giving it credit for all of its good points, the fact remains that it was a poor excuse for housing records that will cost millions to replcae.

Are there many people who fancy that their goods are immune from fire because contained in one of these buildings? If there are any such, here is a very good example of how a good building not only did not protect its contents, but contributed to a considerable extent in its destruction.

The lessons to be derived from the Burlington Building fire are:

(a) Protect exterior openings against *all* exposures. Wired glass in the east wall, while it might not have prevented a loss in this building, would at least have stood up much longer than ordinary glass, kept out sparks for a long time, and given the fire department a much better fighting chance.

(b) Omit in the construction all materials of a combustible nature, that is to say, wooden top floors and nailing strips, wooden doors, trim, sash, etc., etc.

(c) Subdivide floor areas as much as possible by substantial partitions anchored to floor and ceiling.

(d) Make each floor a separate fire area by enclosing floor openings (stairs, elevators, etc.) with standard materials.

(e) Omit easily damaged and expensive building decoration, such as marble.

(f) Eliminate combustible furniture and fixtures.

(g) Use metal filing cabinets in place of wooden ones to reduce the amount of combustible material, but do not expect these metal cabinets to protect papers if surrounded by burning material generating temperatures sufficiently high to fuse brass and glass, as was the case in this building.

(h) Install automatic sprinklers, with the knowledge that they are the most efficient fire extinguishers known but have limitation, as was demonstrated in the Atlantic Building.

(i) Locate standpipes inside stair towers so that firemen may fight fires on floors using the towers as shields.

Curved Pile and Rock Breakwater Built in Deep Water

Piledriver Follows Radius Cable or 50-ft. Chord With Offset Sights—Transits on Pile Platforms Check Lines

BUILDING a pile breakwater on curves of varying radii in water 15 ft. deep, at Chicago, required special survey methods to insure accurate line and location, since this structure is to form eventually the west side of the formal or decorative part of a lagoon in the new Lake Front park, as described in *Engineering News-Record*, Oct. 13, 1921, p. 614. All the work was done in the open water of Lake Michigan, and the piledrivers were kept on the outer or lake side of the breakwater. A plan of the work is shown in Fig. 1.

For radii up to 500 ft. the center of the curve was located by triangulation and marked by a pilot pile, in the head of which a vertical bolt was driven. A ring on the end of a ¼-in. wire cable was placed over the bolt, the cable being coiled on the piledriver and having a tag

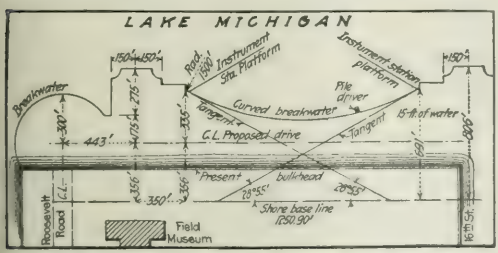


FIG. 1. BREAKWATER BUILT ON CURVED LINES IN DEEP WATER

tied to it to mark the required radius distance. As each pile was placed, the driver was shifted to bring this tag into the leads. The inner row of piles was driven first, and the driver then moved out to place the outer row, the distance being measured by a tape from the piles already driven. At some of the corners it was necessary to mount a piledriver on the two lines of piling in order to place the cross bulkheads.

A chord and offset method, using 50-ft. chords, was used for locating the breakwater line on a curve of 1,500 ft. radius extending over a length of 1,250 ft. At each end of the curve location was placed an instrument platform 8 ft. square, supported on four piles, the instruments sighting on a base line established along the shore. In starting, the instrument was sighted on the base line station and a guide pile was set at 50 ft. from the instrument. The piledriver then worked along this 50-ft. chord. On the last pile a horizontal plank was bolted, with a pole and flag upon it at the required offset distance, 1.66 ft. This is shown in Fig. 2.

At the end of the first chord, the observer on the piledriver sighted from the leads on a backsight placed at this same distance on the instrument platform. The driver then worked ahead another 50 ft., the observer sighting from the leads and along the completed part of the chord to the backsight. At the end of this distance, the observer sighted upon the backsight flag of the first chord. The movement was checked at intervals by the instrument man on the platform, but much of the work was located simply by the backsights.

In this way the curve was laid out as a succession of 50-ft. chords. Since the bow of the piledriver was lashed snugly against the piles already driven there was little difficulty in keeping line, but any slight irregularities were adjusted when the waling timbers were bolted up. In addition to being lashed to the piles, the driver was moored by lines leading from one side of the stern to the completed work and from the other side of the stern to an anchor. With these lines and a bow line the driver was readily shifted and held in position.

The inner row of piles was first driven for the entire length of the curve and then the driver placed the outer row and the cross bulkheads. This part of the work required much more shifting of the piledriver, as it had not only to traverse the curve but to move in and out at each cross bulkhead.

For curves up to 100-ft. radius the 12 x 12-in. wales were built up of two pieces 6 x 12-in., four 3 x 12-in. or six 2 x 12-in., to permit of bending to the curve. The 6-in. steel channel for the outside top wale was sufficiently flexible to bend in place, the sharpest curves being of 75-ft. radius. Carpenter gangs on scows placed the waling timbers on the two lines of piling and the cross bulkheads.

Rock for the filling was dumped outside the breakwater by scows, and was put in place by dipper dredges. Although this method involved additional handling of the material, it was more rapid and economical than placing the stone direct from the scows to the breakwater by means of a crane and grab bucket. This latter method would have detained the scows materially and would probably have resulted in more or less damage to the scows.

Construction was relatively slow owing to the curves and the irregularity of line of the breakwater, but 7,500 ft. of completed work was built in 5½ months. This included the two rows of piles, sheeting and stone fill. Unusually frequent fluctuations in the lake level occurred throughout the summer, the extreme range being 3 ft. This caused some trouble in keeping the pile heads at uniform level, as measurement from the water surface was not reliable. A 150-ft. opening was left near the middle of the breakwater for the passage of scows and floating equipment. With the fluctuations in lake level there was an almost continual change of current through this opening, connecting the lake with the large enclosed water area. This current, flowing sometimes inward and sometimes outward, was a source of trouble in handling scows through the opening and caused variable currents within the enclosed space.

This breakwater was built for the South Park Com-

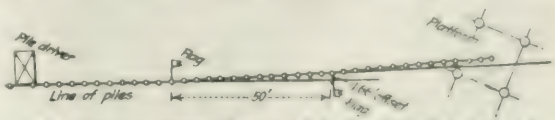


FIG. 2. CHORD-OFFSET METHOD OF GUIDING PILE DRIVER

missioners under the direction of Linn White, chief engineer, with M. N. Lovewell and John P. Ball, as assistant engineers. The Great Lakes Dredge & Dock Co. was the contractor, the work being in charge of John F. Cushing, vice-president and Wm. Murphy, general superintendent.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Anthology of Scientific Verse

Sir—I am making a collection of verse whose subject matter relates to the sciences or the various branches of engineering, with the intention of publishing an anthology of such verse. It has occurred to me that among the readers of the *Engineering News-Record* there must be some who have in their possession verse of this nature. I should be pleased to receive such verses, together with the names of their authors. (My address is—Dr. C. E. Ruby, Box 130, M.I.T., Cambridge, Mass.) Details as to place of publication, if the verses have been published, will be appreciated.

C. E. RUBY,
Massachusetts Institute of Technology.

Cambridge, Mass., Feb. 23.

Teaching Descriptive Geometry

Sir—For a number of years I have taught descriptive geometry from several different textbooks. New textbooks are coming onto the market continually. To my mind there is such a display of ignorance on the part of the writers of these textbooks that I am constrained to offer a few comments with the idea of helping some of your readers, especially those who teach the subject.

For example, I have just read a circular of a new text on this subject in which first-angle projection is taught. In another new text just received the ground line, traces of planes on the planes of projection and the like are used. To my mind that sort of teaching is decidedly out of date. What draftsman out in practical work in an office ever uses the trace of a plane or a ground line such as these textbooks use? They do not use them. The draftsman uses the object itself. He starts with its center line or some line or point on the object. True, he may cut a section and show where the cutting plane lies and the direction of the line of sight, but he does not carry the trace of the plane to the ground line and all that sort of nonsense.

There is just one textbook that presents this subject in conformity with the way it is used in practical work, and that is the one written by Millar, Maclin and Markwardt of the University of Wisconsin. The book is published by Tracy & Kilgore, Madison, Wis. I am not interested in promoting this particular book, but it is the only one I know of that presents the work in a logical practical fashion.

Soon after I was graduated from the University of Illinois I started to work as a templet maker in a large shop in Chicago. One of the first experiences I had was to make a lot of right-hand pieces for left-hand pieces and vice versa. I received a "calling down" that made a lasting impression on me. I had been taught wrong in school. Why cannot our teachers and writers of textbooks wake up and get a little nearer the standard shop methods.

When the subject is properly taught, the student not only gets into the right habit of thinking of projection, but he also grasps the subject much more easily. If you wish to talk of a plane or represent a plane use a point and a line to define the plane, or two intersecting lines or two parallel lines, just as you do when you are actually drawing a bridge-abutment wing-wall. Why worry about the trace of the plane upon some other plane that is somewhere in space? Further illustrations might be given.

Since using this method we have had no trouble in keeping up interest in the subject and we get results. Any textbooks we receive that present this matter in the old fashioned way will immediately go to the scrap heap.

B. KETCHUM,
Professor of Civil Engineering,
University of Utah.

Salt Lake City, Utah, Dec. 8, 1921.

Past Warnings and the Future

Sir—I think many readers of *Engineering News-Record* will have enjoyed that well written and excellently illustrated article, "Controlling a Mountain Torrent in Switzerland," which appeared in the issue of March 2.

We may look back now, not without profit, and see how eloquently, but how fruitlessly, John Ruskin went forth to battle for those rich slopes of Italy, Switzerland and Germany, to save them from their fierce, ungoverned streams. He shows us how, even in 1871, the principles of control of mountain torrents at their sources, and of terraced irrigation, as practiced by half savage peoples in China and Borneo, and then in Italy by that great engineer Leonardo da Vinci as early as 1500 A. D., had been so little used—but wherever used, how powerfully successful. (See "Arrows of the Chase," Letters on "Roman Inundations," and "Verona and Its Rivers" by John Ruskin.) Not without profit, I say, for by examination of repeated disasters of the past, we may win our way to greater public safety for the future.

Have we not had tragic lessons from our grade crossings? I believe (I have no figures) the toll of victims in the United States, every week exceeds that arising from the Knickerbocker Theater disaster. Is our concern what it should be? And does it beget the merited action? We blame our fathers for their slowness in learning such lessons: shall our children still blame us?

HADDON C. ADAMS,
Junior Highway Engineer, Illinois State Highway Commission.

Springfield, Ill., March 7.

Urges License To Raise Building Standards

Sir—Apropos of the recent Knickerbocker Theater failure I should like to offer a few ideas on the licensing of engineers with respect to building construction.

Years ago the architects insisted on state licenses; why did they as a body advocate them? Privately, to protect their pocketbooks, and openly, to protect the public. One of the practices then in vogue among ambitious carpenters and contractors was to offer to make the necessary drawings, secure a permit and put up a building without charge for the drawings. Owners considered the saving in architect's fees and accepted such propositions.

Now this practice affected the earnings of architects, but did they say that when they agitated for building codes that would read "permits will be issued only on drawings and specifications properly made and submitted by a competent architect?" That is the way I think they had it at first. The word "architect" really meant nothing, as any one who could make any kind of a drawing could claim to be an architect. Judgment as to competency was up to the local building department, and the "hail-fellow-well-met" ways of the contractor went further than the dignity of the architect. A more effective cure was then sought in the state license laws. In some cases the contractors took out architects' licenses, as they were entitled to do; for in most cases the law provided that any one then practicing the profession or who had made the plans for two or more buildings could take out a license during a certain period of grace. After that period an examination became necessary, and the building codes were changed to read a "licensed architect" instead of a "competent architect."

So much for the architects' license law. It was the doctors, however, who started the ball rolling. To practice medicine at one time it was necessary only to have a diploma from some so-called medical school or to have studied a certain number of years under another physician; in plain words, to have served an apprenticeship. At a number of so-called medical schools diplomas could be secured in short order on payment of the price, and in the eyes of the law the holders of such diplomas were physicians. Then *legitimate* physicians got together and arranged matters so that no one was allowed to practice medicine unless he had passed an examination by a state

board of medical examiners. The fact that he had graduated from a medical school did not count. That stopped the practice of the medical profession by any except those properly and legally qualified. Public confidence was again restored and the proper respect and standing of the medical fraternity was assured forever.

In those times a couple of law books and an office constituted a lawyer. But the lawyers got together and passed laws calling for examinations at the bar before one could legally practice; and again the public was saved from being imposed upon by shysters, as the incompetent could not practice law. No one can deny that the licensing of these three professions was a benefit to the public and also to the professions themselves.

The doctors, with their national medical society and state associations, have made and enforced a code of ethics that, morally if not legally, makes them a combination in restraint of trade. Likewise, the American Institute of Architects has its ethics, but the proportion of architects who are members of the A. I. A. is not so large as that of the physicians, who belong to medical societies. The lawyers have their ethics and their state and bar associations, but do not fix a certain minimum emolument for their services as do the architects and physicians. You can dicker with a lawyer.

Now the engineering profession is not so old as any of the others either in knowledge or in the eyes of the public. As a matter of fact, until iron and steel were applied to buildings the engineer was not a necessity in the building field and when he did become necessary, the architects were already thoroughly entrenched with their state license laws and building code requirements. They saw to it that the necessity for an engineer did not become a matter of public knowledge; and they have been opposed to licensing engineers and changing building codes for fear the engineer would do the work of the architect.

Times have changed, and today the engineer should be protected as well as any other professional man. Engineering details of construction determine the safety of a modern office, theater or industrial building, and the competence of the engineer should be established just as surely as the competence of a physician to practice his profession.

The architecture on a building today is merely the ornamentation; yet, due to archaic laws, the architect is recognized as the supreme authority on a subject he knows nothing about. Today architects are allowed to make drawings, taking their sections from a Carnegie or other handbook, file them and get a permit. If they do hire an engineer to do the engineering, the engineer cannot compel the architect to do a single thing in the way of changing his plans and, as in the case of the Knickerbocker Theater, the architect can allow the plans of the engineer to be changed without consulting him.

This raises the question, should a fabricating company be allowed to make drawings for the architect or to substitute plans for his? I say no, because those employed in such companies have, as a rule, very rarely had the experience that qualifies them to design properly. Experience is what counts in engineering more than in any other profession, and judging from the design of the Knickerbocker Theater and the details of fabrication of the steel, not only inexperience but also absolute incompetency was shown. The mere fact that a man has graduated from a technical school does not make him a competent designer. He may have all the theory but he has no knowledge of application or of details, etc. After graduation a man should spend at least four years detailing, in the field and in the shop, to become an absolutely competent designer. In addition to all this, all plans should be thoroughly checked before being submitted, and the checker should be an engineer other than the designer. Building codes should call for this.

If we have no license laws and the engineering profession consequently has no legal standing, [illegible] on safeguards as to engineering design [illegible] so long as the architect is licensed and [illegible] recognize his decision as final? This is a condition for which the engineering profession as a whole is responsible. So long as we see the cause and do not try to correct it, accidents like the Knickerbocker failure are our fault and will continue to be our fault.

F. F. CARMIENCKE,
Structural Engineer, Willys-Overland Co.
Toledo, Ohio, March 3.

In Support of Corps of Engineers

Sir—I was not a little surprised to read a letter "In Support of Corps of Engineers" (your issue, Dec. 1, 1921, p. 909), and to find that it should appear necessary to direct or call attention in the United States to the efficiency of the Corps of Engineers. No branch of your service gained higher distinction in France. It was the one branch that won immediate praise even from those inclined to be most critical of their allies.

Your correspondent cites the corps' achievements in France, which were on a scale of operation that called more particularly for powers of organization than for individual or sectional initiative. Less is known, naturally enough, of the corps' representation in the North Russian "sideshow." I had the privilege of being closely associated with the 1st Battalion, 310th U. S. Engineers, commanded by Lieut.-Col. P. S. Morris, throughout their service with the Allied Forces at Archangel, and of seeing their work in detail from base to front line. Arriving at Archangel in September, 1918, fresh from camps, the battalion's ardor for the fray calls for little praise. Any good troops would have shown the same spirit—some troops did not. But their ardor was speedily converted into effective and gallant service, which was proved repeatedly in a diversity of ways during a severe North Russian winter. There was no question as to the effectiveness of the corps' training or as to the rapid and remarkable adaptability of the battalion to abnormal conditions. Whether in the construction of winter barrack-huts, the wiring of front-line entanglements or the building of block-houses and emplacements, whether on river, railroad or forest track, the 310th made good. They gained the lasting esteem of Major-Gen. Sir Edmund Ironside, commanding the North Russian Expeditionary Forces and of their British comrades of every rank and unit.

RALPH S. G. STOKES,
Formerly Colonel, Royal Engineers.
Kimberley, South Africa, Feb. 8.

Rain Gage and Intensity of Rainfall

Sir—About six years ago the writer devised and installed a simple recording rain gage which has given such satisfaction for the outlay that he is prompted to pass a description on to others who are interested in collecting rainfall intensity data.

A standard 12-in. recording gage, making one revolution every 12 hours, built for heads of 75 in., is used. The gage is connected to the base of a 4-in. standpipe about 7 ft. long, which receives the water, through a short piece of ¾-in. pipe, from the collecting funnel above the roof. The top section of the collector, a cylinder, has a section just ten times that of the standpipe so that a 1-in. rain will show 10 in. on the chart.

The accuracy of the instrument has been tested by pouring water into the collector at variously measured rates and by means of a standard rain gage on the ground and is believed to be sufficiently accurate for general purposes.

The records show that we may expect the following for this place: 0.8 in. in 8 min.; 1 in. in 13 min.; 2 in. in 1 hr.; 3 in. in 3 hr.; 4 in. in 12 hr.; 5 in. in 24 hr. These rates have all been reached or closely approached several times during the six years, but have been exceeded by only one rain (6.4 in. in 18 hr.) which, however, showed no intensities for shorter periods exceeding those given above.

J. H. DORROH,
Dean, School of Engineering,
University of Mississippi.
University, Miss., March 8.

NEWS OF THE WEEK

New York, March 30, 1922

Baltimore Plans $50,000,000 Harbor Project

Tentative Layout and Policy Look to Systematic Development of Port Under Central Control

Comprehensive plans for the improvement of Baltimore harbor involving projects that will cost $50,000,000 and will require at least twenty-five years to complete have been announced by the Baltimore Port Development Commission.

The principal elements of the plans are: (1) McComas St. terminal, to be built on the Locust Point water front with a frontage of about 4,800 ft. between Port Covington and Fort McHenry, which will provide eight piers each 1,200 ft. long and 250 ft. wide with berths for thirty-three 12,000-ton steamers, together with twenty warehouses and capacity for 2,500 freight cars; (2) reclamation of the Patapsco flats and the construction there of five piers, each 1,200 ft. long and 300 ft. wide with berths for twenty-three 12,000-ton steamers, together with twenty warehouses and capacity for 4,900 freight cars.

Provision has been made also for the construction by the commission or by the railroads of eight piers on the property of the Canton company near Riverview, and an equal number at nearby Pennsylvania R.R. terminals. Other items include the improvement of existing municipal piers and of the city's Hughes St. property, and several minor projects on the eastern side of the harbor.

Leases to Precede Construction

The announced policy of the commission contemplates the ultimate unification of control and operation for all terminals and their connections with the trunk-line railroads serving the port. Improvement will be undertaken, therefore, with a view primarily to the needs of the port as a whole and secondarily to meeting the immediate requirements of lessees. The commission will design and construct improvements for lessees or will construct to the lesseess' plans provided the latter are approved by the commission. The commission will consider also application from lessees for the improvement of habor facilities anywhere in the port provided these are in line with the policy of the commission.

Construction of any improvement will not be undertaken until the city has taken title to the property involved and until after the execution of a ten-year lease at an annual rental equal at least to the sum of the annual interest on the cost of acquisition and improvement of the property and the annual sinking or retiring fund. In the case of improvements on city-owned property the appraised value of such property ls to be included as part of the cost of improvement.

The commission records its judgment in favor of the construction by the railroads of a belt line around the city that would tap all the railroads entering Baltimore outside the congested area. Such a line, it points out, would make possible ready interchange of freight between the various elements of the port development.

"The Public Improvement Commission," says the Port Development Commission, "now has available for immediate use in the development of the harbor a fund af $2,200,000. With the co-operation of the Improvement Commission, the Port Commission will have at its command the use of this sum. Ten million dollars of the $50,000,000 development loan already has been authorized and will be available as soon as leases are made; and when made, a part of this loan can be used for replacing the amounts advanced by the Public Improvement Commission. In this way a revolving fund will be kept intact for a working capital and the Port Commission would be enabled to initiate immediately the improvements in accordance with the plans herein set forth."

Flat-Slab Case Before Federal Court of Claims

Suit against the U. S. Government for infringement of concrete flat-slab patents has been brought by C. A. P. Turner of Minneapolis, one of the earliest patentees in the flat-slab field. This action of Mr. Turner is a different legal process than has hitherto been applied to the flat-slab situation. All previous flat-slab cases have been in the federal courts and were suits against infringement of patents by one or the other of the patentees.

This case is a suit in the Court of Claims, the only court in which action can be taken against the federal government, and is expected to develop from the beginning the facts and representations in the flat-slab controversy, which have been left in some confusion by different district courts and Courts of Appeal decisions in the earlier patent suits.

New Jersey Engineer Registration Board Appointed

Under an act passed last year by the New Jersey Legislature, Gov. Edwards on March 17 appointed the following as comprising the board of professional engineers and land surveyors:

Thomas J. Wasser, state highway engineer, for the one-year term; George H. Noble, of Clifton, for the two-year term; John C. Remington, Jr., Haddonfield, for the three-year term; Harvey Snook, county engineer of Sussex County, for the four-year term; and Hugh A. Kelly, engineer for the department of Parks and Public Property, Jersey City, for the five-year term.

Under the act the term of office is five years but the appointments are made as indicated above so that a new member may be appointed yearly.

Philadelphia Engineers Hold Hydro-Electric Symposium

Engineers of Philadelphia, under the auspices of the Engineers' Club, held another hydro-electric conference March 21 similar to the successful one held last year. This symposium was under the auspices of the local sections of the American Institute of Electrical Engineers, the American Society of Civil Engineers, the American Society of Mechanical Engineers, and in co-operation with the power division of the American Society of Mechanical Engineers. A remarkably good attendance was had at both sessions, afternoon and evening, and at the dinner. The conference was started at a luncheon at the Engineers' Club, at the end of which Dr. Arthur M. Greene, Jr., the dean-elect of engineering at Princeton University, gave a short talk on the modern trend in engineering education. Dr. Greene presided at the technical sessions devoted to the hydro-electric program.

Chief attention during the meeting was given to the Queenston-Chippawa development of the Ontario Hydro-Electric Power Commission, but there were additional papers by N. C. Grover, chief hydraulic engineer of the U. S. Geological Survey, on the relations of water resources to the country's development; Prof. Charles M. Allen of Worcester Polytechnic Institute on the salt velocity method of measuring water in pipe lines; R. D. Johnson on studies in the problem of unsteady flow in open channels, and by H. Birchard Taylor and Lewis F. Moody of the Cramp Co. on the hydraulic turbine in evolution. Besides these papers, the Queenston-Chippawa job was described by H. G. Acres, T. H. Hogg, E. T. J. Brandon, and P. B. Yates. Finally, F. H. Rogers of the Cramp Co. gave a detailed lecture on the 55,000-hp. turbines in the new Canadian-Niagara project.

Chicago Union Station Program

Great progress is to be made in 1922 on the new Union Station in Chicago. Much of this will be evident to the public, supplementing the foundations, sewer and street alterations, viaducts, and other inconspicuous auxiliary work which has been in progress for some years. It is expected to erect all the steelwork for eight stories of the 21-story headhouse and office building and for the concourse and to lay some of the new station tracks.

As a preliminary to this work, suburban traffic at the south end of the station will be transferred in April to a temporary station, one block south, using part of the permanent tracks which have been laid at the new grade, about 4 ft. below the present track level. A contract for 18,000 tons of steel for the headhouse, concourse and approach viaduct was placed in February. All this work is under the direction of J. D'Esposito, chief engineer of the Chicago Union Station Co., and A. J. Hammond, assistant chief engineer.

Make Progress Toward Uniform Road-Material Specifications

Testing engineers representing the state highway departments of New Jersey, Delaware, Maryland, Virginia, West Virginia, Pennsylvania, and Ohio, met with officials of the U. S. Bureau of Public Roads in Washington, March 23. The object of the meeting, as explained in last week's issue, was to harmonize the specifications for materials used in road construction and thus enable the use of materials from the same source without difficulty. The committee made rapid progress with the work and decided on uniform specifications as to the sizes and quality of crushed stone, crushed slag and gravel for use in the following types of paving: Concrete, bituminous concrete, sheet asphalt, brick, bituminous macadam and waterbound macadam.

Specifications were also decided on for tar and asphalt for bituminous roads and for the quality and grading of sand for concrete and bituminous concrete construction.

The work of the committee along with that of committees representing other groups of states will be reported at the next annual meeting of the American Association of State Highway Officials for final adoption, probably in December.

A meeting of a committe of the American Society for Testing Materials for the purpose of revising its specifications for highway materials was held at the Bureau on March 24.

A sub-committee on non-bituminous materials of the committee on road materials discussed specifications and standard tests for road materials. The membership of this committee is composed of engineers and producers. Among the propositions discussed were specifications for the slump test, specifications for the use of calcium chloride as a dust preventative on gravel roads, and methods of testing subgrades. Another sub-committee discussed specifications of oils, asphalt and tar.

Boise Granted Preliminary Power Permit

The City of Boise, Idaho, has been granted a preliminary permit for a power project on the North and South Forks of Payette River, Idaho. The proposed scheme contemplates a complete hydro-electric development of 8,000 hp. capacity on the North Fork of the river to be followed by development of 4,000 hp. on the South Fork as soon as market conditions warrant. The project on the North Fork includes a diversion dam 75 ft. high, which will create a storage of 2,300 acre-ft. A 7-ft. pipe line is to extend downstream from the dam for one-half mile and connects with a tunnel 1,000 ft. in length, which will be driven through the mountain dividing the North and South Forks of the river. The power house will be located on the South Fork. The turbines will operate under a head of 250 ft.

The proposed development on the South Fork of the river includes a diversion dam 50 ft. high which provides 1,200 acre-ft. of storage. An 8-ft. pipe line will lead from the dam 1,000 ft. downstream to the power house where 4,000 hp. can be developed under a head of 97 ft.

Bayonne Gets Rights to 50 M.G.D. from Ramapo River

Right to divert 50 m.g.d. from the Ramapo River for water supply was granted to Bayonne, N. J., by the Department of Conservation and Development on March 23. Shortly before, the department denied an application from Bloomfield for 10 m.g.d. The Bayonne permit contains provisos stated in the editorial columns of this issue. Clyde Potts, consulting engineer, New York City, is engineer for Bayonne.

Tennessee Engineers Must Register by April 9

H. C. Hibbs, secretary of the State Board of Architectural and Engineering Examiners of Tennessee, has issued a statement in which he calls attention to the fact that architects and engineers practising within the state must be registered by April 9, 1922, or become violators of a chapter of the registration bill which imposes a fine for non-registration.

Bates Road Tests Started

Motor-trucks started traveling over the Bates test road near Springfield, Ill., this week. The loads on the trucks will be progressively increased until the 63 different pavement sections have been destroyed. The construction of this road was described in "Engineering News-Record" Aug. 18, 1921, p. 274.

Philadelphia Sesqui-Centennial Fair Site Chosen

The directors of the Sesqui-Centennial Association have approved the Fairmount Park-Parkway site for the exposition which is proposed to be held in Philadelphia in 1926. This is the site recommended by a joint committee representing the Engineers' Club of Philadelphia, the Philadelphia Chapter of the American Institute of Architects, and the Philadelphia Real Estate Board. The site embraces land on both sides of the Schuylkill River in Fairmount Park, with entrances from the Parkway at some point west of Logan Square.

The Pennsylvania Legislature in 1921 authorized the Governor of the State to appoint a Sesqui-Centennial Exhibition Commission and appropriated $10,000 to defray its expenses. In the spring of 1921 the Mayor of Philadelphia appointed a committee of 100 citizens to take up the project. This committee, in conjunction with the Mayor of Philadelphia, selected a commission of 25 who were later incorporated as the Sesqui-Centennial Exhibition Association with authority to construct and operate the exposition.

On June 1 of this year the city of Philadelphia pledged itself to appropriate $1,000,000 and as much more as may be required of the funds for the exhibition which is to commemorate the 150th anniversary of the signing of the Declaration of Independence. It is assumed that upon the site being selected the commission will ask for appropriations from Congress. On March 3 Senator Baird will introduce the project to Congress.

Marine Borers Subject of Engineering Discussion

An outline of the investigations to be carried on in New York harbor by the committee on marine-piling investigations of the National Research Council was indicated at a meeting held last week at the Engineering Societies' Building under the auspices of the Municipal Engineers of the City of New York. The committee has but recently organized and is now formulating a program which will combine biological, chemical and engineering phases in its investigation.

Various speakers, including R. T. Betts of the Research Council committee; Col. Wm. G. Atwood, director of the investigation, Prof. Thurlow C. Nelson, of Rutgers College, and C. M. Taylor, superintendent of the Port Reading creosoting plant of the Central Railroad of New Jersey and the Philadelphia & Reading R.R., described the life and activities of marine borers and set forth the possibilities for excessive damage in New York harbor that existed in the discovery last year in Barnegat Bay, N. J., of the *teredo navalis*.

From the speeches and ensuing discussion, it was brought out that an adequate investigation should comprise, in its biological phase, studies of food conditions in the water, identification of borers found, their distribution, etc.; from the chemical side, studies upon the salinity of the water, water temperatures, sewage content, and other pollution; and from the engineering standpoint, means of circumventing, if possible, damage from the marine borers. Matters have been complicated, it was pointed out, by the fact that the teredo could live in highly-polluted water, a theory until recently held inaccurate.

Though it was admitted damage might result from the presence of the teredo in Barnegat Bay, the deputy commissioner of the Department of Docks of New York City reported that periodic investigations had failed to reveal either limnoria or teredo in the North and East Rivers, though limnoria had caused some destruction in Jamaica Bay. He asserted that in a recent pulling of several piles in the bulkhead on pier 1 of the Chelsea piers in the North River, piles were found almost as good as the day they were placed and it is presumed that they were driven in 1857.

Passaic Valley Sewer Bids Are Invited

Resumption of construction on the Passaic Valley sewer in New Jersey is indicated in an announcement that the Passaic Valley Sewerage Commission, of Newark, N. J., will receive bids April 18 for the continuation and completion of section 2, comprising the outfall pressure tunnel under New York Bay and Jersey City.

Purchasing Department Created

A bill, passed by the New York Legislature and creating a State Department of Purchase to buy all supplies for state departments and institutions, was signed by Governor Miller on March 15. The Governor is authorized to appoint a superintendent of the department at a salary of $10,000 a year.

Eliminate More Paving Brick Varieties

Recognized Types and Sizes Reduced to Seven at Recent Washington Conference

The standing committee on Simplification of Varieties of Paving Brick met in Washington March 27 under mandate of the conference of Nov. 15, 1921, to consider further eliminations of size and varieties of paving brick. As a result of the deliberations 4 additional sizes or varieties were eliminated, thus reducing the recognized types and sizes to 7. The November conference had reduced the current 66 varieties to 11.

Since this was its first meeting the standing committee effected its organization by electing E. J. Mehren, editor of *Engineering News-Record*, chairman, and H. R. Colwell, of the Department of Commerce, secretary. Organizations were represented as follows:

W. A. Hull, Bureau of Standards; Will P. Blair, American Society for Testing Materials; Col. R. Keith Compton, Federated American Engineering Societies; M. B. Greenough, National Paving Brick Manufacturers Association; L. C. Herrick, American Association of State Highway Officials; E. W. McCullough, U. S. Chamber of Commerce; V. M. Peirce, U. S. Bureau of Public Roads; and W. A. Durgin, chief, division of simplified practice, Department of Commerce.

In the absence of G. F. Fiske, Col. Compton also represented the American Society for Municipal Improvements. The other absent members of the committee were Wm. D. Uhler, American Society of Civil Engineers, and Ross C. Purdy, American Ceramics Society.

Many Organizations Approve

Mr. Durgin reported that the following organizations had approved the eliminations made by the November conference: National Paving Brick Manufacturers Association; American Association of State Highway Officials; American Institute of Architects; American Ceramics Society; Engineers Club of Columbus; Indiana Engineering Society; Western Society of Engineers; American Society of Civil Engineers; the Departments of Agriculture, Commerce, Interior, Navy and War.

The representatives of societies present reported that the reactions they had heard were entirely favorable.

In preparation for the meeting the Manufacturers Association had made a canvass of shipments for the year 1921, and had also canvassed the opinions of the manufacturers with regard to their preferences for the 11 recognized types and sizes. As a result of considering these additional data, together with the facts presented in the survey reported in November, the committee by unanimous vote eliminated the following types and sizes:

Vertical Fiber Lug	3 x 4 x 8½-in.
Vertical Fiber Lug	3½ x 4 x 8½-in.
Wire-Cut Lug Hillside	3½ x 4 x 8½-in.
Repressed Lug	3½ x 3½ x 8½-in.

There thus remain the following seven recognized types and sizes:

Plain Wire-Cut	3 x 4 x 8½ in.
"	3½ x 4 x 8½ in.
Repressed Lug	3½ x 4 x 8½ in.
Wire-Cut Lug	3½ x 4 x 8½ in.
"	3½ x 3½ x 8½ in.
"	3½ x 3 x 8½ in.
Repressed Hillside	3½ x 4 x 8½ in.

Objection was raised to calling these retained types and sizes "standards," since this is likely to be confused with the word as applied to technical standards which aim to define what, in the judgment of qualified experts, is a preferred design, process or procedure. As a result of the discussion the committee concluded to call the retained varieties "Recognized Types and Sizes."

The committee considered that with these four additional eliminations it had proceeded as far as was desirable until there were further reactions from consumers and producers with reference to elimination work. It was therefore concluded that no further eliminations should be considered until March 1923, at which time data of shipments for the year 1922 would be available and the opinions of producers and consumers could be canvassed.

N. Y. Highway Contractors War-Relief Act Unconstitutional

More than 300 claims by contractors seeking to recover approximately $4,000,000 from the State of New York for the difference between original contracts and the cost of work performed during the war are lost by a decision of the Court of Appeals declaring the Knight act unconstitutional.

Attorney-General Charles D. Newton conducted the case for the state. His argument, that the Knight law was unconstitutional, was based on a clause in the Constitution which says "the legislature shall not grant any extra compensation to any public officer, servant, agent or contractor."

In its decision the Court of Appeals likened the contracts involved in this case to other ordinary contracts, pointing out that "equity and justice recognizes the inviolability of contracts, protects and enforces the rights of parties thereunder, inhibits an unlawful abrogation of the same, awards damages arising from a breach thereof and likewise decree specific performance."

The court held that equity and justice do not require the state to reimburse the contractor for an increased expenditure incurred by him in the performance of a contract due in no measure to the act of the state.

"The state," the court said, "did not undertake to indemnify the claimant against loss upon his contract. On the contrary, it required him to give a bond for a strict compliance on his part with the terms of the same. War conditions and the increased cost of labor and materials, or scarcity of labor, were not precipitated by the state or due to any act upon its part."

The Knight act was a special act, passed in 1919 for the relief of highway contractors. The court decision has no reference to the Walters act of 1918, by which the state barge canal contractors and the New York subway contractors have been reimbursed for extra war costs.

May Provide Funds for Snow Removal From Highways

New York County boards of supervisors are authorized to appropriate money for the removal of snow from highways under a bill passed by the New York Legislature and approved by the Governor.

Municipal Home-Rule Bill Passed by New York Legislature

A bill providing for a referendum vote on an amendment to the New York State Constitution passed the New York Legislature March 17. If re-enacted next year the amendment will go to the electorate in November, 1923.

Endorse Coleman for Presidency of Am. Soc. C. E.

John F. Coleman, of New Orleans, was endorsed as a candidate for the presidency of the American Society of Civil Engineers at a recent meeting of the Louisiana section of the society. It is understood that similar action has been taken by local sections in Texas, St. Louis and Buffalo. Mr. Coleman's supporters point out that the only president of the American Society of Civil Engineers ever elected from the far South was Major B. M. Harrod, who took office in 1897.

Tennessee Bridge Site Approved

The location for a bridge across the Cumberland River near Clarksville, Tenn., submitted by the Tennessee State Highway Department, has been approved by the U. S. Bureau of Public Roads. This bridge will be located about 1½ miles up the Cumberland River from Clarksville.

The design submitted by the state highway department calls for the construction of two 280-ft. steel spans, one 180-ft. steel span, eleven 48-ft. and two 24-ft. reinforced concrete-girder-approach spans.

The cost of this structure, for which bids will be advertised as soon as this design is approved by the bureau, will be about $300,000 and will be borne by Montgomery County, the State of Tennessee, and the federal government.

Army Would Enroll Former Enlisted Men as Reserve Officers

In order that the army may be enabled to avail itself of the services of the many engineers who served as enlisted men during the World War, the Chief of Engineers has announced that the War Department will commission such men in the engineer section of the Officers Reserve Corps, provided they have the technical qualifications to warrant their appointment.

Under this policy, these men can be enrolled in the higher grades without affecting in any degree the appointment as second lieutenants of the young and inexperienced graduates of the R.O.T.C. units of the universities; and in considering the applications of enlisted men for commissions in the Reserve Corps the examining board will exercise a wide discretion and will give great weight to professional and technical ability rather than to a detailed knowledge of military regulations. Officers so appointed will be given an opportunity to receive the necessary instruction in military subjects before they are called upon for actual service in their grades or before they are eligible for promotion to the next higher grade.

Detailed information may be had by writing to the Chief of Engineers, Washington, D. C., or to the corps engineer at the headquarters of any of the mine corps areas into which the country is divided.

May Name Engineer as Director of Indiana Highways

Governor McCray of Indiana is reported to be considering the selection of a successor to Lawrence Lyons, director of the Indiana State Highway Department, who is expected to resign in a few weeks. A report is current that an engineer is to receive more consideration than a politician.

Mr. Lyons has said that he probably will not resign on April 1, as has been reported, but will undoubtedly be out of office before the summer begins.

Paint-Labeling Bill Before Congress

Ingredients of all paints and varnishes handled in interstate commerce must be listed on the container, under a Congressional bill of Senator Ladd, of North Dakota, who was influential in enacting a pure-paint law in North Dakota. The latter law in effect now for twelve years, has according to Senator Ladd proved a boon to the public and to paint manufacturers. He expects to secure the co-operation of manufacturers of paints and varnishes in promoting similar federal legislation.

Jersey Central Bridge Project Further Delayed

By rejecting plans presented by the Central Railroad of New Jersey for a new bridge across Newark Bay between Bayonne and Elizabethport, the State Board of Commerce and Navigation on March 20 further delayed the replacement of the present bay crossing. The matter is in the hands of the board because the War Department, whose approval of plans for the new bridge is required by the Congressional act authorizing its construction, has made its action contingent on prior approval by the New Jersey board. Questions of clearance height (as between 20 and 35 ft.) and width of channel through the draw are among the points of contention.

Indianapolis Studies Zoning and Major Street Plan

Studies for zoning ordinance for a major street plan for Indianapolis are being made for the Indianapolis City Plan Commission. The engineering work of the commission is in direct charge of Lawrence V. Sheridan, executive secretary of the commission. Robert H. Whitten, of Cleveland, is consultant for the City Plan Commission—instead of being consulting engineer, as was stated in *Engineering News-Record*, Feb. 16, p. 295.

Long-Span Bridge for Alaska

The Alaskan Engineering Commission has called for bids for the construction of the Nenana bridge on the Alaska railroad. The bridge, which will be ready for service March 1, 1923, will practically mark the completion of the line to Fairbanks. At present the railroad beyond the Nenana River is being operated as a narrow-gauge line, but standard-gauge ties have been placed, ready for setting the rail over as soon as the bridge is completed. The new structure is of particular interest since it will have a 700-ft. truss span, built in large part of special steel.

Am. Soc. C. E. Convention at Portsmouth

The American Society of Civil Engineers will hold its annual convention at the Hotel Wentworth, Portsmouth, N. H., June 21 and 22.

Brick Association Elects Officers

The National Paving Brick Manufacturers' Association, at its recent meeting, re-elected the following officers for the year 1922: Chairman of the board, S. M. Duty, Cleveland; president, O. W. Renkert, Canton; vice-presidents, W. M. Lasley, Chattanooga, and W. P. Blair, Cleveland; treasurer, C. C. Barr, Streator, Ill.; secretary, M. B. Greenough, Cleveland.

Vehicle Tunnel Contracts Awarded at $19,331,723

Booth & Flinn. Ltd., were awarded the contracts for the construction of the Hudson River vehicular tunnel at a meeting of the New York and New Jersey tunnel commissions in New York City, March 28. At the prices submitted the cost will be $19,331,723. The work, in addition to land and river shafts, involves the construction in compressed air of twin tubes of cast-iron, 29½ ft. in outside diameter, to be lined with concrete. The action of the two commissions follows the recommendation of Clifford M. Holland, chief engineer.

Concrete Road-Roller Patent Upheld by Court

The U. S. Circuit Court of Appeals, Fifth Circuit, at New Orleans, Feb. 24, upheld the Macon Concrete Road Roller Co.'s patent No. 1,253,022 for its process and device for finishing concrete pavements. The District Court had previously held valid and infringed claims 5 and 6 of the Ashmore and Morgan patent. The Court of Appeals reached the conclusion that the lower court did not err in its decision, rendered March 2, 1921, holding the patent valid.

The Macon Concrete Roller Co. of Macon, Ga., has issued a notice to infringers of the Ashmore and Morgan patent and process, granted July 16, 1918, that every means will be taken to protect the company's patent rights and to collect damages for unauthorized use.

Charge Limestone Combine

Suit was filed in the Superior Court, Indianapolis, March 24, by Attorney General U. S. Lesh, charging the existence in Indiana of an unlawful combination of companies controlling the quarrying and sale of Indiana limestone. The suit asks for a permanent injunction restraining a continuance of the [illegible] "combination and conspiracy" alleged, dissolution of the corporate charters and franchises of the named companies, [illegible] and for the appointment of receivers to wind up their affairs. Nine[illegible] is one of which is the alleged organization to which the quarrying companies belong, are [illegible]. It is charged that the Bedford Stone Club Auxiliary, Inc., is the controlling organization.

Federal-Aid Road Legislation Moves Forward

(Washington Correspondence)

A long step toward securing definite appropriations for federal-aid highway construction during the next three years was taken when the Senate on March 20 passed the Post Office Appropriation bill, which had been amended so as to carry $50,000,000 for federal-aid roads during the next fiscal year; $65,000,000 for the year to end June 30, 1924, and $75,000,000 for the year to end June 30, 1925. In addition the bill carries $7,500,000 for forest roads and trails during the year to end June 30, 1924, and an equal amount for the year to end June 30, 1925.

The amounts approved by the Senate are the same as those carried in the Woodruff bill, with the exception that the Woodruff bill provides $6,500,000 for forest roads for the year to end June 30, 1924. The Woodruff bill is the subject of hearings before the committee on roads of the House of Representatives. It is believed that the majority of this committee will vote to report out that bill. It will be necessary to bring up the Woodruff bill in the regular manner, as the chances are against the House accepting the Senate amendment to the appropriation bill. Under the rules of the House the Senate amendment is subject to a point of order.

The advantage which comes to the legislation as a result of the Senate's action is that the upper chamber has gone on record, without a single voice being raised in opposition, to the three-year program and to the appropriations likely to be passed by the House.

Indiana Seeks Cement Bids

The Indiana Highway Commission will open bids on from 75,000 to 150,000 bbl. of cement, April 5. In these bids it is required that the companies submit a mill-base price, exclusive of sack rebate, freight rates and cash-discount figures. Highway officials said that bids on approximately 200,000 bbl. of cement received last week from eight companies were still under consideration, but it is understood that the results of the competition were not satisfactory, due to the fact that the bids were made without quoting a mill-base price. An examination showed that some of the bids were based on a $1.60 mill base price, one on a $1.54 and one on $1.68, as compared with the $1.30 mill-base price quoted in February by the Marquette Cement Co.

New Federal-Aid Highway Bills

(Washington Correspondence)

Additional federal-aid highway bills have been introduced in the House by Representatives Doughton, N. C., and Robsion, Ky. Mr. Doughton proposes that for the fiscal year ending June 30, 1923, there shall be appropriated $100,000,000 and a like sum for the years to end June 30, 1924, and June 30, 1925. For forest roads and trails he proposes that $7,500,000 shall be appropriated for each of the years ending June 30, 1924, and June 30, 1925.

The Robsion bill would [illegible] the expenditure of $75,000,000 for the fiscal years of 1923 and 1924 and [illegible] for 1925 under the general provisions of the highway act and $10,000,000 each for 1924 and 1925 under Section 23.

Dr. Merriman To Be Guest of New York Lehigh Club

A dinner in honor of Dr. Mansfield Merriman, editor of the American Civil Engineers' Handbook, author of numerous engineering books, and former professor of civil engineering at Lehigh University, is to be given by the New York Alumni of that institution at the Aldine Club, New York City, April 18.

John R. Freeman, George H. Pegram, Robert Ridgway, Prof. Henry S. Jacoby, Prof. Frank P. McKibben and Prof. Ralph J. Fogg will be the speakers and many of the other associates of Dr. Merriman will attend the dinner.

Long-Service Water Meters at Rochester, N. Y.

In the news item on the recent meeting of he New York Section of the American Water Works Association, printed in the March 9 issue, p. 418, the statement that "Mr. Little remarked that a water meter sold to Rochester 32 years ago by the late John C. Tully, was still in use," should have read: "Several meters purchased 42 years ago from John C. Kelly were still in commission."

Concrete Restored in Indianapolis

Concrete is back on the records of the Board of Public Works of Indianapolis as one of the five materials on which bids will be received for the permanent improvement of streets and alleys in Indianapolis. The board restored concrete after having ousted it by resolution on March 1. The action was looked upon as a victory for John L. Elliott, city engineer, in his fight for lower paving costs.

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Spring Society Meeting, Dayton, Ohio, April 5-6; Subject, "Flood Problems."

NATIONAL FIRE PROTECTION ASSOCIATION, Boston, Mass.; Annual Meeting, Atlantic City, May 9-11.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, Philadelphia, May 15-19.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Annual Convention, Salt Lake City, Utah, June 5-7.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Annual Convention, Portsmouth, N. H., June 21-22.

The Pueblo Engineers Association held its annual meeting Jan. 25 and elected the following officers; President, H. K. Barton; vice-president, D. J. Cox; secretary-treasurer, W. B. Curry.

The Swedish Engineer's Society of Chicago held its annual meeting Jan. 28, at which the following officers were elected: President, John S. Gullborg; vice-president, A. Monson; financial secretary, C. J. Gustafson; treasurer, C. Hallbom; secretary, A. Cederoth.

The Jacksonville Chapter, A. A. E. elected the following officers at its recent annual meeting: President, George W. Simmons, Jr.; vice-presidents James A. Hammack and C. S. Hammatt; secretary A. C. Newman.

Tri-state Water and Light Association of the Carolinas and Georgia will hold its annual convention in Spartanburg, S. C., April 19-21. F. B. McDowell, Jr., assistant manager and engineer, Commissioners of Public Works, Charleston, S. C., will speak on the new 14,000,000-gal. concrete filter plant of the Charleston water department. C. W. Grantham, superintendent of water-works, Greensboro, N. C., will talk upon metering public water supplies. Representatives of the board of health from each state will deliver addresses on what their respective states are doing to protect the public water supplies and streams. Other papers of interest are planned for the various sessions.

Personal Notes

BURTON L. WINSLOW, who for 18 years was in the engineering department of Brockton, Mass., and was subsequently division engineer for the Bureau of Water-Works Improvement, Akron, Ohio, has been appointed town-manager of Stoughton, Mass.

H. W. SMITH, formerly plant engineer in charge of reconstruction and operation for the Great Western Portland Cement Co., Mildred, Kan., has been appointed street commissioner of Evanston, Ill.

F. C. BRUSH, Westfield, N. J., has been appointed city engineer of Norwich, N. Y.

PAUL S. JONES has been appointed superintendent of Imperial Mutual Water Co. No. 1, in Imperial Valley, Cal. He is a graduate of the engineering department of the University of California, and for a time was connected with the California Debris Commission in the San Joaquin and Sacramento valleys. In his new position he will have charge of all engineering work for the water company.

M. P. TUCKER, formerly chief engineer of the Firestone Tire and Rubber Co., has been appointed superintendent of the Akron, Ohio water-works.

H. B. BELFORD, formerly deputy county engineer, Wayne County, Wooster, Ohio, has been made resident engineer for the Illinois Highway Department with headquarters at Carbondale, Ill.

SAMUEL HART has been appointed deputy city engineer of Sacramento, Cal.

ARTHUR P. DENTON, for the past two years district engineer for the Portland Cement Association at San Francisco, has resigned to accept the position of sales manager for the Pacific Portland Cement Co. of San Francisco.

O. C. TRETTEN, for the past two years field engineer for the Portland Cement Association, with headquarters at Sacramento, Cal., has been appointed acting district engineer for that association with headquarters at San Francisco.

WALTER BARBER, who has been city purchasing agent for Long Beach, Cal., has been appointed assistant city manager. Mr. Barber was county engineer of Osceola County, Iowa, 1907-1910, and of Clay County, in the same state, 1910-1918.

ALBERT E. LAVERY, vice-president of the Bridgeport Hydraulic Co., Bridgeport, Conn., was elected treasurer of the company recently to fill the vacancy caused by the death of Walter S. Wilmot, who had been treasurer for many years.

RUDOLPH F. SCHAEFER, Richmond Hill, N. Y., DAVID ROBERTSON, Boonton, N. J., and HERBERT F. BUTLER, New Rochelle, N. Y., have been appointed assistant engineers with the New York-New Jersey Tunnel Commission.

HOLTON COOK, resident engineer, for the Department of State Roads and Highways of Kentucky, has been made assistant division engineer and transferred from Smithland to Ashland.

LOUIS P. SMITHEY and MATTHEWS H. TARDY, have opened an office in Roanoke, Va., for the practice of architecture and engineering. Both served in the World War, prior to which Mr. Smithey was contracting engineer for the Virginia Bridge & Iron Co., and Mr. Tardy was with the Du Pont Co., at Wilmington, Del.

J. H. MANNING has succeeded Col. Peter Junkersfeld as engineering manager of Stone & Webster. Col. Junkersfeld's retirement to enter the firm of Junkersfeld & McClellan was noted in these columns some weeks ago. Mr. Manning has been with Stone & Webster since 1910, prior to that time having been an assistant of Col. H. L. Cooper. He was superintendent of construction of a number of the western hydro-electric projects. During the war he was chief engineer and manager of the construction activities at Hog Island, and on his return to Boston became assistant engineering manager of Stone & Webster.

COL. GEORGE L. WATSON, consulting engineer, will collaborate with the George A. Johnson Co., consulting engineers of New York City, instead of incorporating his practice with that of the Johnson organization as announced in this journal, March 16, p. 465. Col. Watson has moved his office to the same address as that of the Johnson Company. In addition to serving his personal clientele Col. Watson will work with the Johnson Company on matters relating to surveys, reports, designs and supervision of construction of water works, water purification plants, sewerage systems, sewage disposal plants, refuse disposal stations, power developments and numerous other branches of civil, electrical and mechanical engineering. Col. Watson's experience covers a wide field in mining, tunnel, bridge, harbor improvement, pipe-line and sewerage work in the United States; and service with the British and American armies in Europe during the World War. He is a member of the board of consulting engineers to the New York State Bridge & Tunnel Commission and the New Jersey Interstate Bridge & Tunnel Commission.

T. J. IRVING has been promoted from assistant engineer of the Iowa division to division engineer on the Minnesota division of the Chicago & Northwestern Ry., with offices at Winona, Minn. He succeeds the late W. J. Jackson.

C. H. WELLS has been appointed assistant engineer on the Iowa division of the Chicago & Northwestern Ry. at Boone, Ia., to succeed T. J. Irving, promoted to the Minnesota division.

BUSINESS NOTES

FRANK A. FURST, who recently resigned as president of the Arundel Corp., has been elected chairman of the board of directors. JOSEPH J. HOCK, vice-president of the corporation, has been made its president.

F. E. WELSH, general superintendent of the Fred R. Jones Co., contractors, Chicago, Ill., has resigned to enter the contracting field with his own organization.

C. E. SKINNER, who has been with the Westinghouse Electric and Manufacturing Co. in various capacities since his graduation from Ohio State University in 1890, has recently been appointed assistant director of engineering, with headquarters at East Pittsburgh, Pa.

THE DOULLUT & WILLIAMS CO., Inc., engineers and general contractors of New Orleans, La., announces the reorganization, consolidation and incorporation of the following companies under the above title: Doullut & Williams, Inc., Southern Lighterage & Wrecking Co., Inc., Shell Beach Land & Improvement Co., Inc. The new company will carry on the work previously handled by the above named companies and will extend its operations to provide for various kinds of construction with a department for each class of work under the management of an engineer skilled in the work of his particular department.

OBITUARY

CORNELIUS DONOVAN, civil engineer formerly on duty with the Corps of Engineers, died recently in New Orleans at the age of 73. He was born in Ann Arbor, Mich., and was a graduate of the University of Michigan. For many years he had supervisory control over the jetties through the South Pass on the Mississippi River which he had helped to construct under James B. Eads. Mr. Donovan retired from active government service in 1916 because of ill health.

CLARENCE E. SPRAGUE, assistant engineer at the Trenton plant of the American Bridge Co., died suddenly March 16. He had been with the American Bridge Co., and with its predecessor the New Jersey Steel & Iron Co., since 1895.

CLARENCE E. STUBBS, 42 years old, building inspector of Baltimore, Md., from 1911 until 1915 and later engaged in the contracting business in that city, died on March 21 at Denver, Col.

EQUIPMENT AND MATERIALS

Adapt Loader for Snow Removal

To adapt its mechanical truck loader to snow-removal work the George Haiss Manufacturing Co., of New York, during last February's storm in New York City, operated a machine on which a pan conveyor was substituted for the standard bucket conveyor. Other mechanical changes included the lengthening and widening of the elevator frame, a 20-per cent increase in all speeds, and a decrease in the inclination of the elevator frame.

The endless pan conveyor consisted of a series of overlapping steel plates carried by two parallel roller chains, with angle cleats spaced 12 in. on an elevator shaft 20 ft. long, inclined at 30 deg. to the horizontal. On each side of the extended tail shaft are steel feeding propellers cleaning out a path about a foot wider than the machine. The elevator frame is pivoted at the center, to give it low clearance when moving, where it is carried by A-frames on a structural steel chassis carrying the engine and transmission parts, which, in turn, are supported on creeper treads.

The conveyor speed is 175 ft. a minute, the forward speed 100 ft. and reverse 50 ft.

This snow loader, according to the observations of its manufacturer, operating in piles of snow, averaged 2 min. 10 sec. per truck rated at 7.7. cu.yd. The piles handled were so stiff that



when the loader was backed into them they slid so that it was necessary to use hand labor to break the piles down as the machine backed into them. On this operation there were required one loader operator and three or four laborers breaking down the piles. Ordinarily the operator and one laborer would handle everything.

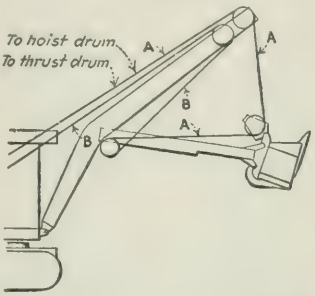
New Gasoline Shovel Can Shake Bucket

[illegible] transmission of gas-engine power to the thrust of a revolving shovel without an excessively complicated design, so as to give the machine the powerful thrust and quick reversals of [illegible] are the characteristics of the new 1½-yd. gasoline shovel recently put out by the Bucyrus Co., South Milwaukee, Wis.

Power is derived from a single, [illegible] by four cylinders [illegible] through four [illegible] the first motion of a small drum [illegible] on the engine shaft and mounted on the upper shaft and the hoisting drum, which runs loose on the shaft and *B* to the thrusting drum also running loose on the same shaft. Thrusting out is accomplished by a pull on rope *A*, thrusting in by a pull on rope *B*. Hoisting is accomplished by setting the brake on the thrust drum which makes all the motion go into hoisting. If the brake is partly released, the resulting motion will be combined thrusting and hoisting. If it is entirely released all motion will go into thrusting and if fully applied, hoisting will result. Shaking the dipper can thus be effected.

Specification data are as follows: Length of boom, 25 ft., 9 in.; handle, 14 ft.; traction speed, 0.4 miles per hour; width on caterpillars, 10½ ft.; working weight on caterpillars, 47 tons; fuel consumption 4½ to 5½ gal. per hour. The machine may be equipped as a drag-line excavator, a crane or a clamshell operated with simple changes made in the field. It is mounted on crawler tractions, traction wheels or railroad trucks.

tions of the dipper are controlled, thus eliminating the usual complication entailing chains, bevel gears, belts or telescopic shafting. A dry-type, asbestos-lined disk clutch, engaging or disengaging the entire machinery, connects the engine crank shaft to the transmission. The thrust and hoist-drums run loose on the same shaft. The hoisting clutch is operated by an independent thrust-cylinder and the



thrusting clutch by a hand-toggle mechanism. Propelling is accomplished by a positive spur-and-bevel-gear drive direct from the engine. The swinging mechanism consists of a spur-and-bevel-gear drive direct from the engine and the two cone clutches for reversing the motion.

The thrusting motion on the dipper handle is accomplished by means of a small drum, keyed to the shipper shaft. On this drum are anchored ropes *A* and *B* (see sketch), *A* running to the

Business Side of Construction

Facts and Events that Affect Cost and Volume

Large Contracts Let

Among this week's announcements of contracts awarded in Construction News, pp. 137@150 are the following large projects: A 12-story bank and office building at Boston, to I. G. Harsey & Sons, 75 Wareham St., $1,000,000; four 8-story apartments and a 6-story office building at Pittsburgh, to Hegeman & Harris, 185 Madison Ave., New York City, $1,400,000 and $500,000 respectively; superstructure of Porter St. pier, Philadelphia, to F. H. Harris & Co., 1520 Parrish St., $1,250,000; an 11-story clubhouse at Indianapolis, Ind., to Bedford, Stone & Construction Co., 810 Fletcher Trust Bldg., $1,000,000; a hotel at Grand Rapids, Mich., to Owen-Ames-Kimbal Co., 42 Pearl St., $1,000,000; a hotel at Los Angeles, to Scofield Engineering Construction Co., Pacific Finance Bldg., $5,086,000; shaft caissons and tunnels between New York and New Jersey to Booth & Flinn, Ltd., 17 Battery Pl., New York City, $19,331,723.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for in Construction News, pp. 137@150 are the following:

A high school at Hartford, Conn., $1,000,000.

An apartment at Chicago, Ill., $2,000,000.

An office building at Chicago, Ill., $1,500,000.

Materials and Labor Prices in Four Canadian Cities

Montreal to Vancouver—Rapid Comparison with United States Quotations—Canadian Dollar About 97 Cents

These Canadian quotations were collected by *Engineering News-Record's* Construction News correspondents as of the following dates: Montreal, March 18; Ottawa, March 15; Winnipeg, March 14; Vancouver, March 3. The Canadian dollar is now rated at about 97 cents, exchange value, which allows a comparison to be drawn between prices in Canada and the United States. Further reductions of materials prices in Canada will depend largely upon the action of the new Dominion administration in regard to freight rates.

Wage rates quoted in Winnipeg will remain effective until April 30, 1922, at which time changes, on a reduced basis, are anticipated. The construction outlook in Canada is very optimistic, particularly in Ottawa where agreements have been entered into between the employers and the bricklayers, carpenters, hodcarries and common laborers to maintain the wage scale, as of March 18, 1922, in effect until May 1, 1923. The present wage rates, however, paid hoisting engineers and structural ironworkers will not remain in effect after May 1, 1922. Although union common laborers are paid 45c. in Ottawa, non-union comon laborers are employed at 30c. per hour on county and provincial road work.

Winnipeg — Gravel obtained from local pits is quoted at $1.90 per cu.yd., f.o.b., for 1½ in.; $2.25 in dealers' yards for ¾-in. Sand is delivered on job at $3.15 per cu.yd. Crushed stone, 1¼-in. to 2-in., is quoted at $3.75 per cu.yd. delivered; $2.85 at yards; $2.45 f.o.b. cars and at $1.55 f.o.b. quarry. Size ¾-in. costs $4 delivered; $3.10 at yards; $2.75 f.o.b. cars and $1.90 f.o.b. quarry. Quarries are located at Stonewall, Manitoba, about 20 mi. from Winnipeg. No paving stone, brick paving blocks or wood-blocks are used in this city and no asphalt is obtainable. Commercial cement (natural) is quoted at $3.20 delivered; $3 at yards and $2.64 per bbl. f.o.b. cars, exclusive of bags. Hydrated lime is handled in 50-lb. paper and jute bags. American fire bricks are quoted in Winnipeg at $100 per 1,000 delivered; $95 at yards and $90 f.o.b. cars, in city. Canadian fire bricks are quoted at $85 delivered; $80 at yards and $75 per 1,000 f.o.b. cars. Chimney bricks are

PRICES OF PRINCIPAL MATERIALS AND RATES OF LABOR IN FOUR CANADIAN CENTERS

	Vancouver	Montreal	Ottawa	Winnipeg
Sewer pipe—carlots, per ft.				
4-in	$0 20	$0 30	$0.21	$0 35
6-in	30	.45	.32	45
8-in.	.35	70	.60	60
12-in	65	1.35	.95	1.00
24-in.	2 40	4.50	3.15	.
36-in		6 50		.
Asphalt—carlots, in packages, per ton		28.00	31.18	.
carlots, in bulk, per ton		21.00	24.90	.
Paving stone—per sq.yd.		125.00 per M	3.65	.
Wood-blocks—16-lb. treatment, per sq.yd		4.50	4 15	.
Sand—cargo or cars, per cu.yd	2 75 (del.)	1.50 per ton	2.50 (del.)	3.15 (del.)
Gravel—cargo or cars, 1½-in. per cu.yd	2.75 (del.)	1.25 per ton		1.90 f.o.b. cars
¾-in. per cu.yd	2.75 (del.)	1.50 per ton		2 25 at dealers' yards
Crushed stone—cargo or cars, 1½-in. per cu.yd	4 00	2 00 per ton	2.07@2.19	2 45
¾-in. per cu.yd	4 00	2.10 per ton	2.68@2.80	2.75
Cement—carlots, without bags, per bbl. natural—500 lb. and over				2.64
portland—f.o.b.	3 35	2.40	3.75	2 90
portland—delivered	3.45			
Lime—warehouse prices, including cloth bag				
hydrated—finishing, per ton	25 00	26.00	35.00	24 00 in paper bags
hydrated—common, per ton		21.00		.
lump—finishing, per 180-lb. bbl. (net)	2 60	15.00 per ton		.
lump—common, per 280-lb. bbl. (net)		11.00 per ton	19.00 per ton	3 20
Brick—cargo or carlots, per 1,000, common	25.00	16.00	25.00	19 00
paving block 3½x8½x3	60 00	.	3.65 per sq.yd	
3½x8½x4	60 00	.	.	
Hollow wall tile—carlots, per block—4x12x12	12	20	11	085
8x12x12	25	30	.22	.12
Lumber—wholesale, carlots, to dealers, f.o.b. No. 1 grade, per M. ft. b.m.				
1-in. rough, 10-in. x 16 ft. and under, pine			85 00	76 50
fir	16 00	48 00	83 00	31 50
hemlock	16 00	35 00	30 00	34.20
2-in. tongue and groove, matched, 10-in. x 16 ft. and under, pine			70.00	.
fir		45 00	56.00	35.50
8-in. x 8-in. x 20 ft. and under, pine			75.00	.
fir	18 00	47 00	75.00	36.00
hemlock		35 00	45.00	37 00
spruce		35 00	60.00	37 00
12-in. x 12-in. x 20 ft. and under, pine			85 00	.
fir	10 00	47 00	85 00	36 00
Manila rope—¾-in. and larger, 1200-ft. coils, per lb.	19	30	.52	235
Explosives—small lots, delivered, 40 per cent gelatin, per lb.		21½	213	287
60 per cent gelatin, per lb		25½	227	327
Labor rates per hour, bricklayers	1 06½	80	85	1 15 (44 hr. week)
carpenters	81½	60	70	90 (44 hr. week)
hoisting engineers	90	50	75	90@1 10 (50 hr. week)
hodcarriers	67½@ 75	30	45	.
pile drivers	81½	50		.
structural iron workers	1 12½	50	72½	1 10 (44 hr. week)
			45	47½@ 55 (50 hr. week)
common labor—union	45 @ 50	20@ .30	30	.35
non-union				

quoted at $25@$30 per 1,000. Douglas fir is the principal lumber and is shipped direct from mills in British Columbia. Bricklayers, carpenters and structural ironworkers operate on the 44-hr. basis; hoisting engineers and union common laborers work 50 hr. per week.

Ottawa—Common bricks are quoted at $25 both in Ottawa and Vancouver as against $19 in Winnipeg. Sewer pipe, 4-in., is quoted at 20c. in Vancouver; 21c. in Ottawa; 35c. in Winnipeg. Sand is quoted in Ottawa at $2.50 as against $2.75 per cu.yd. delivered in Vancouver. Dynamite, 40 per cent gelatin, costs 21.3c. in Ottawa as compared with 28.7c. per lb. in Winnipeg.

Vancouver—Structural steel is quoted at $150 per ton in comparatively small quantities; reinforcing steel in less than carload lots at $4 per 100 lb.; manila rope, ¾-in. costs 19c. Wage rates in the building trades are: Cement finishers, $5.50@$6; electricians, lathers and plumbers, $8; electricians' helpers, $5; glaziers, $4.80@$5.20; painters, $6; roofers and sheetmetal workers, $7.20.

Prices in United States and Canada

Construction materials prices in Vancouver as compared with those prevailing in Seattle show 8-in. sewer pipe, for instance, at 35c. in the former city and 36c. per ft. in the latter. Other materials, however, do not compare so closely. Hydrated finishing lime is quoted at $2 per ton, lump finishing lime at 40c. per bbl. and 8-in.@12-in. Douglas fir lumber at $2 per M. ft., higher in Seattle.

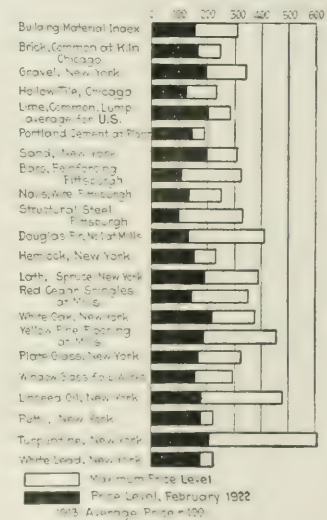
Piledrivers receive 18¾c. and structural ironworkers 22½c. more per hr. in Seattle than in the Canadian city, but bricklayers receive 6¼c. and carpenters 1¼c. more per hr. in Vancouver than in Seattle. Scales for hoisting engineers, hodcarriers and common laborers are the same in both cities.

Materials prices are evidently slightly higher in Winnipeg than in Minneapolis. Sewer pipe, 8-in., is quoted at 20c. per ft., gravel at 40c. per cu.yd., crushed stone 45c.@50c. per cu.yd., cement 66c. per bbl., brick $4 per M., hollow tile 2c. per block, 2-in. fir at 75c. per M. ft., manila rope at 4c. per lb., and dynamite at 6c.@7c. per lb., higher in Winnipeg than in Minneapolis. Hydrated finishing lime is quoted at $5 per ton, Douglas fir lumber at $4 per M. ft. and 8-in. hemlock at $1 per M. ft., higher in Minneapolis than in Winnipeg. Hemlock lumber, 1-in., is quoted at the same price in both cities but 1-in. yellow pine is twice as high in Winnipeg as in Minneapolis. Wage rates in the building trades are higher in the Canadian city in question, as bricklayers receive 15c., carpenters and hoisting engineers, 10c., and ironworkers 30c. per hr. more in Winnipeg than in Minneapolis. Non-union common laborers, however, receive 5c. more per hour in Minneapolis than in Winnipeg.

Building Materials Prices—Now and at Peak

(Bureau of Labor Statistics Figures)

The building material index of the Bureau of Labor Statistics was 158.7 for February, as just reported, against 159.9 in January, and 304.6 at the peak (April, 1920). The chart and table show both this index and the indexes of the twenty-two materials which comprise it. Four materials are given as more than 100 per cent higher than in 1913: Lump lime, sand, white oak and turpentine. Cement at the plant is 48.4 per cent above the 1913 level. Structural steel is reported 99.3 per cent compared with 100 in 1913 and 331 at the peak.



BUILDING MATERIALS INDEXES OF BUREAU OF LABOR STATISTICS

Commodity	At Peak Date	At Peak Index	Index Numbers Dec. 1921 Index	Jan. 1922 Index	Feb. 1922 Index
Building material index*	Apr. 1920	304.6	160.8	159.9	158.7
Brick, common at kiln, Chicago	Oct. 1920	231.1	180.8	170.1	169.7
Gravel, New York	June 1920	254.4	199.6	199.5	198.6
Hollow tile, Chicago	June 1920	216.9	128.9	128.3	128.3
Lime, common, lump, average for U.S.	Oct. 1920	266.0	210.0	207.8	206.8
Portland cement at plant	Sept. 1920	148.9	144.4	144.4	148.4
Sand, New York	May 1920	211.5	201.7	201.7	201.7
Bars, reinforcing, Pittsburgh	Jan. 1917	111.1	100.0	100.0	100.0
Nails, wire, Pittsburgh	Jan. 1920	311.9	151.3	145.0	136.1
Structural steel, Pittsburgh	Jan. 1917	331.0	99.3	99.3	99.3
Douglas fir, net at mills	Jan. 1920	211.1	124.9	124.9	135.8
Hemlock, New York	Jan. 1920	211.1	151.8	151.8	153.8
Lath, spruce, New York	Jan. 1920	311.6	207.2	199.6	192.6
Red cedar shingles at mills	Dec. 1920	311.6	148.5	151.0	148.0
White oak, New York	May 1920	311.7	224.5	224.5	216.2
Yellow pine flooring at mills	Jan. 1920	311.1	181.1	181.9	180.0
Plate glass, New York	Aug. 1920	311.5	166.0	166.0	169.0
Window glass, f.o.b. mills	Aug. 1920	311.2	211.0	161.5	154.0
Linseed oil, New York	Aug. 1920	311.4	211.2	181.2	178.9
Paint, New York	Jan. 1920	311.4	179.2	177.2	177.2
Turpentine, New York	Nov. 1920	311.4	181.2	211.4	210.9
White lead, New York	May 1920	311.5	181.2	181.2	181.2

*Copper wire, sheet copper, lead pipe and sheet zinc are included in the group weightings on the building material index, which makes a slight change [illegible]

Detroit Receives Cement Bids

In response to advertisement for proposals for furnishing the City of Detroit with 75,000 bbls. of cement to be delivered as directed during the year ending Jan. 31, 1923, bids were received from the following companies:

	F.O.B. Shipping Point — Price per Bbl.	F.O.B. Detroit — Price per Bbl.
Wabash Portland Cement Co., Detroit, Mich., (works at Stroh, Ind.)		
Paper sacks	$1.76	$2.22
Cloth sacks	2.01	2.47
Universal Portland Cement Co., Chicago, Ill.		
Paper sacks	1.75	2.22
Cloth sacks	2.00	2.47
Bulk	1.55	2.02
Huron and Wyandotte Portland Cement Companies, Detroit, Mich., at Alpena:		
Paper sacks	1.72	2.22
Cloth sacks	1.97	2.47
Bulk	1.52	2.02
Wyandotte:		
Paper sacks	1.85	....
Cloth sacks	2.10	..
Bulk	1.65	..

The commissioner of purchases and supplies recommended that contract be awarded to the Huron and Wyandotte Portland Cement Companies and the approval of the City Council was asked.

Proposals have been asked for the transportation of 75,000 bbls. of cement by truck from the cement plant at Wyandotte, Mich., to be delivered to any place within the limits of the city of Detroit as may be directed by the Department of Purchases and Supplies.

Cheaper Materials and Freights Lower Bidding in Ohio

(Columbus Correspondence)

Low bids on road work opened by the Ohio Department of Highways and Public Works since Jan. 1 have been almost 20 per cent below the estimates of the engineers in the department. The reason for this decline is an interesting study in costs and psychology. With the opening of bids about the middle of January, road contractors were anxious for work and they figured that much of the labor that is to be employed during the present season can be hired at greatly reduced prices. Little of the work has started yet and of course the exact wage that must be paid to unskilled labor is not known, but it will range between 25 and 35c. per hour, instead of 50 to 65c. per hour as during the peak of high wages.

Another important factor is the reduction in prices of road materials. Gravel, which formerly cost from 80 to 90c. per ton at the plant is now being bought for 60 to 70c. and sand is about 5c. less than gravel.

Cement is down from 15 to 25c. per bbl., while crushed stone is down about 25 to 35 per cent.

The greatest reduction has been made on brick which sold at $30@$35 in the middle of 1920 and now sells around $25. All of these prices are f.o.b. plants.

Another factor is the reduction in freight rates in Ohio on all road building materials which was ordered by the Ohio Utilities Commission on Oct. 20, 1921. This removed the last (40 per cent) increase in freight rates and was a reduction of 28 per cent. As freight enters into the cost of road building on the average of 15% per cent this reduction was equivalent to [illegible] important. These factors have aided in bringing about lower bids on state work.

Railroads Plan To Spend Millions

The Great Northern Railway Co. will spend about $800,000, according to its estimate, in construction of engine terminals in Northeast Minneapolis, together with some incidental grade separation there. Contract for the terminals has been let to A. Guthrie & Co., Inc., of St. Paul.

Included in this contract is the erection of a 30-stall brick roundhouse, a machine shop, turntable, cinder pit and coal facilities, while power and store houses will be erected later. The Great Northern is now building a $2,000,000 concrete and steel ore dock at Duluth, and has authorized 40 miles of second main-line track laying in Washington and North Dakota, as well as erection of a car-repair shop at Minot, N. D., together with certain trackage improvements there.

While rumors have been published that the Great Northern improvement budget for 1922 totals $17,000,000, President Ralph Budd is to make a definite statement about April 1.

At the office of the president of the Northern Pacific it is announced that the 1922 improvement budget, as approved, totals about $18,000,000 of which $4,000,000 represents items carried over from last year.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of March 2; the next, on April 6.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	—$2.48	$3.35	$4.00	$2.63	$2.66	$3.50	$3.10	$3.25	$3.75
Structural rivets, 100 lb.	—3.35	3.90	5.50	3.43	3.90	4.55	4.50	3.75	6.50
Reinforcing bars, ¾ in. and larger, 100 lb.	—2.38	3.25	3.50	2.53	2.56	3.42½	2.75	3.25	2.75
Steel pipe, black, 2½ to 6 in. lap, discount	61%	68%	45%	50½%	61 9–57%	44%	58.8%	53%	35.10
Cast-iron pipe, 6in. and over, ton	47.30@48.30	40.00	48.30	43.10@44.60	+47.00	52.00	48.00	52.00	55.00
Concreting Material:									
Cement without bags, bbl.	2.40	2.39	2.25	1.94	2.24	2.90	2.73	2.94	2.40
Gravel, ¾ in., cu.yd.	1.75	1.85	2.25	2.00	1.50	2.50	2.25	1.50	1.50
Sand, cu.yd.	1.00	1.15	2.25	2.00	1.00	1.10	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd.	1.75	1.90	2.75	1.60	2.25	3.50	2.25	3.00	2.00
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	40.00	37.00	—33.50	43.00	38.00	34.75	28.00	20.00	47.00
Lime, finishing, hydrated, ton	15.80@16.80	18.00	25.00	18.00	29.00	24.00	22.00	27.00	21.00
Lime common, lump, per bbl.	2.75@3.48	1.25	2.50	1.40	1.40	2.70	1.75	2.75	11.00
Common brick, delivered, 1,000.	19.40@19.90	8.75	11.15	11.00	15.00	12.00	15.50	14.00	16.00
Hollow building tile, 4x12x12, block	Not used	.07975	115	.0821	.0752	.08	....	.10	—.08
Hollow partition tile 4x12x12, block	.11120	.06525	.115	.0657	....	.10	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal.	—.83	+.89	.109	—.90	.93	1.08	1.04	.86	1.05
Common Labor:									
Common labor, union, hour	.60	.35	.....	72½	.....	.50@.55	.56¼	.50@.60	.....
Common labor, non-union, hour	.....	.20	.25	35@.40	.40@.50	.35@.40	.47½@.56	.50	.20@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations are delivered except tiles, which are "on trucks." Common lump lime per 200-lb. net, both lump and hydrated quoted f.o.b. cars New York. Sand gravel and crushed stone are quoted alongside dock. Cement and steel pipe delivered to contractors on job. Gravel ready mixed $2 per cu.yd.

Chicago quotes hydrated lime in 50-lb. bags; common lump line per 180-lb. net.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5⅓ x 8 x 11⅓. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net Lumber prices are to contractors in yards at San Francisco. Lumber price is for No. 1 fir, common.

Seattle quotes on Douglas fir instead of pine. Common lump lime per 180-lb. net. Hollow building tile delivered.

Montreal quotes on fir instead of pine. Sand, stone, gravel and lump lime per ton. Lime and tile are delivered; cement, sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 97.70 cents). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net.

Changes Since Last Week

Steel shapes are quoted in the New York warehouses at $2.48 as against $2.63; structural rivets at $3.35, reduced from $3.50 and reinforcing bars at $2.38 as compared with $2.53 per 100 lb. one week ago. With prices declining in the warehouses, producers of shapes, plates and bars continue to quote $1.50 per 100 lb., Pittsburgh, but still seem unable to firmly establish the market on that basis. Actual buying is possible at $1.40@$1.45 f.o.b. mill. Cold rolled shafting is quoted in Minneapolis at $3.43 as against $3.68 per 100 lb. delivered; cast-iron pipe, 6-in., at $47 as compared with $46 per ton, last week.

Raw linseed oil is quoted at a reduction of 1c. in New York; 7c. in Chicago and at an advance of 8c. per gal. (5 bbl. lots) in Atlanta.

A total of 382 mills reporting to the National Lumber Manufacturers' Association for the week ending Mar. 18, show 180,944,123 ft. of lumber cut; 193,311,165 ft. shipped and orders for 203,325,892 ft. b.m. Production stands at 20 per cent; orders at 10.5 per cent and shipments at 17 per cent below normal.

Comparison of materials prices and building trades' labor rates in four representative Canadian centers with quotations in the principal markets of the United States, may be had by referring to the article on p. 548 in connection with the weekly construction market quoted above. Ottawa wage agreements effective until May 1, 1923

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, President

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. Mehren
Editor

Volume 88 — NEW YORK, APRIL 6, 1922 — Number 14

A Step Forward

SO ENGROSSING has been the difficult problem of making a living in these years of war recovery that the average man has rather lost his appreciation of the great things that are being done not only to prevent a similar visitation on his descendents but to make it more easy for him to get back to a normal way of life. The Senate's ratification of the naval and Pacific treaties are accepted, therefore, too much as a matter of course. In reality these treaties are landmarks in the progress of mankind toward mutual understanding—the triumph of common sense over killing competition. They are not perfect—so few human things are and so difficult it is to agree as to perfection—but their acceptance by the United States is the first necessary step toward putting together the shattered pieces of world economics.

An Invalid Industry Runs a Fever

IN SOME phases of the coal strike the consuming public is not interested. It cares nothing, for example, about the check-off practice or the factional proclivities of union leaders. In others it has the vital interest of a party, even though "of the third part." It wants plenty of coal at a fair price, it wants the miners as part of itself to earn a decent living, and it wants the operators to earn a reward for their enterprise that will insure a continuing development of the industry along constructive lines. At the roots of the controversy lies overexpansion. There are too many mines. The industry, moreover, is divided against itself; some mines are unionized, some are not. The non-union mines are fixing the price and getting the business and the non-union miners at a lower wage are earning more than their union brethren. The operators contend that war-wages must go. The miners cannot see this and insist that while prices should come down economies must be sought elsewhere, in profits for example. The public maintains that the war is over for the coal business as well as for the rest of us and that war-wages, war-profits and war-prices all must go, and go for good. This, however, is but the dispute of the day. However it may be settled the coal business evidently is a sick business which needs a thorough overhauling in the interest of miner, operator and consuming public. It will be cured only by the application of economic and social principles and not by its exploitation in the interest of industrial politics.

Wet-Batch Haulage Safe

CRITICISM of central mixing and wet-batch haulage as a method of concrete road construction is based on the opinion that hauling injures the mixture. No quantitative determination of the injury is ever cited nor is its nature ever clearly defined. A general charge of segregation or of loss of strength because of incipient hardening is ordinarily the extent to which injuries are particularized. Both segregation and loss of strength are logical possibilities of wet-batch haulage and examples of both can be named by anyone who has observed central-plant-mixed concrete road operations in any number. There is nothing constructive in reporting them as faults—it gets nowhere toward the solution of the real problem which is: Where does safety end and danger begin in hauling wet batches, for the method often offers economies in road construction and merits employment within the zone of safe operation? Tests have to be made whose results will measure the kinds of mixtures which can be most safely hauled, etc., before it can be asserted or denied that wet batch haulage is a safe and desirable road construction. method. The Bureau of Public Roads tests summarized in this issue are an attempt to arrive at precise measures. In the preliminary conclusions there is assurance that central mixing and wet batch haulage, as now practiced, may *safely* be continued as a road construction process until the completed investigations disclose what ultimate refinements are required.

Map Questions

BY AND LARGE engineers are the principal map-using class. They are the people most directly concerned in the matter of how our maps are made—except perhaps the general public, whose wishes and needs are rather undetermined. Questions such as that of scale, discussed on p. 572 of this issue, reduce in the last analysis to the question of what is best suited to engineering service, at least in so far as topographic maps are concerned, which are used almost exclusively by technical men. Recognition of the engineering interest in mapping was the motive that led a group of engineers some years ago to call the government's attention to the backwardness of our federal topographic mapping work, and to urge that more systematic effort be made to carry it toward completion. Out of the action of this group, there resulted the formation of the interdepartmental Board of Surveys and Maps that is at present endeavoring to improve the federal mapping. Of the two lines along which this board has worked, centralization of all government mapping in one bureau, and standardization of methods used by the various bureaus, the former is perhaps chiefly of administrative interest. Standardization of mapping methods, however, is of public interest, and thus a matter that concerns engineers more than the departments themselves. It would be desirable if the questions of method coming before the board could be placed before the engineering profession of the country for discussion and expression of choice. There has been some attempt to provide for this by the creation of an advisory council to the board, made up of representatives of various technical societies. More direct opportunity of the engineering profession to participate in the deliberations is to be desired. The presentation of the question of scale supplies one opportunity of the kind.

Highway Department Organization

PREMISING that highway improvement is a continuing business Pennsylvania has developed a noteworthy organization to direct its state roadwork. The theory of organization and the distinguishing departmental practices are outlined in this issue. They are notably not the things commonly considered in discussions of state highway department organization. It is possible, indeed, that to most highway commissioners, educational supervision, co-ordination, separation of planning from performance, reward according to performance and positive financial control, are merely resounding phrases. They are actualities to the engineer; they need to be made realities to state road officials.

Conception of state highway improvement as a business enterprise established on a continuing basis is only gradually creeping into the thinking of highway officials. This is most true, of course, of the states in which departmental control of roads is new or where substantial expenditures for road improvement have been only recently possible. Road engineers generally have a fair understanding of the essential business character of highway improvement; political commissioners have some comprehension of the fact, and the road using and taxpaying public is supremely ignorant. This is a condition that cries louder at the present moment for change than any other thing in highway development. Too many state highway departments, given millions to work with, are being organized more like a committee to spend a fourth of July celebration fund than like the directing personnel of a business enterprise. A radical reform is necessary. Pennsylvania experience helps to indicate its direction.

Outstanding in this experience is the fact that it is not the machinery of organization nor even any unusual practice that makes a strong and efficient highway department. The supreme quality is organization morale. With such morale in Pennsylvania, remarkable work has been accomplished—an output per man unit far beyond that of most states. Morale has been created partly by personnel direction and in some measure by several other things, but fundamentally, it has come from enthusiastic leadership. The executives of the Pennsylvania highway department have "sold" its importance, its technical competency and its business rectitude so completely that every least departmental clerk is afire with belief in the department and its work.

Another fact that stands out is the perception that a state highway department is not merely the curator of an assigned system of state roads, but is the guardian of the roads of the state. In this broad capacity the duty devolves of educating the people to good road practice and of lending them technical aid and expert business and financial advice in their local road development.

Finally, the lesson that requires to be observed by those states of the West and South which are young in highway improvement is that maintenance is ultimately the governing task of state highway departments. Even with its enormous new construction programs in full swing last year, almost a quarter of the money which Pennsylvania spent went for keeping the roads in repair, which is perhaps a fair average between the state whose maintenance exceeds construction and the state whose work is yet all construction.

These lessons that have been indicated need to be taken to heart by the people who are voting millions for highway development. In every state they are constructing and assuming the maintenance and operation of a transportation system comparable with the railway system within the state and a comparable directing organization is required. Obvious as is this conclusion it is slow in being accepted, largely because of the lack of effort by engineers and contractors, through their national associations, to call even the briefest attention to its importance.

Vehicle Tunnel Under Way

AFTER about a year of delay due to friction between the two state commissions charged with the administration of the project, work on the Hudson River vehicular tunnel, comprising twin tubes of cast iron 29½ ft. in external diameter, has been started, under two contracts involving a total expenditure of nearly $20,000,000. The project is noteworthy not only because of the exceptional size of the adopted section—the largest subaqueous tubes to be built by the compressed-air shield method in the United States—but also because it marks the resumption of a type of construction on which there has been little activity in the New York district for several years past following the driving of the 14th St. subway tunnel under the East River.

The award of the vehicle tunnel contract comes opportunely at the beginning of the construction season—although tunneling is not so dependent upon climatic conditions as other forms of construction—and also at a time when labor is seeking employment not only in the construction of the tubes under the river but also in the plants which will supply the equipment and materials for the work. Ample funds are available for the project, an engineering staff headed by well qualified men has been developed, and a contractor experienced in subaqueous tunneling has been selected. The old animosities between the New York and the New Jersey tunnel commissions have been buried, following the recent removal of several Jersey commissioners, and the way is now clear for construction progress.

The design of the tubes follows well-established practice and, while new features have been introduced in a few details, the job will go ahead according to methods which previous experience has proved dependable. In the earlier stages of the project, it will be recalled, numerous suggestions for departure from previous practice—chief among which were the adoption of a larger tunnel section, the use of concrete blocks, and the trench method of construction—were suggested. Throughout this controversy the chief engineer to the two commissions held to the policy of following well established methods of design and construction rather than of embarking on experiments with the public funds.

In the contract and specification, as outlined elsewhere in this issue, one of the new features covers the matter of payment to the contractor. For work of this magnitude a very heavy outlay in construction plant will be required at the beginning of the job, to say nothing of the cost of the $4,000,000 surety bonds specified. The tunnel commissions have recognized this fact and have made provision for payment on plant, when installed, with subsequent monthly deductions from the contractor's estimate until the allowance for plant is thus wiped out. This plan, it is anticipated, will relieve the contractor to some extent of the heavy financial load ordinarily assumed at the beginning of a large job.

Exposure Fire Hazards and Protection

THAT fireproof buildings are excellent furnaces has been well known for many years. Great fires such as the Baltimore conflagration demonstrated this truth with startling clearness. In general perspective the Burlington Building fire in Chicago three weeks ago is a further demonstration of the same fact. But, in addition, it brings out new facts of first-rank importance.

The resistance of the building gives gratifying evidence that we have made progress in building construction. The fire did not communicate from floor to floor; protection of vertical openings, long fought for as a necessary objective by fire protection men, appears to have been substantially complete. Had an interior fire originated on any floor it would not have communicated to another, and would have left the exit and entrance facilities unimpaired. In this important respect, then, the building performed excellently. Moreover, no structural parts of the building failed, which also represents an advance, as may be realized by comparison with the general crippling of office building structures in the San Francisco and Baltimore conflagrations. But when we have looked at these pleasant facts, we face the unpleasant fact that the building wholly failed to protect its contents. It offered no resistance whatever to the attack of severe exposure fire.

If this is the best that can be expected of a "fireproof" office building, the business community has a choice of three evils: In the case of every large and important headquarters office the chance of total destruction at long intervals must be taken into account; or, such central offices must be split up among several different quarters not likely to be exposed to destruction at the same time; or, the outside exposure hazard must be eliminated by removing from the neighborhood all special hazards, that is to say all buildings that may become the seat of severe interior fire.

The choice is not so hard as it seems. The third alternative would be ideal if an equal and high degree of fire protection could be enforced on all structures but unfortunately this is rather beyond the bounds of present possibility. To mass all fireproof buildings in one group, and, separated therefrom, to mass all buildings of greater hazard in another group, would increase rather than diminish the general fire exposure of any community and would be counter to the principle recognized as desirable, namely that the fire risk of a community should be broken up as much as possible by fireproof buildings capable of serving as barriers between groups of buildings of lower fire resistance. There is something, however, in the idea of taxing property in proportion to its fire risk, but so revolutionary a practice does not offer any early relief.

So also may the second alternative be eliminated as improbable. The conduct of modern business appears to call for the concentration of large headquarters offices in one place, and for the present at least it is not to be expected that business will seek greater safety against infrequent fire risk by splitting up headquarters establishments. We face the conclusion, then, that occasional complete destruction of a central office establishment by fire must be considered probable. Exposure fires are the principal, perhaps the only, hazard in this regard, although a secondary teaching of the Burlington fire is that the contents of a modern office contribute in a surprising degree to the intensity of such a fire, and presumably may also give rise to a very destructive interior fire under favorable circumstances.

The risk of complete destruction will remain until better protection of window openings is applied than the Burlington building possessed. One question is whether we have or are likely to have better means of protection. But the important problem is to lead builders, owners and architects to appreciate the exposure risk sufficiently to use such means of protection.

We already have wire-glass as a protective device against exposure fire. According to the best authorities, wire-glass would have been of decisive value in the Burlington Building, had it been applied to the street front windows. Some believe that it would have protected the building completely, while others assert that it would probably not have prevented the entrance of the fire, but would have given the fire department a better chance. On either view, and especially with the fact before us that a few rows of wire-glass windows on the exposed street front of the Burlington Building showed more than twice the resistance of the plain glass windows, we must conclude that this one simple precaution would have had great value. It would have saved perhaps half of the loss experienced by the Burlington railway.

Since wire-glass has a limited resistance, as was demonstrated in the Burlington Building itself by the destruction of many wire-glass windows on the court faces, from heat developed in the interior, it is not the full and satisfactory protection that may be looked for. Perhaps some system of fire shutters may find a trial application as the result of this fire. This is a matter of the future, however.

Ten or twelve years ago wire-glass and metal windows were as readily available as now. Their use would have added a vanishingly small fraction to the cost of the Burlington Building. Their omission puts the whole building at risk. Undoubtedly, the officials of the Burlington did not appreciate this; they surely did not contemplate the possibility of destruction of a large part of the contents of their building when they erected it. They knowingly placed their office structure in a region where manufacturing and other buildings—both wooden and brick—surrounded them. Consciously or unconsciously, they as well as multitudes of others relied on distance—the width of a street—as adequate protection against exposure fire.

Fire protection engineers themselves rarely went so far as to suggest wire-glass or fire protection at street fronts; they themselves relied on street-width protection. Perhaps both classes of people were led to this in part by the feeling that under conditions so severe that the width of a street would not longer protect, nothing would protect. But that this feeling, if it existed, was not genuine after all is shown by the fact that they did demand and apply wire-glass and metal windows in rear walls, where distance was not available as a protection.

Reduced to the elements, the situation is that the sentimental and esthetic objections to applying wire-glass to street fronts were the real final obstacle to consistent application of window-opening protection. The Burlington Building is an unavoidable challenge to the attitude of mind that supported the objection. It sets up the query whether building construction must not take careful account of the exposure hazard, and, by protecting against it, seek to produce buildings that will come nearer to being safe for contents as well as for structure.

Placing 410,000 Cu. Yd. of Concrete on Ontario's Niagara Power Development—I

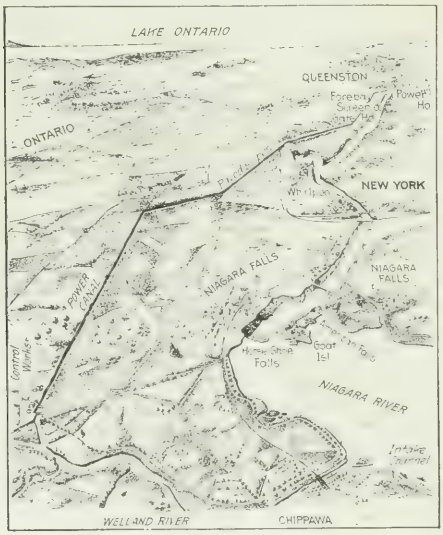
Plant Layout for Mixing and Placing Concrete for Power House, Forebay and Lining of Nine-Mile Queenston-Chippawa Canal—Design and Testing of Mixtures To Meet Prescribed Strengths

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IN a period of 13 months 410,000 cu. yd. of concrete were placed from 21 different plants along 8½ miles of canal on the Queenston-Chippawa project, the power development around Niagara Falls that has just been put into initial service by the Hydro-Electric Power Commission of Ontario. The problems of maintaining adequate supplies of materals to these scattered plants and placng this quantity of concrete at a rate frequently exceeding 2500 cu. yd. per day required methods and equipment adapted particularly to the work in hand. The uniform excellence of the concrete which has resulted is an interesting example of the application of modern scientific methods to the control of the quality of a material ordinarily produced almost entirely by rule of thumb.



AIRPLANE SKETCH OF THE QUEENSTON-CHIPPAWA PROJECT

The general scheme of the development has been described fully in previous issues of *Engineering News-Record* and will be referred to but briefly in this article. It will divert around the Canadian side of Niagara Falls a flow of approximately 15,000 sec. ft. through a reversal of the Welland River for 4½ miles and a dug canal of 8½ miles to a power house at the Lake Ontario level at Queenston. In this construction the structures are all of concrete and the canal is lined with concrete. Practically all of this concrete was placed in the year prior to the opening of the canal on Dec. 24, 1921.

Concrete Structures or Project.—The intake, or head works structure, is at the junction of the Welland River with the Niagara, a short distance above the falls and upper cascades. For a distance of four miles upstream, the Welland River is dredged to give an added depth of 20 ft., with sufficient increase in width to provide the low velocities required for navigable streams.

From the upper end of the river improvement the canal extends for a distance of a mile in dredged earth excavation; the section of the waterway gradually changing from earth slopes to vertical walls as the rock formation is entered. Near this transition is situated a Stoney sluice-gate for the control of the flow of water in the rock section and for emptying the canal in case of necessity. The rectangular section in canal rock excavation continues through to the forebay, a distance of about 7½ miles, with the exception that the ravine, near the Niagara Whirlpool, is crossed by means of a heavy rock fill and this portion of the canal (three-fifths of a mile long) is constructed in trapezoidal form with transitions to the rectangular section at each end.

At curves, instead of maintaining the walls parallel to a common center line, the alignment of each side is on a radius of 300 feet and this arrangement provides an additional width varying with the amount of curvature throughout the length of the curves.

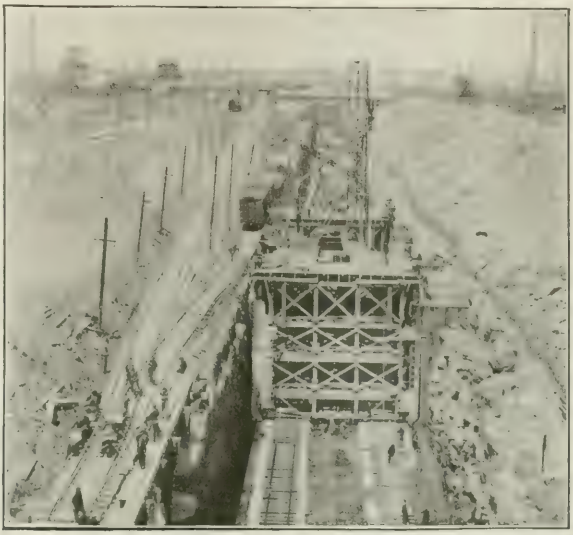
The rock section is lined throughout to a height of 34 ft. with plain concrete ranging in thickness from a minimum of 6 in. to an average maximum of about 24 in. The trapezoidal section is lined with reinforced concrete of 12 in. thickness.

The forebay, 1,000 ft. in length, forms a basin at the downstream end of the canal and is terminated by the gate-house, which controls the supply to the penstocks and in which are situated the screens and a by-pass for ice. A wedge shaped deflector is located at the throat of the forebay for the purpose of dividing the flow into two equal streams in order to avoid the formation of eddies and whirlpools within the forebay with a consequent loss in head. This structure is composed of thin concrete walls and has a length of 220 ft.

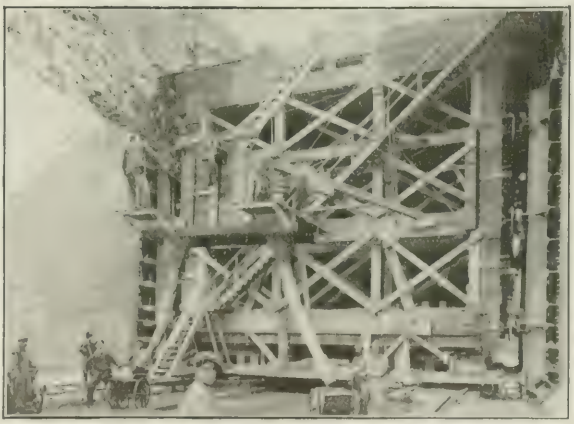
The upper ends of the steel penstocks are imbedded in concrete head blocks which form continuations of the gate-house structure. The penstocks are laid at an angle of 60 deg. with the horizontal in trenches cut in the rock forming the escarpment face and are encased throughout with concrete. The ice-chute is a reinforced-concrete pipe built in place and encased in a similar manner.

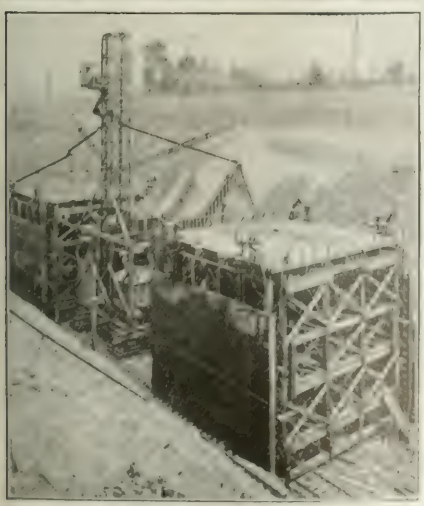
Generating Station.—The powerhouse is a massive concrete and steel structure founded on red Medina shale 25 ft. below the ordinary river level. As a precaution against possible floods due to ice jams in the gorge below, it is constructed as a water-tight monolith to a height of 55 ft. above ordinary river level. The outside walls are reinforced against this possible water pressure and all openings are provided with seals for use in case of emergency. Special care, therefore, was taken to secure a water-tight and dependably strong concrete in the substructure.

The whole weight of the generator and turbine is carried by a slab of concrete, with a span of 37 ft. It forms the casing for the upper, or vertical portion, and the roof of the lower, or horizontal portion of the draft tube. The slab is heavily reinforced, and in order to carry out the intent of the design it was necessary to place the concrete to a depth of 12 ft. in one continuous operation. From the bottom of the slab and integral with it, is suspended the lip or curtain wall forming the draft tube scroll, providing a gradually enlarging section. It was necessary to take the greatest care in connection with the design and erection of the centering and formwork and the placing of the concrete in order to obtain the results re-



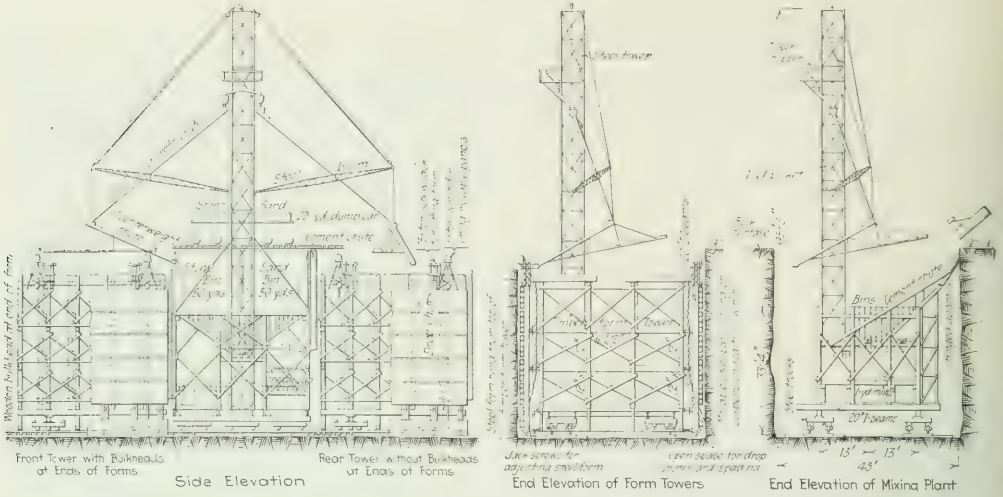








LINING THE RECTANGULAR SECTION OF THE SUPERSTITION-CHILLAWA HYDRAULIC CANAL



MIXING PLANT AND FORMS FOR PLACING LINING ON RECTANGULAR SECTION OF QUEENSTON-CHIPPAWA POWER CANAL

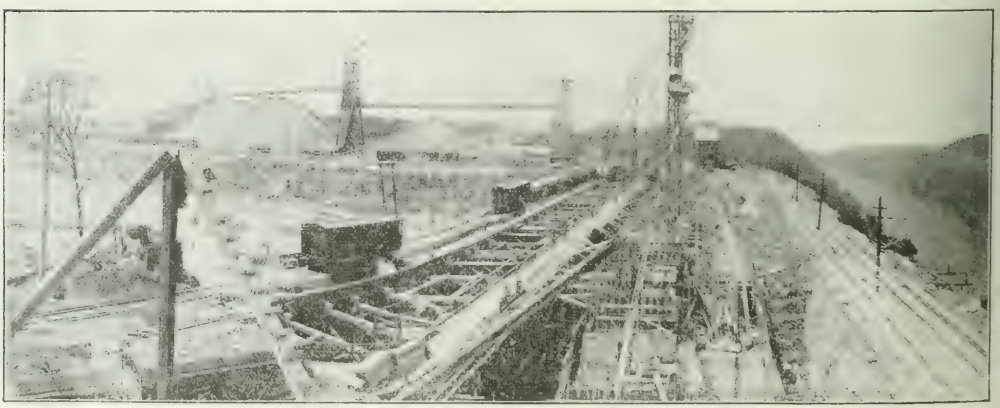
quired by the design. The substructure contains, in addition to the unit settings, the usual sumps, stairwells, pipe-tunnels, passages and chambers formed in the mass concrete.

The superstructure of the powerhouse is of concrete with steel columns and roof trusses. The interior walls are rubbed down with buffing machines but the exterior walls are to be left without other finish than that provided by the forms. The roof and floors are of reinforced concrete, the roof being waterproofed with asphalt and tile.

The structure for housing the transformers and high and low tension equipment is integral with the powerhouse and is similar in construction to the powerhouse superstructure, excepting that the concrete facing of the cliff forms the rear wall of the building. The cliff facing extends above the roof of the transformer house to an elevation 50 ft. below the top of the escarpment and forms the foundation for the escarpment wall, consisting of a series of arches carrying the high tension line towers and a portion of the boulevard of the Queen Victoria Park Commission, skirting the edge of the cliff.

Gate House and Forebay.—The gate house is a building similar in architectural features to the powerhouse. The substructure contains 27 openings, which merge into the 9 penstock entrances: the rectangular section converging to a circle at the upper end of the steel penstocks. It contains also openings for the penstocks supplying the service units. The substructure is of reinforced concrete throughout. The head blocks at the penstock entrances are heavily reinforced and their monolithic construction required an 800-yd. pour in one operation.

The design called for an especially good finish both as to smoothness and absence of waviness and projections. These requirements were met by care in construction of the forms and in the handling and placing of the concrete, and notwithstanding the presence of a



LOOKING ACROSS THE GATE HOUSE AND FOREBAY DURING CONSTRUCTION, SUMMER OF 1921
Downstream on Niagara River at right, gate house concreting plant and gate house forms in center; forebay and aggregate storage piles at left background.

large amount of intricate reinforcing, there was no necessity after the forms were removed to repair or rub down the surfaces exposed to the flow of water.

About half a million cubic yards of rock were removed to form the forebay basin. The rock throughout is seamy and in shallow layers and in many places it was found that seams and cracks extended to the face of the escarpment. To guard against seepage and consequent trouble due to water reaching the cliff face, the rock walls were treated by guniting 1 in. in thickness. This material, as applied, was extremely satisfactory, resisting every effort to destroy its bond with the rock.

Generating Station Plants.—All the concrete placed in the generating station and escarpment face has been poured from two mixing plants. Plant No. 1 was installed at the south end of the work on the cliff face just below the level of the penstock tunnels from the forebay. Material was delivered entirely in car lots from a trestle built across the forebay with its track at the upper ground level. The aggregates were dumped into large bins beneath the trestle and conveyed by belt to the hoppers at the mixing plant. The cement was unloaded from cars, passed down a chute to a belt and delivered thus to the plant storage. Both conveyors passed through the tunnel opening provided for the service penstock

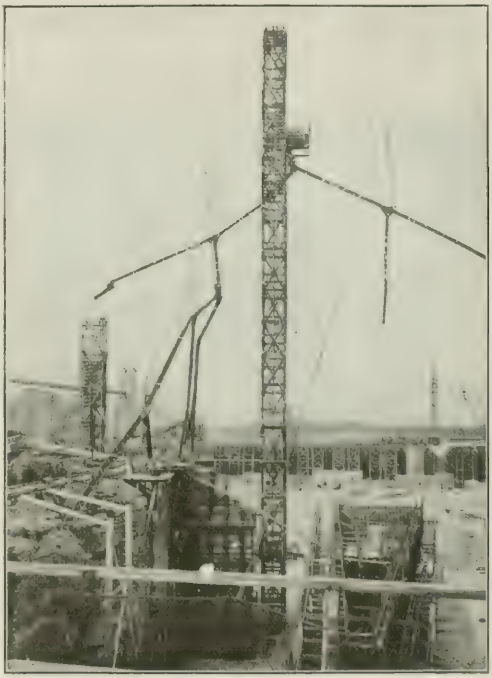
Progress of the work eventually required the dismantling of Plant No. 1 and its replacement by Plant No. 2 in a new location at the top of the escarpment near the north end of the work. The mixers of this latter plant were installed at a sufficient elevation to discharge into cars at the upper level. Cement and aggregates were delivered directly from the main storages to this plant, the conveying systems passing above the tracks and wires of the electrically operated International Ry. Each of these plants contained two 1-yd. mixers and concrete was delivered for the construction of the generating station by means of long steel chutes suspended from cables. The concrete required for the upper escarpment face and walls was poured from cars operating along the edge of the escarpment.

Gate House Plant.—The concrete for the gate house structure was placed from a plant located near the base of the forebay trestle; the materials being dumped from the trestle, stored in bins and conveyed to the mixing hoppers. Concrete was elevated in the central tower for distribution by chute. On account of the distance between this plant and the north end of the structure, it was found necessary to re-elevate a portion of the concrete.

Forebay Plant.—A mixing plant was erected at the junction of the canal with the forebay for the purpose of constructing retaining walls around the top of the forebay, the deflector and that portion of the floor of the forebay which was to be concreted. This plant was served from a track parallel to the side of the forebay; the whole arrangement being similar to the plant used for the construction of the gate house. To build the more distant walls, the mixed concrete was conveyed from this point in cars and discharged directly into the forms. The cars used for concreting the upper escarpment face and the forebay walls were of special design, consisting of four hoppers of 2 cu.yd. capacity each, mounted on old flat cars. These were fitted with side gates and were elevated on the cars to permit placing concrete to the tops of the walls under construction.

Two guniting machines were used for the forebay lining. These machines were of 4 cu.ft. capacity each and covered the rock walls to an average thickness of 1 in., at the rate of about 50,000 sq.ft. per month.

Canal Lining Plants.—The sequence of operations in lining the canal was: First, the paving of a strip 15 ft.



MIXING PLANT AT CANAL END OF FOREBAY

wide on each side of the floor; second, the construction of the side lining in alternate panels, 40 ft. in length; third, filling in of the intermediate panels of the lining, and fourth, the paving of the center strip of the floor.

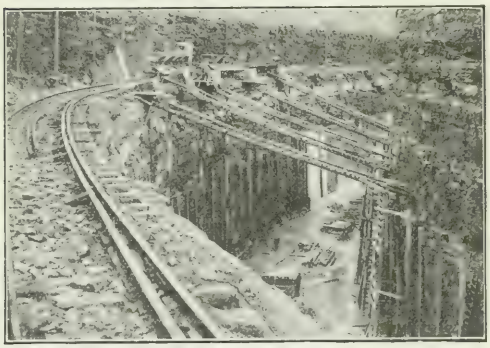
For the transportation of concrete materials to the mixing plants, a track located on the rock surface at the edge of the excavated section extended on one side of the canal from end to end of the work. Part of this track was originally laid for the removal of rock excavation but a high level crossover involving a temporary railway bridge together with approximately three miles of additional track was provided expressly for concreting purposes. Pipe lines parallel to the work supplied both water and air under pressure.

The dividing up of the floor into three strips was arranged in order to get widths which could be screeded properly in a longitudinal direction. The central strip was left until after the lining was placed for two purposes—to provide space for materials cleaned up from the sides and also so that the dripping from the lining plant mixers would not fall on finished work.

The rock forming the floor foundation and the backing of the lining was seamy and water bearing. To give an idea of the amount of water entering the canal through the rock, it may be said that at times over fifteen million gallons per day were handled by the pumps; consequently before concreting could proceed preliminary operations of some magnitude were neces-

sary. To provide drainage for this water a concrete pipe-line was laid below grade along the center of the canal bottom. Sumps were opened and pumps installed at intervals of about half a mile. Wherever there was noticeable flow through the rock, the seams were opened up and bulkheaded with planks and the water was led from behind the bulkhead through a small pipe extending to floor level.

When the side strips of the floor were laid, expansion joints were placed at intervals of 30 ft. and these joints



CONCRETING THE VERTICAL LINING ON A CURVE

were made of two thin boards laid as an inverted "V": the top of this joint being 2 in. below the floor surface. A channel was thus provided for carrying all the water from the sides to the center drain. Where the seepage behind the side walls was so diffused as to render its collection impracticable, it had to be absorbed by the concrete and for this purpose the mix was adjusted from time to time by juggling the quantities of cement, sand and water in the batch.

The floor was for the greater part placed by means of traveling paving plants. Later the use of these was abandoned and the work was done by the several lining plants as they progressed, using chutes and buggies. The paving plants received materials through chutes extending up to cars spotted on the service track.

Wall Lining Forms.—The outstanding problems to be solved in connection with the lining of the walls of the canal were the extreme heights to be concreted in a single operation; the disposal of seepage; the necessity of obtaining the very best results in regard to density, smoothness of finish and adhesion to the rock; and the great distance over which the operations extended.

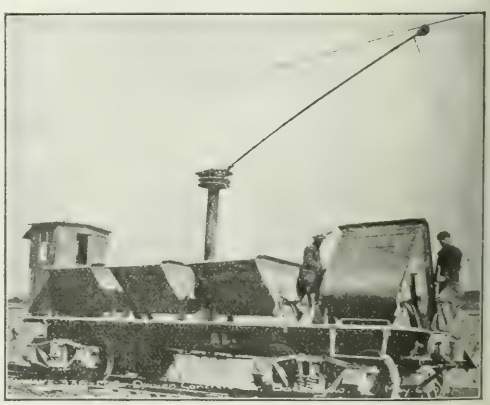
By the end of 1920 two miles of the canal prism had been excavated to grade and made ready for concreting and the program for concreting the remaining distance of 5½ miles had to be adjusted to suit the operations of the five high lift shovels, which were working in separate openings and scheduled to finish simultaneously. Hence it was necessary to install somewhat more lining equipment than would have been reqquired, for the sole purpose of completing the concrete work immediately after the shovels had finished the excavation. This program worked out so that excavation was completed on Nov. 30; concreting was finished on Dec. 18, and water admitted to the canal on Dec. 24, 1921.

For the purpose of constructing the side walls in the canal prism nine lining plants were erected and used while a half plant was re-assembled from the two plants first dismantled. The lining plants were designed having in view the requirements of strength and speed under which they were intended to operate. Details are shown in the accompanying drawing and views. Each plant was complete in itself and consisted of three units; form units in front and rear, with a mixing unit between the two. Each unit was mounted on special trucks and travelled on tracks laid on the two side strips of the floor already placed. Moving was accomplished by means of tackle attached ahead to heavy pins set in the rock bottom; motive power being supplied by the mixer hoist. Each form was suspended from two 75-ton jacks resting on a central structure of steel beams and heavy timbers designed to take care of the dead weight of the form panels; the heavy stresses due to moving, and the thrust from a full head of liquid concrete. This last assumption was fully justified by the conditions which developed after the forms were in use. Each form was kept in place by means of 24 screw jacks operated by hand wheels. The form was made of ⅜-in. plate backed with steel beams and consisted of a base panel four feet high and five movable panels each about six feet high. The base panel was shaped to form the bevel at the bottom of the side walls. The movable panels could be raised so that spading operations for each 6 ft. lift might be carried on by working between the panels The panels were raised and lowered by means of rods suspended from winches at the top of the structure.

The top of the structure supporting the forms was floored over and through this flooring five openings were provided on each side for concrete hoppers, which discharged into flexible drop chutes reaching to the bottom of the forms. A stairway extended from top to bottom giving access to platforms at intermediate levels from which the concrete was spaded.

With this type of plant it required from but 6 to 8 hours to fill one set of forms while the maximum output per week reached was 320 lin. ft.

The mixing plant carried a divided bin for aggregate storage with a total capacity of 80 cu.yd., arranged

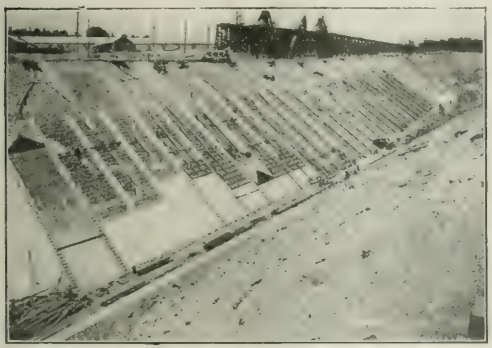


SELF-DRIVEN CONCRETE CAR USED IN SLOPE PAVING

to receive aggregates side-dumped from standard 20-yd. cars discharging from the service track which in some places was over 40-ft. higher than the bins. It also contained storage room for a carload of cement. The mixer, of 1 cu.yd. capacity, was operated by electric motor and concrete was elevated in a 1-yd. skip by means of an electric hoist and a steel tower 95 ft. high.

At the top of the tower was situated a hopper discharging into two lines of chutes for concreting front or rear forms as desired. The mixing plant also contained apparatus for the application of calcium chloride. The total weight of the three units composing a single lining plant was over 500 tons.

Lining the Curves.—The extra width of the canal section at the curves made possible the ready moving of the lining equipment through them. Special wooden forms were used for the concreting of the curves, the surface of the lining being a true arc. The panel sec-



SLOPE PAVING IN THE WHIRLPOOL SECTION
Concreting plant in background on bank; alternate methods of laying concrete shown in view.

tions were held in place by vertical timbers bolted to the solid rock; sleeve nuts just inside the concrete face being used to permit the removal of the outer portion of the bolts. At first a portable plant was used for the mixing and placing of concrete at the curves but during the final period, concrete was transported from the stationary plant at the Whirlpool section. Concreting of each curve occupied a period of about three weeks; the forms being erected for one-half the length and used twice. The same forms were then removed for use at another curve, of which there were five in all.

Slope Paving.—Due to the depressed elevation of the rock surface at the Whirlpool section and its total disappearance from the canal prism in the Whirlpool ravine, it was necessary to construct this section in the trapezoidal form referred to previously, with two transitions from the sloping, to the vertical sides, and over a mile of retaining-wall on each side of the prism. For this work a stationary plant was erected capable of turning out 1,000 cu yd. of concrete per day. This plant consisted essentially of a timber trestle on a 3 per cent grade for delivery of aggregates arranged so that materials could be discharged either from bottom or side dump cars into storage bins. The materials were delivered by gravity to the mixers—cement was unloaded from a track alongside the plant. The mixers were set sufficiently high above the ground so that the mixed concrete could be discharged into cars.

It was regarded as impracticable to [illegible] delivery of raw materials throughout the [illegible] side of the canal and for this reason the plant was designed to do all mixing for the section of the canal and convey such of the concrete as was required to the opposite side by means of a chute 330 ft. long. Material was elevated for this purpose by means of a tower 180 ft. high. A low tower was erected on the opposite side, and between the two towers the chute was suspended on a slope of 22 deg. from the horizontal. Two mixers supplied concrete for the work on the side on which the stationary plant was erected and a separate mixer was provided for the concrete to be delivered for use on the opposite side. Approximately 15,000 cu.yd. of mixed concrete was chuted across the canal from this mixer. The consistency of the concrete was such that delays or stoppages due to clogging of the chute were practically non-existent.

Specially designed all steel motor-driven cars, made on the job were used for the handling of material from this plant. Steel beams were mounted on standard gage car trucks and on these were placed four 1½-yd. side dump concrete car bodies, so spaced that two mixers could be discharged into them simultaneously.

The work done by the Whirlpool plant was in itself a job of large proportions and while the construction of retaining-walls and transitions offered no unusual features other than their magnitude, methods devised for placing the concrete forming the slopes of the trapezoidal sections, was of a most interesting nature.

With the use of wooden forms narrow concrete strips were constructed up each slope to the finished canal section, these strips acting later as guides for the movable forms used for filling the wide spaces between. The movable forms were essentially wide screeds and consisted of a steel plate on a structural steel frame. These forms were weighted down with sand bags and drawn up the incline by means of an eight-part-line tackle attached at the top of the slope to a small hand-operated winch. Continuous operation of this winch resulted in a rate of progress up the slope of about 8 ft. an hour. Concrete reached the forms in galvanized iron chutes laid on the slope and as the forms progressed the surface was given a trowel finish. Six of these forms were in commission and a daily rate of 4,000 sq.ft. was reached.

The Whirlpool plant supplied concrete for other works along the canal. Concrete was delivered in good condition from cars, at a distance of over 3 miles, the mix being specially proportioned for the long hauls.

Separate Plants for Bridges.—During the period of canal construction several heavy reinforced-concrete arch skew bridges were built to take care of four important railway crossings. The bridges were similar in design and construction and the largest only is described here.

This bridge carries the double-track main line of the Grand Trunk Ry. and a single track of the Michigan Central R. R. on a parallel right-of-way. It has a span of 72 ft. and a width of 187.4 ft. During construction the tracks were diverted to a 3-track trestle in a middle position, permitting the two outer portions of the arch to be built first. The lines were then replaced in their original locations on temporary trestles resting on the arch, after which the central portion of the structure was built. Finally the arch was earth-filled from a borrow pit nearby.

For the construction of this bridge concrete aggregates were dumped into bins built at the bottom of the canal and cement unloaded directly from cars. The mixer was fed by gravity and the mixed concrete elevated by skip and tower and distributed to all points by chutes. The skew was poured over the [illegible] of the arch in rings varying from 6 to 18 ft. in width.

(To be concluded)

Railway Ties from the Tropics

By Nelson Courtlandt Brown
Professor of Forestry, Syracuse University, Syracuse, N. Y.

Abstract of paper before American Wood Preservers' Association.

UNLESS more extensive treatment of ties is practiced in this country and a comprehensive system of foresting is decided upon we will soon be looking to the tropics, the only available source of supply for our 450,000 miles of trackage. At the present time our knowledge of these tropical resources is exceedingly meagre.

During the past 30 years or more, attempts have been made to introduce tropical ties to this country, especially from the West Indies and South America. Steamship lines have offered tonnage at a negligible cost or in some cases at no cost in order to get such a movement under way. It is obvious, of course, that tropical woods of high durability, hardness and weight, such as mahogany, greenheart, lignum vitae and quebracho would prove to be very excellent ties if their prohibitive cost for cross-tie material did not prevent their further introduction.

Ties have been brought here from Cuba, Colombia, Brazil, Argentine, Africa and Venezuela. Generally speaking, the atmosphere and soil conditions are much more severe as affecting the life and utility of ties in those countries than here.

About 25,000 ties were imported from the Amazon district of Brazil and placed in the trackage of five eastern railways in the years 1915-16-17. One railway placed 5,000 ties, including 15 to 20 different varieties of hard, heavy woods from Brazil. They were presumably well-seasoned when put into service and it is reported that all failed within four years except one species locally known as masaranadauba. During the past year all other varieties have been removed from the track. The failure was reported due to "brooming" and to some extent to decay. All of these ties were 7 in. x 9 in. x 8½ ft. Various opinions have been given as to the cause of "brooming" which is not supposed to exist in the native habitat of the wood. Some state that the difficulties were due to changes in climatic conditions; that is, change from extreme heat to extreme cold combined with heavy traffic and loads, crushing the ties after they have been checked severely. Some engineers have stated that if properly seasoned the ties would work out much more favorably. Another species, javaira, is reported to have done fairly well.

It may be of further interest to recite the experience of railways in several tropical regions and of other sporadic attempts to use tropical ties in this country.

The director of Forestry at Manila reports that the following woods last from 8 to 12 years untreated in the Philippines; that they require no tie plates and that the ordinary rail spike does not work loose in them. Locally these woods are called molave, ipil, yacal, apitong and guigo. The Philippine Ry. Co. now accepts 35 different native woods for ties.

The Sante Fe has tried out 200,000 stringy bark and blue gum (eucalyptus) ties from Tasmania. These were nominally only 5 in. x 8 in. x 8 ft. long but many of them were less than 5 in. in thickness. These ties did not stand up under the heavy service to which they were subjected on account of the thinness. The same railroad tried mangle prieto and chico sapote from Mexico but on account of the inexperience of the tie makers they did not prove satisfactory. Officials of this railroad state that it is really unfair to give wide publicity to this failure.

In British Guiana tests were made on 13 varieties of treated native woods and Baltic pine by a local railway. The native woods were all of hardwood measuring 4½ in. x 9 in. x 9 ft. long, the ties were grooved ½ in. in depth to receive the rails and bored with ⅞ in. holes for nail spikes. After eight years all varieties except three were sound and in good condition. These three were kautaballi, untreated mora and treated Baltic pine which was badly decayed throughout. The latter wood is the one chiefly used by European railways and lasts 25 years in England when treated. The tests showed that (1) the native woods after treatment were far superior to the treated Baltic pine and that (2) mora and wallaba (*eperua falcata*) when treated resist decay under extremely adverse conditions of climate, precipitation and poor ballast.

Both mora and wallaba are abundantly available and can be produced fairly cheaply. There are three varieties of mora of which the red mora (*dimorphandra mora*) is by far the best. When properly seasoned the red mora makes an excellent tie timber.

This experiment would also seem to bear out the contention that tropical ties should be used only in the treated condition. If this is so, it is unlikely that we shall look to the tropics to supply any considerable portion of our cross-tie supply for a long time to come.

One large American railway carried on a test covering 30 varieties of tropical ties, chiefly of South American origin. Most of these failed in 7 years due to splitting and decay. Some only lasted 2 to 5 years, while a few such as mora, cacaque, roble pellin and quebracho remained for 10 to 12 years except the mora which varied from 4 to 12 years.

Another railway in the East used several thousand Brazilian ties in recent years. Of 2,647 ties examined closely 827 were removed from the track on account of splitting, "brooming" and decay after a service of 2½ to 3½ years. The engineer of tests states that many more will have to be removed after slightly longer service.

In Cuba, two of the railways report extensive experience with 25 different kinds of hardwood ties, all of which must be bored for spikes on account of their extreme hardness. Of these woods they report the following to be most satisfactory—in the order named—jiqui china, arabo, jucara negro, sabicu, caoba, quibra hacha and acaua. The length of service varied from 5 to 25 years, the average being about 11 years. All are used untreated. All ties are 6 in. thick, 8½ ft. long with round edges. No tie plates are required and all ties are adzed. An extremely rigid inspection is necessary as many woods resemble each other and an expert in tropical woods sometimes will err in classifying them. At present practically all the available hardwood ties in Cuba come from the province of Camaquey.

The railways of Brazil, at first particularly dependent on imported ties, are now using almost entirely native woods. One company with about 2,000 miles of railway uses 350,000 ties annually and accepts 47 different kinds of wood growing along the right of way. These last from 10 to 12 years untreated. They are all hewn from comparatively small trees, and in 1918 cost the railway 60c. apiece delivered.

The railways of Southern Brazil (Parana, Santa Catharina and Rio Grande do Sul) use annually about 450,000 ties which are now cut from embuia, a common hardwood. These are said to last 15 to 20 years untreated and are much sought after by the railways of the State of Sao Paulo.

Many tropical countries, such as Brazil, Guatemala, Colombia, Venezuela and the Guianas are now using native ties whereas formerly they imported ties from Sweden, Canada, the United States and Australia. Lack of a knowledge of the local timber and its suitability for cross ties, labor difficulties or insufficiency were responsible for importing ties from temperate to tropical climates.

London Subway Extensions Sanctioned

(London Correspondence)

The London Underground concerns have completed their negotiations with the British Government on the question of extending the city's subway system. As a result of these negotiations the extensions sanctioned will involve a capital outlay of £5,000,000, the work will take two years to complete, and employment will be found for about 20,000 men for this period. The proposals include the enlarging of the City and South London tube and linking it up with the London Electric Railway; the extension of the Hampstead and Highgate Railway (north London); and the linking up of the Central London and London and Southwestern railways at Shepherd's Bush (west London).

Putting Business Methods Into State Highway Management

Pennsylvania Develops Theory of Organization—Management Division Co-ordinates Work—Educational Supervision Emphasized—Work Authorizations Control Expenditures of $45,000,000 in One Year

FOR two years Pennsylvania has led all states in the combined mileage of paved roads built and of roads of all kinds intensively maintained. In 1921 the state spent $35,000,000 for new construction and in excess of $10,000,000 for maintenance. It is common knowledge that this extensive program of improvement proceeded with less friction and more speed than prevailed in many states whose expenditure was not one-tenth as large. A highly developed state highway department organization is the reason for this success. The salient characteristics of this organization, therefore, invite careful attention by states in which extensive construction and maintenance are, comparatively, just beginning. They are as follows:

A Few Features of Pennsylvania's System

Complete Graphic Records
Close Financial Control
Promotion on Performance
Square Deal for Contractors
Developing Teamwork
Intimate Data on Personnel
Uniformity in Office Practice

A definite theory of state highway department organization has been worked out. All branches of department work are co-ordinated through a management division which has called to its aid the most complete system of graphic records perhaps ever employed in engineering construction. Educational supervision by the department has been carried down to township construction and maintenance through an advisory bureau. Exact financial control is managed by means of a budget plan and a system of work and cost authorizations.

Premising that highway development is a continuing business the organization of the department is that of an industrial enterprise. It functions directly; it has flexibility for curtailment or extension of operations; it seeks permanence of personnel and bases promotion on performance; it requires precise accounting and cost keeping; it keeps all records in shape for instantaneous use. In brief, *business efficiency* is set down as the first organization requirement.

Public service is the second requirement. Being an organization for public service, it is held that quality of product is primary; that expert technical direction is therefore essential; that fair dealing with contractors and in all business relations is called for; that information and records are at the command of any legitimate inquiry, and that complaints must receive immediate and courteous attention and errors must be promptly corrected.

An *organization adequate to the work* is consistently maintained. This is considered so important a requirement as to be subordinate only to business efficiency and public service as a fundamental organization principle. Size of organization, as Pennsylvania highway officials interpret it, does not signify merely a large force; it signifies large capacity for production. This involves logical division of labor under central direction; a planning bureau to co-ordinate effort; a skilled personnel trained in teamwork; and high organization morale. Pennsylvania experience stresses size of organization.

A state highway department transacts annually a business amounting to millions. Pennsylvania in 1921 spent in round figures $35,000,000 for road construction and $10,000,000 for road maintenance. Many states are spending from $10,000,000 to $20,000,000 and there are few states in which the annual expenditure for highway improvement is not at least $5,000,000. These are large business operations and they require directing organizations of commensurate size. If they are not provided the mileage cannot be produced or if it is produced either the cost is high or the quality is inferior.

The machinery of organization, though carefully planned by the Pennsylvania highway officials, is regarded as less vital than organization morale and teamwork. Emphasis is placed on these qualities because, without them, it has been found by experience that an organization for public road work, however perfect its machinery, gives partial and less efficient service. The performance records for three years show that practically every function of the organization—routine testing, materials surveys, engineering supervision, general administration—costs less per unit, with three years of heavy construction and intensive maintenance behind, than it did at first with men not trained to work as a team.

Capacity, business efficiency and public service, are, then, the fundamental requirements of highway department organization as they have been determined in Pennsylvania. With them as principles, the functional organization has developed as shown by the chart, Fig. 1, standing out in which is the central circle of management.

The management division is a co-ordinating authority to interpret executive policies and reduce them to standard procedure. In general, its functions are:

To determine the various operations of the department in accordance with the requirements of the highway laws; to group these operations on a divisional basis and assign them; to create the necessary divisional organization, and instruct each division in the standard methods of operation; to interpret executive policies in accordance with the scheme of organization and present them to the divisions in their proper relation to each; to schedule the performance of all department work and follow up the schedules. The chart, Fig. 1, shows the bureau and section organization created for the work.

Authorization and recording, it will be observed, are the outstanding functions, with personnel work next in importance. Authorization can be explained more clearly in considering maintenance direction and will be disregarded for the moment.

Personal relations and personnel are made a special care by the management division. Permanence of employment and promotion for merit are considered

matters of course. Personnel direction goes much further. A detailed—almost intimate—personal record of each employee is kept. Its first purpose is to rank the employee in respect to promotion and pay, but an equally important purpose is to ascertain his availability for transfer from one branch of service to another. This is very important in preserving permanency of personnel, for different divisions or bureaus have their peak loads at different seasons, and an employee, if his proficiency is known, can be shifted from a department where work is slack to another where it is crowding the regular force, when otherwise he would often be laid off. So intimate are the personal records kept that they cover an employee's absences from work and their reason and his tact, diplomacy and personal likability.

Instruction is an essential part of personnel direction. It is directed particularly to the outside office employees to co-ordinate their work and thinking with department practice and policies. Regular visits to district offices, combined with questionnaires and books of instructions, are the means employed.

Personal records, as described, are an index of the comprehensive recording system by which the management division keeps in touch with the department work. Four of the eight sections of the division, as the chart Fig. 1 shows, are concerned with records. The notable feature is that all records possible are graphs. Examples of any but the most simple charts, as Figs. 2, 3 and 4, are impracticable to show, because of the combinations of colors and symbols employed to indicate almost every detail which the statistical tables contain, but their number and purpose comprehend practically all department information. A glance will tell for example how many days any employee has been absent for sickness or any cause; or what condition of maintenance exists on any highway; or the mileage of each kind of highway in every county, or any other thing that the statistical tables embrace and the department or the public is likely to want to know. These scores of charts are mounted on swinging panels and can be consulted at any time by any one having a legitimate reason.

This chart system of records is considered highly important and is kept closely up to date. It is stated that the time consumed in charting current records is only a few man-hours a week. The use of the records, on the other hand, is constant within the department and also by the department heads to instruct delegations with petitions or bringing complaints. The system is usable by any of the department officials, without searching out the record keeper to disclose and interpret the information. Indeed the visitor conversant with highway work can by a few minutes study interpret almost any chart, as may be seen from the samples, Figs. 2 to 4.

Instruction of branch office employees in connection with personnel direction has been mentioned as an example of educational supervision. A more important line of effort is through the Township Division, Fig. 1, which acts in a supervisory capacity to the township highway officials. This work is considered constructive

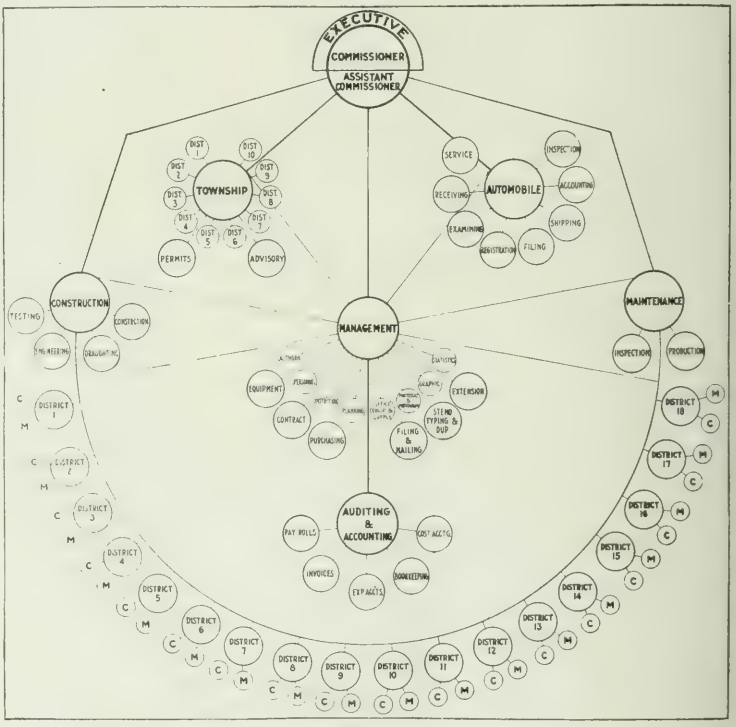


FIG. 1. FUNCTIONAL ORGANIZATION CHART

in two ways: (1) It ensures that local roads, which ultimately may come under state department direction, are in the meantime being developed along the standards and practices of the department; (2) it keeps the public thinking intelligently of road improvement and helps in getting authority voted when extensions of the state-system improvement program are under contemplation.

Briefly, through the township division, local road construction and maintenance has at command engineering experience and skill far beyond the possibilities open to small communities dependent solely on their own initiative and resources.

Exact financial control is set down as a cardinal department policy. It is effected by a budget based on estimates and by means of work authorizations which cannot be exceeded. To illustrate procedure the finance chart of any maintenance operation is illustrated, Fig.

5. With appropriations made, there follow careful estimates from which a budget is planned, then definite authorizations for work to be done, followed by accounting and cost reporting, as the work proceeds.

It is laid down as a principle that the intelligent distribution of funds must of necessity result in a *budget*, this budget being prepared from annual estimates furnished the main office by the representatives in the field. For convenience, maintenance estimates are divided into six general classes: (1) Indirect expense is a charge covering salaries and expenses of

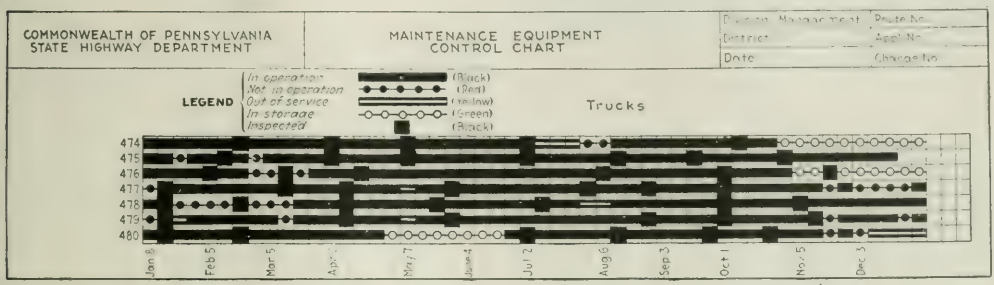


FIG. 2. SERVICE OF EVERY PIECE OF EQUIPMENT RECORDED

the field offices and forces. (2) General repairs, as the term implies, takes into account the different classifications for the proper maintenance of the total mileage of highways—the crowning and dragging of earth roads; placing of drainage other than bridges, and the necessary repairs to improved roads. (3) Resurfacing, which includes the reconstruction of the different types of pavements already laid, either with the same material or with a higher type of construction. (4) Surface treatment, which includes the purchase and application of the bituminous material and the chips or other covering material. (5) Bridge construction, and (6) repairs to tools and equipment.

The preliminary estimates are prepared by the field of guard rail, and the placing of surface and subsurface drainage at particular locations. The reduction in estimates for resurfacing is made after a personal inspection of each project by a maintenance inspector from the maintenance division, who takes into account the importance of the road, the traffic, and the possibility of substituting cheaper repairs. Reduction in surface treatment estimates is made by a personal inspection of the roads and a reference to the chart showing the character of the treatment they received in past years, together with an appraisement of the probable traffic that the road will carry during the coming season. Reduction in the bridge construction estimates is taken from the bridge records kept in the main office. These records are compiled from an actual inspection of each bridge, made by an engineer of the bridge division, which gives in detail the physical condition of each structure.

These estimates are then returned to the engineers with notations as to the advisability of the reduction or elimination of certain work and after the corrections have been made are again forwarded to the main office for approval and the issuance of the necessary authorizations.

Upon receipt of the final estimates, *authorizations* for

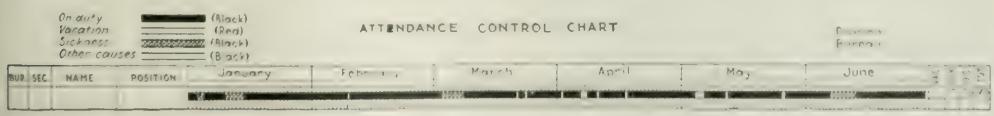


FIG. 3. EMPLOYEE'S DAILY ATTENDANCE CHART

representatives after a careful and thorough study of each route. The roads are gone over foot by foot, distributing each estimate among the several units of work coming under the various classifications. No guess or approximation is allowed. The engineers are held strictly to actual figures, so that each has a personal pride in seeing that the work is done within his estimate.

These estimates are totaled in the Maintenance Division under the different classifications and are gone over very carefully. In the event that the estimated amount required is in excess of the estimated revenues, it is necessary to make reductions. In the estimate for general repairs, the reduction is accomplished by comparing such estimate with the amount of money expended during the preceding three years upon the different roads, always endeavoring to develop work of a permanent character, such as widening, construction of guard rail, and the placing of surface and subsurface drainage at particular locations.

The different classes of work are issued from the Maintenance Division. A code number system is used to readily designate the type of work and approximate location. These authorizations are issued in quintuple, one copy going to each of the several interested bureaus. This includes a copy to the auditing division, from which an account is opened up chargeable to the authorization; one to the management division as the co-ordinating division of the department; one to the purchasing bureau, in order that purchases can be checked against the authorizations; one to the maintenance division, for the purpose of record and control, and one to the district engineer, which is his notification of the specific amount he has been allotted for a particular object.

This authorization is the instrument used to control the funds and in no case can it be exceeded. It denotes the funds which are to be distributed over the entire

season and, in the case of general repairs, the entire length of the route in the specified county.

Field control of funds is vested in an engineer's authorization by which he apportions to the superintendent the funds for a certain definite amount of work which is listed on the face of the authorization, excepting in the cases of surface treatment and resurfacing, when the entire amount of the department authorization, is issued. The engineer's authorization is issued in triplicate and forwarded to the maintenance division for approval. One copy is kept in that division for record and the other two returned to the district engineer, who retains one for his file and forwards the remaining copy to the superintendent as his notification that the work is authorized.

A special single-entry ledger is used both in the field and main office to keep a record of expenditures. The purchase order, which is the authority for a vendor to furnish certain material to the department, is considered as a liability. The main office receives a report each month upon each authorization issued, according to

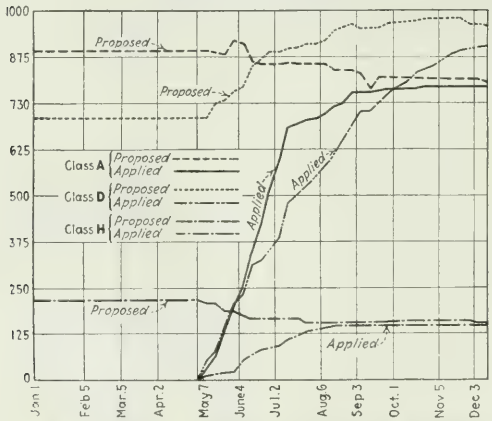


FIG. 4. MILEAGE OF SURFACE TREATMENT RECORDED

classifications. This, being summarized, gives the total amount expended each month under each classification on every route in the entire state.

In order that there may be uniformity in all office procedure, a regular system of field office inspection and audit is employed. Any field representative can be transferred from one office to another and the same system of bookkeeping and filing will be in effect.

Occasionally, the funds authorized for a certain project will be in excess of those actually required and by means of a cancellation and transfer report the engineer, with the approval of the maintenance engineer, may transfer funds from one project to any other authorization in his district coming under the same fund. Upon the completion of an authorization and at the end of the year a report is compiled by the superintendent, which itemizes all payrolls and purchases. This is in turn checked by the district engineer's office and is forwarded to the auditing division in the main office for check and record. Any unused amount, not specifically transferred to other work, automatically reverts to the general fund.

While the details of financial control, that have just been given, apply specifically to maintenance, the general practice indicated is the same for all department expenditures. Every piece of new construction, for example, is controlled by a work and cost authorization.

Pennsylvania experience has developed a theory of

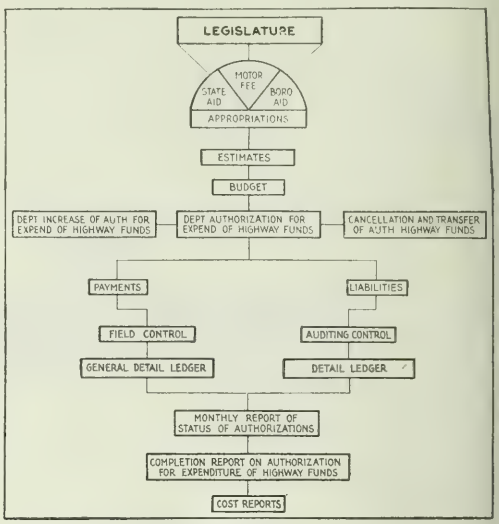


FIG. 5. MAINTENANCE FINANCE CONTROL CHART

highway department organization which, with central planning and co-ordination, educational supervision and financial control by budget and by job authorization, is universally true and applicable.

A Newspaper Appreciation of the Engineer

Commenting on the organization of a Minnesota federation of architectural and engineering societies, the Minneapolis *Journal* published recently under the head "What the Engineer Does for Us" the following appreciation of the services rendered by the engineer:

Few laymen realize or comprehend what a part these men play in the development of this state and city. It is the engineer who plans our highways and railroads and automobiles. He provides our electric light and power, our oil and gasoline, our supplies of pure water. He plans our buildings, bridges, elevators and mills. He has developed our great iron mines, the water power that runs our industries. He has now come to the rescue of the farmer, and is showing him how to irrigate or drain and prepare his land, how to plow, seed, cultivate, harvest, store and market his crops at a less cost and with less labor. To the engineer practically nothing is impossible, if money with which to do it is available, but he is the last man to advise expenditure, unless practical and commensurate results can be obtained. He must know how to accomplish the required results, how to calculate the cost in advance, how to select the method that will cost the least, considering all things. He must assume heavy responsibilities for the safety of life and property. He must be engineer, salesman, diplomat and statesman, and with all have a knowledge of law and economics. He must build his castles in his mind, before he can put them on paper; he must study, cut, fit, and try, before his plans are ready for the constructor who will execute them. But it is these same paper plans that control and make the success or failure, the economy or extravagance, the safety and security of the enterprise. If the engineer errs in his knowledge and judgment, the results may be not only unsatisfactory but disastrous.

Elimination of Odor in Sewage Gases by Burning

After Numerous Costly Experiments at Austin, Tex., Imhoff Tank Gases Burned to Destroy Own and Raw Sewage Odors

By C. E. Leonard
City Engineer, Austin, Tex.

ODORS from the raw sewage and treatment plant at Austin, Tex., are eliminated by passing them through a furnace in which the fuel is the gas from the digestion tanks. Numerous experiments using gasoline and distillate as fuel did the work but at too much expense. By the present method the plant generates its own purifying fuel. The disposal system (*Engineering News-Record*, Dec. 25, 1919, p. 1066) consists of a diversion chamber, pumping station, four cylindrical Imhoff tanks and sludge drying beds. It has a nominal capacity of 2.5 m.g.d. but can handle a maximum of 4.6 m.g.d. The population served is about 40,000. The plant was put into operation Nov. 1, 1919, at a cost of $110,000, and with the exception of the trouble with odors has been a success. The following is a history of the expedients used and the experiments which led to the present satisfactory installation:

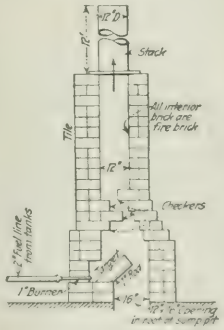


FIG. 1. GAS FURNACE FOR ELIMINATING ODORS

On May 17, 1920, bad odors arose from the open outfall chamber, diversion chamber, sump pit and settling tanks. To remedy this condition the outfall chamber was covered with concrete, the sump pit fitted with a wood and tar paper roof and a 40-ft. stack 30 in. in diameter was erected over the diversion chamber. Instant relief was obtained for the time.

After July 19, 1920, when troubles began again, with the odors at times as bad as ever, the following steps were taken: Conical galvanized-iron hoods were erected over the gas vents to collect the gases from the digestion chambers. The gases were ignited as they passed through the reduced area. On account of foreign matter, tars, gas drip and oil, there was considerable trouble from explosions and finally the burners were abandoned and the gases vented into a 4-in. stack 75 ft. high. The next step was to replace the 40-ft. stack over the diversion chamber by a 100-ft. stack and to cover the settling tanks with semi-airtight roofs in which swing doors were left for rodding and also as a means to jet scum from the top of the gas vents. This procedure removed all odors from the plant and grounds but complaints still persisted, the complainants contending that the gases had only been harnessed and that under certain winds and atmospheric conditions the odors would come from the stacks to the ground level in the vicinity of the plant.

By careful inspection it was concluded that at times the odors in the vicinity of the plant were bad and that if they were not eliminated either the plant would have to be abandoned or the city would have to defend many

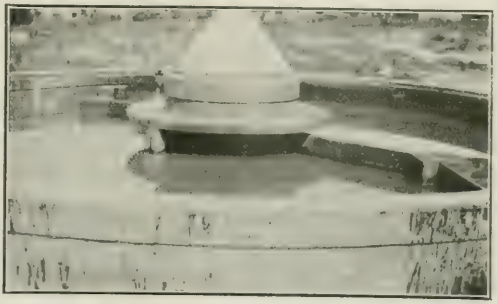


FIG. 2. HOODS TO COLLECT DIGESTED GAS
Scum boards removed to let oils pass over outlet weirs.

lawsuits. The raw sewage odors, which were the predominating odors, occurred in greatest amount during the warmer months. In my opinion the artesian water, which is itself foul when stale, greatly aggravated the situation, although much of the trouble came from oil and tar products from the gas works and several other sources. The gas wastes were cut off and piped into a creek. Most of the scum boards in the tanks were removed to allow the oils on the surface to flow over the weir directly into the effluent. As to the settling effects, the results were practically the same as with the scum boards in place.

The next step was to respond to court summons to show why the city should not be enjoined from operating the plant. Upon showing the court that there was good reason to believe that the odors could be eliminated by a burning process further time was granted during which this contention proved to be correct. In the first experiment on deodorizing the raw sewage odors a tem-



FIG. 3. TAR PAPER ROOF AND HOOD WITH BURNER

porary brick furnace checkered with firebrick was installed on top of the diversion chamber. A suction fan of the type used to suck cotton from wagons at a gin was set up with a 10-hp. motor so as to convey the air carrying the odors to the furnace through a 12-in. galvanized-iron pipe. As a fuel, gasoline was forced through special burners. Results were satisfactory, although the heated firebricks did not reach the degree of heat desired. Nevertheless, the principle was demonstrated.

For a permanent installation an air compressor, distillate burners and a high pressure tank were purchased. A furnace was constructed over a manhole of the diversion chamber. The heat and 100-ft. stack created the necessary draft to suck the sewage air through the furnace. In fact the draft was too strong and the

checkers had to be placed closer together. As long as the distillate was of proper grade the result was satisfactory but occasionally the burners would choke or water would be found in the distillate and then the firebrick could not be kept at the proper temperature. Whenever these things occurred the residents would promptly file their complaints. Further, the process was prohibitively expensive. Distillate cost 20c. per gallon and the monthly cost of operation was $700.

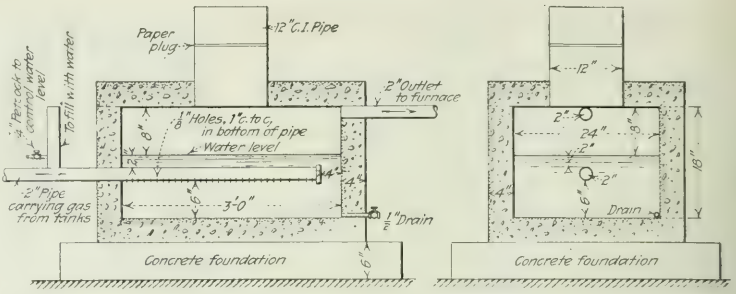


FIG. 4. SECTION OF SAFETY WATER SEAL TRAP

The above described failures brought us to the present plan which has been in successful use for more than eight months without one cent of cost for fuel. Gas from settled sewage arising from the digesting sludge is used as the fuel for the furnaces into which the raw sewage gases are pumped. To carry out this plan it was essential to close all openings over sewage surfaces



FIG. 5. FINAL CONCRETE ROOFS AND GAS PIPING

and to bottle the gases so that they could escape only through the red hot furnace. The temporary covers over the settling tanks were replaced by dome-shaped concrete roofs, provision being made for airtight slots for rodding the sludge and for connections for jetting the scum. A concrete roof was constructed over the sump pit. The 100-ft. stack was removed and all manhole covers on the diversion chamber were sealed. A rotary blower was installed in the pump house to force the air of the sump pit to the furnace, which was located 300 ft. away, near the tanks. The fuel or "digested" gas together with whatever raw sewage gas may arise from the sewage in the tanks is forced by a small gas pump through a safety water seal into the bottom of the furnace. There are sufficient heat units in the gas to keep the furnace red hot at all times, readily deodorizing all small obnoxious gases at small cost.

Since writing the foregoing account certain changes have been made at the plant to increase the efficiency of the deodorization process. The rotary blower did good work but was unable to deliver the gases through the 300 ft. of 2-in. pipe quite as fast as they accumulated in the sump pit. In consequence, at times an odor was noted around the pump room and sump pit. To remedy this condition we moved the furnace, or rather constructed another one on the concrete roof of the sump pit. To this furnace a 12-ft. section of 12-in. galvanized-iron pipe was attached as a stack. A 12 x 16-in. slot was also cut through the roof so as to allow the raw sewage gas to be sucked up into the furnace and through the 12-in. pipe by means of the draft created by the heat and stack. The 2-in. pipe line through which the raw sewage was formerly conveyed to the furnace at the tanks now carries the fuel or "digested" gas, together with whatever raw sewage gas may arise from the sewage in the tanks, back to the furnace at the sump pit. The new installation deodorizes the gases as fast as they accumulate. No longer is the rotary blower used, thus making quite a saving of power. The only power now used is a 1-hp. motor attached to the small gas pump which pumps the settled sewage gases through the safety seal to the furnace.

The writer wishes to acknowledge the valuable assistance of Dr. E. P. Schoch, professor of chemistry, University of Texas, especially with reference to the burning process and safety seals against back fire; also for the practical ideas advanced, later proved correct, he wishes to thank Lee H. Bowles, superintendent in charge of the plant since it was placed in operation.

Provisions of a Recent Cost-Plus Contract

The dam for the new water-supply system of Decatur, Ill., is being built under a cost-plus contract, in which the base price is $700,000 and the contractor's fee is 10 per cent. To this is added a lump sum of $20,000 for plant charges, to cover the use, rental and depreciation of machinery, tools end equipment.

There is an upset or maximum price of $975,000 and a provision for adjusting the base price to the quantities actually placed and at the unit prices bid, provided no changes have been made that would affect these prices. If the actual net cost of the completed work should exceed the base value, the contractor is to be paid as his fee the sum of 10 per cent of the base value, with a deduction from this 10 per cent of 20 per cent of the amount or cost in excess of the base value. But the total deduction is not to exceed 50 per cent of the 10 per cent. Further, if the actual net cost of the completed work is less than the base value, the contractor will be paid as his fee the sum of 10 per cent of the base value, with an addition thereto of 20 per cent of the difference between the actual net cost and the base value.

The contractors are L. N. Cope & Son, Decatur, Ill., and the engineers are Pearse, Greeley & Hansen, Chicago.

Chicago Double-Deck Drawbridge with Elevated Railway

Double-Leaf Trunnion Bascule of 268-Ft. Span—Operating Pinions Engage Racks in Trusses—Massive Truss Members and Supporting Girders

OF THREE double-deck double-leaf bascule bridges built at Chicago within the past six years, forming distinctive structures among the numerous bridges across the Chicago River, the longest is the new Wells St. bridge, shown in Fig. 1, having a span of 268 ft. c. to c. of trunnions and giving a clear channel width of 220 ft. This bridge, put in operation on Dec. 4, 1921, is the second to carry an electric elevated railway on the upper deck. It is of the fixed trunnion type designed some years ago by the city's engineers (but modified by certain patented features, noted later), and is the twenty-third bridge of this type built across the Chicago River. Each leaf is carried by two trunnions and weighs 2,500 tons (1,300 tons of counterweight).



FIG. 1. DOUBLE-DECK 268-FT. BASCULE BRIDGE FOR STREET AND ELEVATED RAILWAY AT WELLS ST., CHICAGO

Next in order of span is the 256-ft. Michigan Ave. bridge, opened in 1920, which has an upper roadway for fast or pleasure traffic and a lower deck for commercial vehicles. Its weight is 3,500 tons for each leaf, including counterweight. The third is the 245-ft. Lake St. bridge, opened in 1916, which carries an elevated railway on the upper deck and is in general similar to the Wells St. bridge, with a weight of 2,000 tons per leaf, including the counterweight. Both of these latter structures have two lines of trusses with two trunnions carrying each leaf. The Michigan Ave. bridge is notable in having four trunnions in four lines of trusses, with a spacing of 6 ft. between the middle trusses, but its width is about 90 ft. as compared with 72 ft. for the other two bridges (see *Engineering News-Record*, Sept. 9, 1920, page 508).

Traffic on the old Wells St. swingbridge was maintained during the construction of foundations and superstructure for the new bridge, except that the roadway on the lower deck was closed for some weeks, partly on account of changes in grade on the street approaches. The program of putting the new bascule bridge into service and removing the old swing span with a minimum of interruption to traffic was given in *Engineering News-Record* of Oct. 13, 1921, p. 606. The new bridge was put in service for the elevated railway on Dec. 4. Fig. 6 shows the north leaf completed except for the deck framing in the end panels through which pass the elevated railway and the street.

Deep Concrete Substructure.—For each leaf there is a concrete tailpit or counterweight pit 48 x 48 ft. inside, with its base 31 ft. below water level in the river, supported on six cylindrical concrete sub-piers built in open wells in the Chicago clay, as shown in Fig. 4. It was intended at first to carry the sub-piers to rock, at a depth of about 117 ft., but this design was modified and they were seated in a hardpan stratum at a depth of about 75 ft. These sub-piers were belled out at the base, increasing the area to limit the pressure on hardpan to 8 tons per square foot, which is the unit adopted for other bridge foundations.

Two piers under the side walls of the pit and carrying the trunnion columns are 10 ft. in diameter, belled out to 18 ft. Two under the front wall or river pier are 11 ft. in diameter and two under the rear wall are 8½ ft. in diameter, these last carrying the anchor columns for the transverse girder which restricts the upward movement of the heel of the bridge leaf.

In the cofferdam for the pit, the bottom course of bracing was supported by jacks on upright posts. During the concreting of the 72-in. floor, which is heavily reinforced to resist upward pressure, the jack supports were moved from place to place in order to avoid leaving holes through the floor. To make the pits watertight, 10 lb. of hydrated lime per bag of cement was added to the concrete and a 1:2 mortar course 6 in. thick was applied in the floor and on the outside of the walls, being carried up with the concrete of the walls.

Trusses, Framing and Floors.—Two lines of trusses, 27 ft. deep c. to c. of chords and spaced 41 ft. 9 in. c. to c., carry two sets of plate-girder floorbeams, at the bottom-chord level and 4 ft. below the top chords, giving a headroom of 14½ ft. above the roadway paving (see Fig. 4). The panel length is mainly 14 ft. 10 in. In general design the trusses are of the parallel-chord type, but with the bottom chords curved downward toward the heel in order to increase the depth at the trunnions and to improve the appearance. An inverted trough

section with outside flanges is used for the top chords, and a double channel section with flanges inward for the bottom chords. Details of the trusses are given in Figs. 2 and 3. Members radiating from the trunnion are of horizontal H-section with lacing over the open sides. A heavy H-section is used for the first vertical post, which takes a bearing on the pier when the bridge is closed. Connection plates are of large dimensions and have curved outlines to improve the appearance, these curves being finished accurately by grinding. Fig. 3 shows the heavy connections at the trunnion. Between the heels of the two trusses is a steel counterweight box filled with mass concrete. Adjustments of weight will be made by means of cast concrete blocks of about 170 lb. each, secured in recesses in the counterweight box.

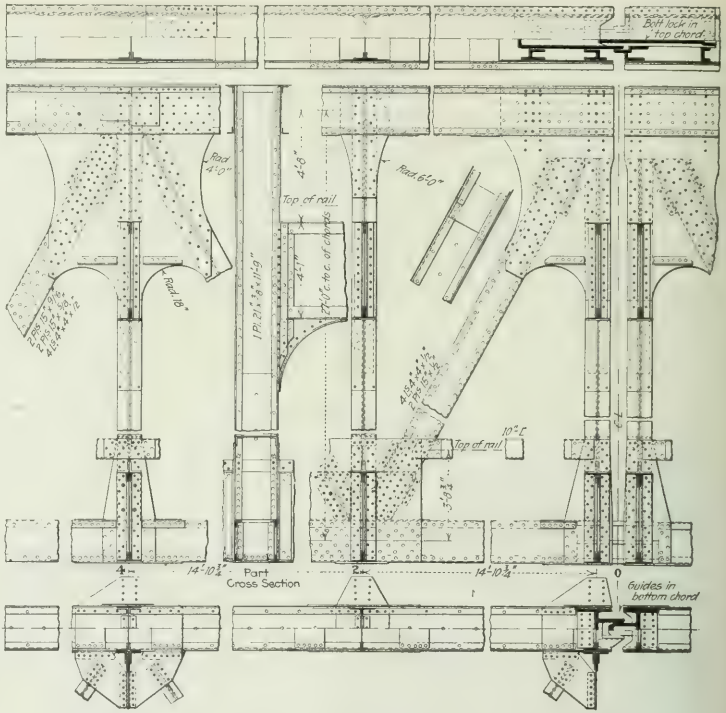


FIG. 2. PART OF MAIN TRUSS, WITH END LOCKS AND GUIDES

Floor framing in the lower deck consists of nineteen lines of 15-in. I-beams between the floor beams, five stringers being grouped under each car track (see Fig. 4.) Cantilever extensions of the floor beams carry timber joists for 15½-ft. sidewalks. For the upper deck there are five 18-in. I-beams, two under each of the elevated-railway tracks. These tracks are spaced 24 ft. c. to c., while the street-car tracks on the lower deck are 10 ft. 2 in. c. to c.

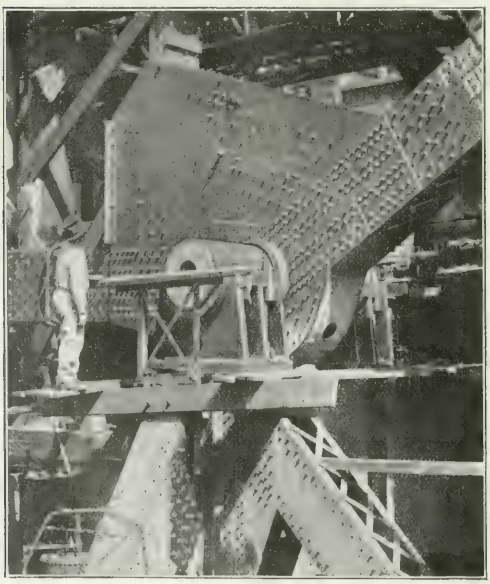


FIG. 3. TRUNNION AND MASSIVE TRUSS MEMBERS

Roadway paving consists of rectangular yellow-pine blocks 3½ in. thick laid on 6 x 12-in. transverse planks, which rest on 4 x 6-in. oak strips on the I-beams and are bolted through the top flanges of these beams. Sidewalks are of transverse planks on wood joists. The upper or railway deck is of the usual open construction, with ties laid across the stringers and carrying track rails with double lines of guard timbers. All timber is creosoted. Grooved girder 129-lb. 9-in. rails for the street-car tracks are bolted to cast-steel saddles riveted between pairs of I-beams, as shown in Fig. 5.

In order to reduce wear, these rails are manganese steel castings for 8 ft. at the end of the leaf and on both sides of the break in the floor at the heel. On the leaf the rails project so as to take a bearing on the end of the opposite leaf. The rail ends are halved so as to give lateral support at the joints in mid span. At the break in the floor at the heel, the 1-in. opening in the roadway is covered by a steel plate set in the recessed face of castings attached to the ends of the approach and leaf. This plate is secured to the approach casting by countersunk rivets. Details of these breaks in the floor are given in Fig. 8.

Live load on the upper deck consists of 50-ton cars of the elevated railway, or 2,000 lb. per lin.ft. for trusses. On the lower deck it includes 50-ton street cars, a 24-ton four-wheel truck and 100 lb. per sq.ft. on the sidewalk and unoccupied space of the roadway.

Trunnions and Supports—In each truss is a forged steel trunnion shaft, having its ends carried in cast-steel

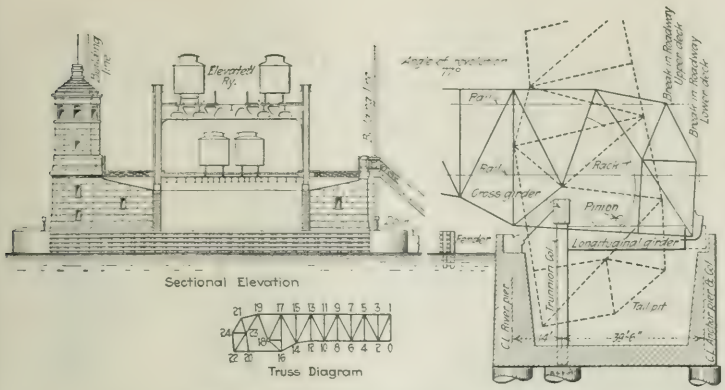


FIG. 4. CROSS-SECTION AND SECTIONAL END ELEVATION

bearing blocks with phosphor-bronze lining. The shaft, bored for the detection of flaws, is 108½ in. long, 29½ in. in diameter in the truss and 27½ in. in bearings. It is made for a light driving fit in the truss and a running fit in the bearings, with allowance for free movement and lubrication. These dimensions are proportioned for a load of 2,500,000 lb. on each trunnion and a unit pressure of 1,250 lb. per sq.in. on the bearings. In setting the trunnions, an accurate base line was established at right angles to the center line of the bridge, and was transferred to a fine piano wire stretched in close proximity to the trunnions, which were then placed parallel to the wire.

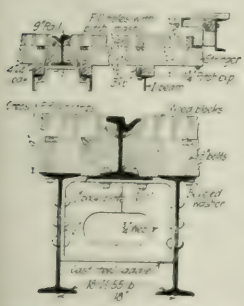


FIG. 5. HIGHWAY DECK AND STREET-CAR TRACK

The four bearings for each leaf are seated on a heavy 79-in. box girder 51½ ft. long, extending across the tail pit and supported on massive columns in the side walls. The ends of this girder pass through the trusses, the members of which are so arranged as to clear the girder in all positions of the leaf. Against the trunnion columns are framed the ends of similar 72½-in. longitudinal girders 39½ ft. long, which are anchored to shoes on the side walls. Brackets or gussets on these girders are riveted to the rear of the cross girder, the forward side of which is braced against the front wall or pier of the pit by a pair of inclined struts. Fig. 4 shows the general arrangement and Fig. 9 gives the details of these heavy girders.

As the longitudinal girders were placed at an early stage of the work to support temporary trusses during the erection of the span, they were built with temporary extension panels 4 ft. 10 in. long to frame against the anchor columns in the rear wall until such time as the side walls of the pit were carried up to the elevation for the shoe bearings. After completion, these extensions were cut off at splices which were provided for the purpose.

In the meeting ends of the top chord are center locks of the bolt type, each operated by a 3-ho[illegible] on the leaf. In the bottom chords no locks are provided, but the trusses are held in line by projecting lugs on one leaf which enter slotted lugs on the end of the opposite leaf (see Fig. 2).

Tail locks of the toggle type take the live-load reaction on the heel of the closed leaf and also force the bridge down to its final closed position for engagement of the center locks. These toggles are upright, each composed of a pair of levers hinged together, the lower lever being seated in a foot bearing and the upper one entering a cup-shaped lug on the heel of the truss. To release the bridge in order that it can be opened, the toggle is slacked by the pull of a motor-operated horizontal lever, thus drawing the lock member downward and backward so as to clear the lug.

Upward reaction at the heel of the leaf is taken care

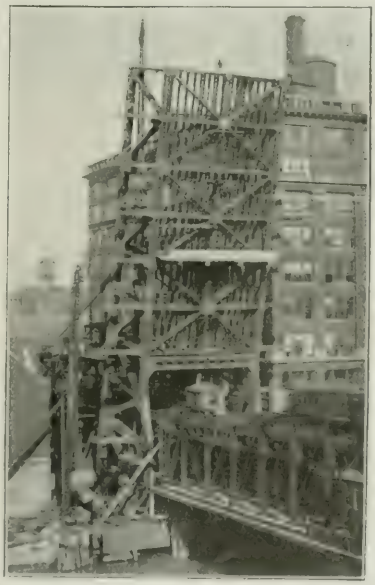


FIG. 6. NORTH LEAF ERECTED WHILE STREET AND RAILWAY TRAFFIC PASS THROUGH LOWER PORTION

of by brackets on the trusses, which engage the bottom of a transverse anchor girder on columns in the rear wall of the tail pit. When the bridge is closed, the bottom chord of each truss takes a bearing on the pier or front wall of the pit, this bearing being directly under the first vertical post or panel point beyond the trunnion. A heavy bearing plate is riveted to the bottom of the lower chord at this point (see Fig. 7).

A pinion and segmental rack for each truss constitute the operating mechanism, the pinion shaft being carried by an inboard bearing on the side wall of the pit and the rack, of 20-ft. pitch radius, being built into

the heel of the truss, as indicated in Fig. 4. The pinion is 17 in. wide, with a pitch of 7 in. and a pitch diameter of 31.2 in. It is driven by a 100-hp. motor through a train of gearing shown in Fig. 9. This arrangement was devised and patented by the late Alexander Von Babo, while assistant engineer of bridges for the city, and it has been used on a number of the river bridges.

Each leaf is operated by two motors and two gear trains. Torsion between the two opposite trusses is resisted by the transverse girders which carry the counterweight box and by similar trusses in vertical and horizontal planes in front of the trunnion. These girders provide sufficient rigidity to enable the leaf to be operated by one motor and pinion if necessary. The machinery is designed to raise or lower the leaves in 45 seconds.

To hold the bridge in any position there is an electrically-operated band brake on the motor shaft, with a similar hand-operated emergency brake on the first countershaft from the motor. Either brake is designed to hold the leaf against a 20-lb. wind pressure. It was at first intended to use grip brakes on the heel of each truss, engaging curved rails on the tail pit, as at the Michigan Ave. bridge. In view of the extra expense it was decided to rely on braking through the machinery, as in most of the other Chicago River bridges.

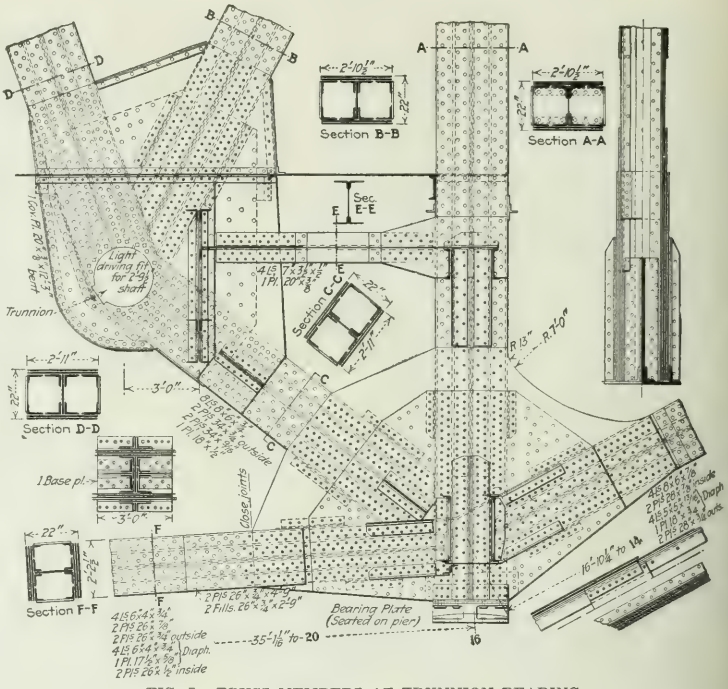


FIG. 7. TRUSS MEMBERS AT TRUNNION BEARING

In addition to signal lamps, gongs and the usual roadway gates of the railroad type, with swinging arms, there will be yielding cable barriers of the Strauss type to close the roadway beyond the large tail pit, which is open when a double-deck bridge is raised. This barrier will be 21½ ft. from the break in the roadway. To prevent undue sag in the cables across the 38-ft. roadway, the center of the barrier will be attached to a light vertical cable wound upon a drum in the framing of the upper deck.

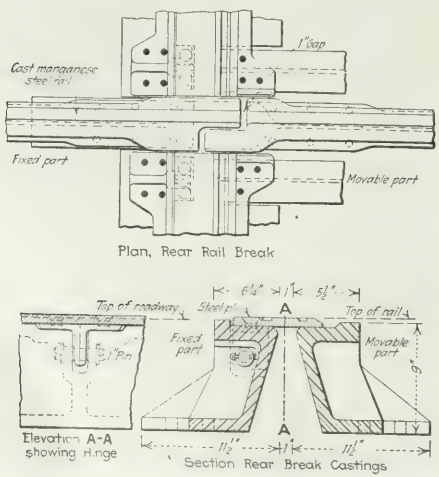


FIG. 8. BREAKS IN CAR TRACK RAILS AND ROADWAY

To open the bridge, five motor operations are made in series, as follows: (1) Close roadway gates, (2) lower roadway barriers, (3) release center lock, (4) release heel locks, (5) raise bridge. The electrical mechanism is so interlocked that each operation must be completed before the next one can be made. The bridge is so interlocked with the signal system of the elevated railway as to prevent the center lock being released until the railway signals are set at the "stop" position. Trains on the elevated railway are equipped with devices for automatically applying the brakes and shutting off current if a motorman should pass a "stop" signal.

Operating equipment includes four bridge motors of 100 hp., two heel lock motors of 7½ hp., a 3-hp. motor for center locks, twelve motors for operating gates and barriers and two 15-hp. motors for the tail-pit pumps. Two sources of current are provided for each leaf, from the power systems of the elevated and surface railways respectively.

In putting the new bridge into service, the program differed slightly from that outlined in *Engineering News-Record* of Oct. 13, 1921, p. 606. The elevated-railway traffic was stopped at 8 p.m., Friday, Dec. 2, and the railway forces then began to remove the tracks from the upper deck of the old span and old approaches. The old swing span was swung open at midnight, and

as soon as it was blocked up on the protection pier, work was begun in cutting it apart so that the center portion could be removed to allow the bascule leaves to be lowered. Placing the floor beams, stringers and laterals in the panels left open for passage of trains through the leaves was begun at 9:15 a.m. Saturday.

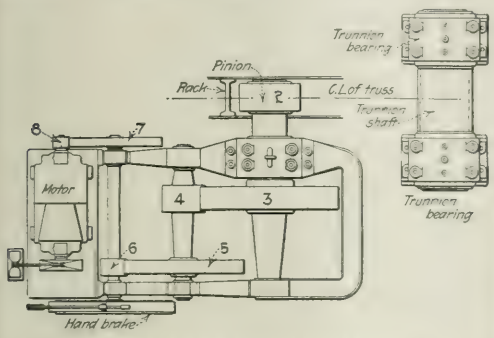


FIG. 9. PLAN OF MACHINERY LAYOUT

This work was discontinued at 5 p.m., for although lights were provided the shadows made it dangerous for the men to work at night. The work was resumed at 6:30 a.m., Sunday, Dec. 4, and was completed by 4 p.m. Both leaves were lowered at 5 p.m.; tracklaying on the upper deck was begun at once. Elevated traffic over the new bridge started at 7 a.m., Monday, Dec. 5.

This bridge was designed in the bureau of engineering of the Chicago Department of Public Works, under the direction of Alexander Murdoch, city engineer; C. F. Healey, assistant city engineer, and Thomas G. Pihlfeldt, engineer of bridges. Its construction is under Clarence S. Rowe, engineer of bridge construction, with F. A. Berry as engineer in local charge; C. F. Harrington, is electrical supervisor. The Ketler-Elliott Co. had the contract for the superstructure, including machinery and erection, the steel being fabricated under subcontract by the Fort Pitt Bridge Co. The FitzSimons & Connell Dredge & Dock Co. had the contract for the substructure, and the Norwood-Noonan Co. had that for the electrical equipment. Since patents of the Strauss Bascule Bridge Co. cover the cross-girder support of the trunnion bearings and the arrangement of members in the heels of the trusses so as to clear the cross girder during the movement of the leaf, the bridge is operated under license from that company.

Lincoln Highway Construction in 1921

Nearly 400 miles of Lincoln Highway were improved in 1921. For new construction $7,700,000 was expended and for maintenance $1,700,000. The additional mileage improved last year represents 12 per cent of the total

	Miles		
Concrete	231.75	Granite Block	7.10
Brick	241.07	Graded Gravel	[illegible]
Bituminous Macadam	383.28	Natural Gravel	[illegible]
Macadam	281.10	Graded Earth	[illegible]
Asphalt	78.00	Natural Earth	[illegible]
Creosote Block	5.99	Sand	[illegible]

mileage. Since 1913 when the route was dedicated more than $40,000,000 has been expended on [illegible] continental line of 3,305 miles. The surfacing types are noted in the above table.

Failure of Old Bridge Masonry

AN INTERESTING case of progressive failure of old bridge masonry exists at Belvidere, N. J. The east or New Jersey abutment of the Delaware River bridge at that point is cracked, and the outer portion is slowly moving toward the stream. The two views herewith show the north and south face respectively, the latter being stiffened by a heavy buttress, out of which a young tree is growing.

According to Charles A. Mead, chief engineer, Division of Bridges and Grade Crossings of the State Board of Public Utility Commissioners, there is no accurate record of the age of the masonry or of the material on which the abutment is founded. He states that the



CRACKS IN NORTH FACE

abutment is probably about 80 years old, and that the buttress on the south side appears to have been built soon after the construction of the abutment, to counteract bulging of the wall. It is believed that the abutment rests on a layer of slippery material overlying rock, dipping toward the river, and it is not heavy enough to resist the pressure of the fill and the live-load surcharge.

Measurements of the cracks in the two wings of the abutment have been made during the last two years,



SOUTH FACE SHOWING CRACKS AND HEAVY BUTTRESS

after these cracks had been pointed. The cracks increased in width during this period from ⅛ in. to nearly 3 in.; on Dec. 14, 1921, the main crack in the north wing wall was 2 in. wide, that in the south wing 2¼ in.

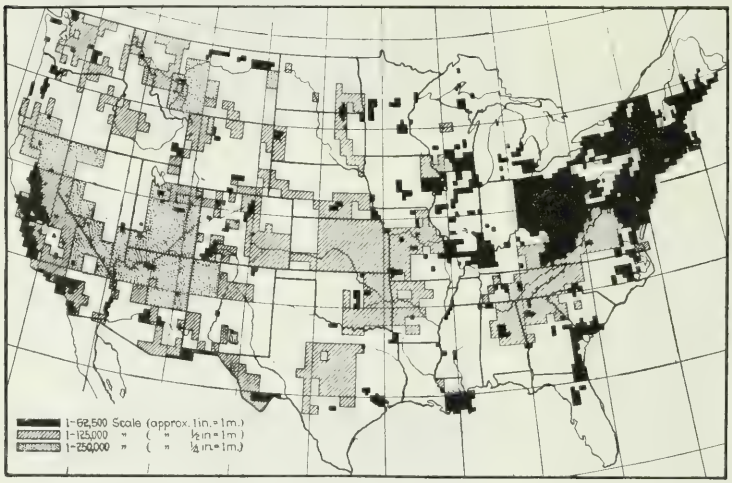
The bridge comprises four spans of lengths ranging from 153 to 169 ft., with trusses 26 ft. deep center to center of chords and 19 ft. apart center to center of trusses. The superstructure, built about 1905, is very light for present-day traffic loads. The bridge is privately owned and operated as a toll bridge. Investigation of its safety for public travel is in progress.

Shall Map Scales Be Decimal or Inch-To-The-Mile?

Present Status of a Question Before Federal Board of Surveys and Maps—Views of Map Users—Cost of Change

By F. E. Bonner
Assistant Chief Engineer, U. S. Forest Service, Washington

SUPPOSE a civil engineer building a bridge should find himself confronted with this problem: The bridge, which is to cost about $100,000, has progessed 20 per cent toward completion when the taxpayers demand that the roadway width should be changed to 16 ft. from 12 ft. originally planned, in order to correct the mistake of not providing for the unquestionable need for a double-track bridge. If the only additional cost caused by the adoption of the amended plan consisted of an expenditure of $200 (0.2 per cent of the total cost) for modifying some of the work already done, would the engineer dare ignore the demand for the change with its undoubted advantages and proceed with the original design? Quite probably not. Yet the proper decision on a parallel problem has been agitating the Federal Board of Surveys and Maps at Washington.



PRESENT STATUS OF TOPOGRAPHIC MAPPING OF UNITED STATES

The question concerns the scale of the standard topographic maps of the United States. All engineers are familiar with the topographic quadrangles published by the Geological Survey. These maps are printed on a scale of 1:62,500 (0.9864 miles to the inch) with some on the smaller scales of 1:125,000 and 1:250,000. No one seems to know why such a scale system was selected in the first place except that it embraces beautifully even multiples of one millionth. It is generally admitted that this attraction hardly compensates for the inherent disadvantages of such a scale, and strong sentiment on the Board of Surveys and Maps is inclined toward the adoption of a change to the inch-to-the-mile scale system. Through various committees the board has been thoroughly investigating the proposal for more than a year.

The chief objection to the present scale is simply that it is meaningless to the average map user and a source of much inconvenience. Specially graduated measuring scales or transfers from the bar scales printed on the maps facilitate their use, but unfortunately the measuring scales employed by practically all map users in this country are divided into inches. The inch is thus used as the unit of measurement on the map and preferably it should represent an integral number of feet or miles, the common units of measurement on the ground. The difference between the two scales is small but sufficient nevertheless to cause much doubt and confusion in the use of the maps. Even in the more expert use made by highway, irrigation and hydro-electric engineers, land classifiers, timber appraisers, etc., the present scale is a source of exasperating uncertainty.

Practice in the Bureaus—Among the government organizations themselves no standard practice prevails at present. Of the principal mapping agencies represented on the Board of Surveys and Maps, five employ mostly decimal scales similar to the 1 : 62,500, while nine use scales on the inch-to-the-mile system. The five using the decimal scales are the Coast and Geodetic Survey, Geological Survey, Lake Survey, International Boundary Commission, and Army. Those using inch scales include the Bureau of Public Roads, Bureau of Soils, Forest Service, General Land Office, Indian Service, Reclamation Service, Hydrographic Office of Navy Department, Post Office Department and Federal Power Commission. Most of the last group have extensive use for the topographic quadrangles and are inconvenienced considerably through the necessity of converting the data to their standard scales on the inch system.

What Map Users Think—From information collected by the Board it appears that the opinion among technical map users—including engineers, surveyors and educators—is strongly in favor of changing the scales to the inch system. An inquiry directed to nearly 1,000 individuals throughout the country representative of the various classes of map users disclosed that 76 per cent believed the change should be made. This expression of opinion included 83 chief engineers of railroads, of whom 53 voted in favor of the inch-scale. The deans of engineering colleges voted in favor of it 42 to 14, state highway engineers 31 to 15, state foresters 22 to 2, city engineers 61 to 13, county engineers 94 to 15, members of the A. S. C. E. 50 to 16; and proportionate majorities in every group of the technical map users solicited for opinion.

The maps have very extensive use by the logging engineers, timber cruisers, foresters and others engaged in the lumber industry. A special investigation of the opinion of this class showed that about 90 per cent considered that the present scale system is a nuisance and should have been discarded long ago. In commenting on the matter J. W. Toumey, Dean of Forestry at Yale

University, states, "It is unfortunate that this scale (inch to the mile) was not established at the outset. Although it will entail some immediate difficulties and some cost, it is my judgment that the change should be made." W. R. Ballard, general manager Somers Lumber Co., Montana, says, "In practical use the present scales are a nuisance." Charles C. Deam, state forester of Indiana says, "I do not understand why they ever used anything else but the scale of one inch to the mile instead of the fraction of mile."

Twenty-two states are co-operating in the mapping of areas within their borders; in ten of these states the co-operating official has been reported adverse to the change, as against three who favor it. However, this argument against the change seems discounted by the fact that a large majority of state highway and state forestry departments want the proposed scale adopted.

Established practice by states, counties and city governments as well as commercial map concerns almost universally embraces the use of the inch scale system, and a large amount of effort is now required for the transfer of the useful data from the government topographic maps on a slightly different scale. Many foreign governments employ a decimal scale system on their maps, but England and Canada, practically the only countries using the same system of measurement as the United States, employ principally the inch scales for their topographic maps.

Other Scale Possibilities—It has been suggested that perhaps a scale of 1:50,000 or 1:60,000 would be preferable to either the inch-to-the-mile or the 1:62,500. The 1:50,000, while excellent for the metric system of measurement, does not fit with the foot and the mile units, which we shall doubtless have with us in this country for a long time to come. The 1:60,000 scale is exactly 5,000 ft. to the inch, and on this account might be favored for a great deal of engineering use; but the greater convenience of the inch-to-the-mile scale for other technical use and for most popular use is paramount.

One of the major arguments advanced against the change is that it would be impracticable to have all the existing maps republished immediately and that during the period of several years while maps on both scales are in use considerable inconvenience would be caused the map-using public due to the sheets not matching perfectly.

Matching Sheets—In this connection it should not be overlooked that the topographic sheets at present are printed on three very different scales. Of the total area of the country mapped so far, 20 per cent is published on the scale of 1:250,000, about 50 per cent on 1:125,000 and only 30 per cent on 1:62,500. There are also a large number of maps on the scale of 2 in. to the mile.

All of the maps cover in the aggregate only about 43 per cent of the country and it is freely admitted that at least half of the work is so old or so much below present standards that the maps are of little value and the areas must be resurveyed. It develops that *less than 10 per cent* of the area of the country is mapped satisfactorily on the standard scale of 1:62,500. About half of this lies in a solid block in the northeast corner of the country. Throughout the rest of the country the area mapped satisfactorily is so small that the anticipated trouble in matching sheets diminishes to almost nothing. In this connection it has been pointed out, too, that the major use of maps is confined to one sheet without reference to those adjacent. There may be a possibility of inconvenience to some map users, but apparently this would be of limited extent and presents no serious barrier to the change.

Cost of the Change—The change in scale will not add to the expense of producing new maps, but to reprint the existing maps to the new scale will require a photolithographic process more expensive than the direct transfer process used now. All of the present maps must be reprinted periodically anyhow, and it is calculated that $100,000 is a fair estimate of the added cost of reprinting the satisfactory old maps to the new scale. This alone constitutes the price which must be paid to clear away the effect of the original mistake of selecting the present scale system.

Reduced to the briefest terms, it may be stated that the inch-scale system possesses such advantages and superiority that the change is favored by the large majority of map users, including government bureaus, state, county and municipal agencies, the technical professions and the public generally, whereas the only factors adverse to the change consist of a possible slight inconvenience during the transition period and an added cost of not to exceed $100,000 for reprinting the existing maps.

Nothing of value can be secured without paying some price and in this case it would seem that the price is less than $100,000. Compared with the benefits and actual money savings that the change will effect this price seems ridiculously small. Many times the amount could be justified easily.

Strong efforts are now being concentrated in support of legislation by which Congress will authorize a meritorious expansion of the mapping program, which will cost in the aggregate about $40,000,000. This great expenditure can be justified only by the usefulness of the finished maps. The voice of the map users is unmistakably in favor of the proposed change of the scale, and the government should be responsive to the opinion of those for whom the service is rendered and who provide the resources to make the accomplishment possible.

In conclusion let us go back to the analogy of the engineer and his bridge. The added cost of about $100,000 for reprinting the old maps is in respect to the total cost proportionate to the $200 required to change the work already done on the bridge, and the advantages of the scale change are proportionate to the benefits from making the bridge width 16 ft. instead of 12 ft. The answer relative to the bridge seems clear, but various complex elements in the scale situation are influencing the majority of the board toward the opposite course.

Manifestly, from the evidence it would seem that a decision could not be other than decidedly in favor of the change with the least possible delay. But before the majority of the board accepts this view it will be necessary, apparently, that the engineers and other map users of the country express their opinion in even more convincing manner.

Decatur, Not Danville

The impounding dam, in the construction of which a moving form was used, as described in *Engineering News-Record* of March 16, p. 452, is at Decatur, Ill., and not Danville, Ill., as was erroneously stated.

Specification Details of Hudson River Vehicle Tunnel

Largest Subaqueous Tunnels in United States to be Built by Compressed Air Shield Method —Some Contract Provisions

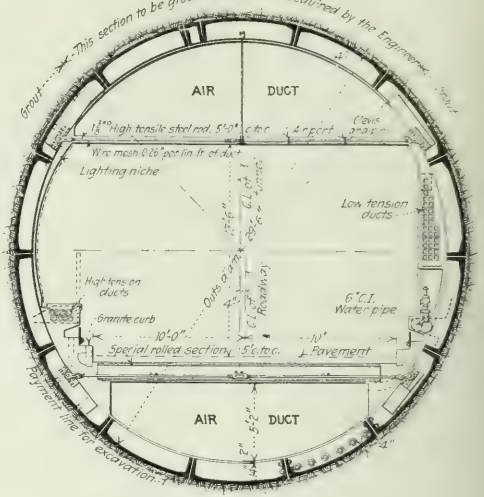
CONSTRUCTION of the Hudson River vehicular tunnel, consisting of twin tubes of cast iron 29 ft. 6 in. in outside diameter and extending from a point at Canal and Spring Streets, New York City, to Jersey City, is provided for in two contracts, designated as Nos. 3 and 4, both of which were awarded to the firm of Booth & Flinn, Ltd., of New York City, March 28. The New York State Bridge and Tunnel Commission and the New Jersey Interstate Bridge and Tunnel Commission are in joint charge of the project.

Contract 3 covers the New York portion of the tunnel and Contract 4, the New Jersey portion. The two contracts were awarded at an aggregate cost of $19,331,724. The tunnel structure specified is "of cast iron or cast steel, lined with concrete." The land-shaft structures consist of reinforced-concrete walls with steel bulkheads and roofs. The river-shaft structures comprise steel walls filled with concrete.

The accompanying drawings show some of the details of the tunnels—which are the largest subaqueous tubes in the United States—while the following notes cover a few of the features of the specifications:

Compressed Air-Work.—The tunnels are to be built by the compressed-air shield method, thus disposing of previously discussed projects involving the trench method of construction and the use of concrete blocks. The air-compressing plants must be capable of furnishing simultaneously to each heading a supply at 50 lb. per square inch pressure equal to at least 15,000 cu.ft. of free air per minute and an additional supply of air at 100 lb. per square inch for operating drills, grouting machines and other appliances. When the air pressure in the heading exceeds 22 lb. per square inch two air chambers are called for, the pressure in the outer chamber not to exceed one-half the pressure in the heading.

The distance from the heading to the nearest bulkhead in operation shall not exceed 800 ft. The carbon dioxide limit in the air is placed at 1 part per 1,000. A safety screen or steel diaphragm with air-tight joints extending from the springing line of the tunnel to the top of the chamber must be kept within 115 ft. of the shield. Two of these screens are specified, so that one



SECTION IN EARTH FOR 29 FT. 6-IN. CAST-IRON TUBE

Provides for 20-ft. vehicle roadway and ventilating ducts at top and bottom.

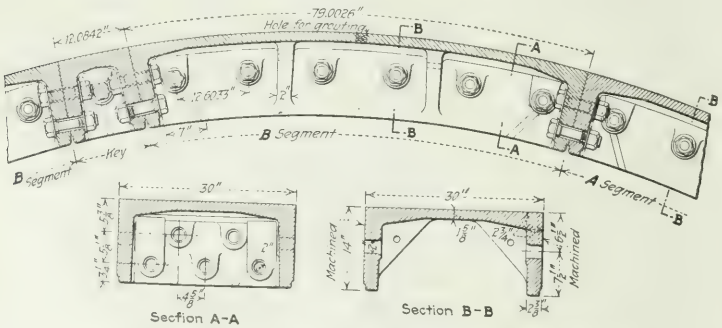
will always be in service while the other is being moved forward. At least two tunnel service tracks between each heading and the nearest bulkhead are called for. Mechanical haulage is specified.

In addition to the tunnel construction proper, which forms the major work of each contract, there is called for, under Contract 3, a river shaft consisting of a steel caisson, with double steel wells filled with concrete, and under Contract 4 two land and two river shafts. The land shafts on the New York side have been completed under another contract and are ready for the erection of tunnel shields.

Where the present river bed is below a plane 55 ft. below high water the contractor must deposit a permanent blanket of clay over the tunnels to the elevation above mentioned.

In the specifications for waterproofing woven cotton fabric treated with asphalt before being brought on the work is called for.

In erecting the cast-iron lining it is specified that all the bolts of the two preceding rings shall be retightened before the erection of the next ring is undertaken.



DETAILS OF CAST-IRON SEGMENTS AND SPECIAL KEY SECTION

Payments to Contractor.—Each contract provides for the retention on monthly estimates of 10 per cent until the amount so deducted reaches a total of $500,000, which is to be held as security for the performance of the contract. Provision is made for paying to the contractor one-half of the retained percentage on his estimates after all the tunnel lining has been erected and compressed air removed. The contractor is entitled to receive in his monthly estimates payment for steel and

cast iron, including tunnel lining, delivered at the work but not incorporated in it, at the rate of $75 per ton for steel, $60 per ton for cast steel, and $35 per ton for cast iron.

The 10-per-cent deduction is not to be applied to payments made to the contractor for plant. The two commissions specify that payment for power plant shall be $250,000 and for shields $250,000 on Contract No. 3, and $250,000 for power plant and $450,000 for shields on Contract 4. The total payments on plant and shields are not to be made until the power plant is in working condition and the shields in operation. After this time 8 per cent of the amounts certified in the monthly estimates will be retained until the total amount paid to the contractor for plant has been deducted.

Under each contract the contractor is required to furnish two bonds, each in the sum of $1,000,000 for the states of New York and New Jersey, or a total of $4,000,000 for both sections of the tunnel. The time allowance for the completion of both contracts is 36 months and a penalty clause, for delay, requires the payment of $1,000 per day.

Clifford M. Holland is chief engineer for the New York and the New Jersey Tunnel commissions.

Limited Installation Space Leads to Special Elevating Equipment

By M. W. Hibbard
Manager of Engineering Construction, The Jeffrey Mfg. Co., Columbus, Ohio

SPECIALLY-DESIGNED elevator equipment was installed recently in the Curtis Publishing Co. plant in Philadelphia to handle heavy rolls of paper from basement level to the various floor levels. Several conditions existed to make the problem one of special study, but it was solved through the design and installation of a chain-type elevator, illustrated in the view herewith. The equipment was designed, manufactured and installed by the Jeffrey Mfg. Co., Columbus, Ohio.

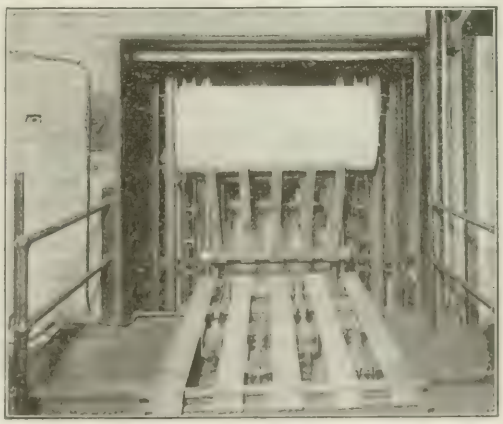
An increase in the amount of paper used made the handling of paper rolls to and from the platform elevator by hand truck increasingly difficult. It was found necessary, therefore, to install some apparatus which would do away with the labor required to put rolls on and take them off the platform elevator and to increase the amount of paper which could be handled per day. No suitable place could be found for the installation of an additional platform elevator. Moreover, the shaft of the existing platform elevator was the only space which could be utilized for new equipment. The installation made consisted of a double-strand chain elevator 178 ft. on centers operating at a speed of about 45 ft. per minute and having a capacity of ninety rolls of paper per hour. The rolls are 27 in., 30 in., and 31 in. in diameter, and from 32 to 68 in. long, weighing from 900 to 1,800 lb. Since the building has to be equipped with fire doors at all openings several features of the installation offered interesting problems for solution.

First of all the handling mechanism had to be so arranged that there would be no possibility of breakdowns or accidents due to attempts to discharge paper at incorrect points; to prevent the handling of paper except it be loaded centrally on the conveyor; to prevent rolls of paper larger than the design contemplated; to prevent accidents through the loss of power; and furthermore in case of fire, if fire doors automatically closed up, they would in their turn trip switches which would shut down the conveyor immediately, thus preventing damage to the conveyor, etc.

The elevator is made up of structural framework so arranged as to guide the trays on both the up and down-going paths. It is operated by an electric motor placed at the top floor or the roof of the building. The entire hoisting mechanism is mounted upon a structural steel framework of a heavy and substantial type.

As it was not possible to go below a certain depth in the pit because of possible interference with the foundation of the building, the paper could not be sent by gravity from the basement floor onto the elevator, so it was necessary to install an automatic feeder. This feeder elevates rolls to a sufficient height to allow them to pass by gravity from feeder to the tray elevator. As the tray elevator is forced to deliver on the same side as it ascends, suitable pivoted trays are made equipped with ball-bearing guide rollers run in guides arranged so that paper can be delivered at four different points. At each of these points is a fire door which is closed except during the passage of paper.

As the rolls of paper are very heavy, each must be taken from the elevator as soon as delivered. Provision was therefore made for stopping the elevator until the paper had been removed by the installation of suitable interlocking electrical devices arranged so that the elevator cannot be operated unless one fire door at least is open.



ELEVATOR DISCHARGING ROLL ONTO SKIDS

The elevator itself is made up of two strands of knuckle chain with twelve centrally-hung trays and with shafts arranged to pass through hollow bushings at the articulation point of the chain, thereby eliminating any eccentricity of loading in the chain itself. The lower ball-bearing rollers of the trays travel in guides arranged so as to hold the trays level except at the tripping point, where, by removing a sliding tongue, the rollers pass around curved guides letting the trays trip down and forward, depositing the paper rolls on the incline skids leading into the proper room. The feeder consists of two strands of steel thimble roller chain with one loading tray, the conveyor being arranged to make twelve rotations of the chain to one rotation of the main elevator chain. Thus the single

loading tray keeps in step with the twelve loading trays and deposits the roll at the proper time for each tray to pick it up.

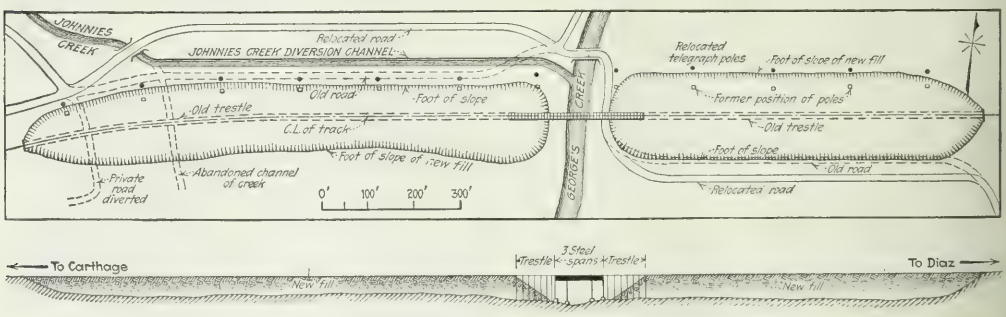
All of the operations of the elevator are controlled by one attendant located at the basement floor. Motive power is furnished by a single unit of 25 hp. driving the elevator through a suitable train of cut-spur gears. The motor is equipped with a solenoid brake. There is also provided on the head shaft a suitable gear lock to prevent reversing of the elevator under load in case the power fails and the solenoid brake does not operate.

Recent Practice in Replacing Trestles by Earth Fill

300,000-Yd. Fill on Missouri Pacific Ry. Is Characteristic of That Road's Consistent Elimination of Deteriorated Timber Structures

EXTENSIVE work in filling large timber trestles on the White River Division of the Missouri Pacific Ry. has been in progress for seven years and a fairly definite practice of making such improvements has been built up in that time. The recent filling of the Georges Creek trestle near Yellville, Ark., a job which required about 300,000 cu.yd. of material, may be taken as a good example of that practice.

The policy of filling was adopted on the basis of economy in maintenance charges and interest on investment, combined with greater safety to traffic and better control of maintenance on remaining trestles. In-



PLAN AND ELEVATION OF THE TRESTLE AND FILL AT GEORGES CREEK

sufficient funds made it necessary in some cases to build new trestles in 1921 instead of replacing them with earth fills. However, the extent to which the replacement of timber trestles with earth fills has been undertaken by the Missouri Pacific is indicated by the fact that since 1915 twenty-one trestles of a total length of 12,171 ft., ranging up to 122 ft. in height and requiring 4,528,853 cu.yd. of material, were filled.

The trestle crossing the valley of Georges Creek was the largest on the division, having a length of 2,159 ft. and a general height of 57 ft. It was built of six-post frame bents placed 14 ft. on centers, most of the bents being of three decks. The track deck was solid and covered with 3 in. of gravel for fire protection. The creek itself was spanned by a steel bridge which was left in place after the fill was made. The trestle was built in 1904 and, as it had about reached the limit of its life, either filling in or reconstruction had become necessary.

Filling Operations—The embankment was built by dump wagons working below and trains of dump cars operating from the trestle. Fresno scrapers and dump wagons were employed to form the base of the fill up to a height of about 30 ft. Material for this part of the work was clay and clayey gravel brought from a borrow pit, with a haul of from 50 to 450 ft. An elevating grader hauled by a 40-hp. tractor and a steam shovel with a ¾-yd. bucket were used to load the wagons. About nine wagons were served by the steam shovel and nine by the grader. In addition, twelve scrapers pulled by four-horse teams were used to level the fill.

Clay and rock in proportions of about 70 and 30 per cent were the principal materials handled by cars. Shrinkage averaged about 12 per cent in volume for that part of the fill placed by teams and 15 per cent in that dumped from cars. No slipping or sliding of the fill occurred, nor was there any subsidence of the original surface, as firm earth underlay the fill. Owing to the dampness of the material it took a slope of about 1 on 1½ or even steeper, but the slopes flattened slightly as the material dried. The fill was finished to a width of about 40 ft. at grade line.

For this dumping, the guard timbers, deck fillers and gravel covering were removed. No ties were removed or shifted, as the cars were sufficiently large to throw the material clear of the deck. When the material was at such a height that it would not fall clear, it was leveled by means of a spreader car operated by a separate locomotive. No leveling of material dumped from the trestle was done beneath the deck, but about 30 per cent of this material had to be leveled by the spreader car. Alternate trains dumped on opposite sides of the structure in order to equalize the pressure on the trestle bents. Dumping of the cars was done by hand, requiring a gang of five men on the trestle to release and attach the side chains.

A steam shovel with a 2½-yd. bucket, loaded the material at the pit into 12-yd. dump cars. These were handled in trains of about twelve cars each by the contractor's locomotives, but the railway company supplied the engine crews as the movements were on the single-track main line. The haul was about 3.7 miles. A telephone block system, with operators at the ends of working limits, provided for the protection of work trains against regular traffic, which averaged a total of eight passenger and freight trains daily. About ten work trains were dumped during a 10-hour working day, as an average. From July 27 to Aug. 27, these trains were

operated on two 10-hour shifts, with two 12-car trains for each shift.

Trestle Repairs—The trestle was strengthened at all weak points prior to the commencement of filling. None of the original bracing was removed, since it did not interfere with the operations. A bridge gang was main-



GEORGES CREEK TRESTLE

tained at the structure during the work, to carry out necessary repairs as weak points developed or as the bents settled. This gang also maintained the track in line and surface, placing additional caps or jacking the bents into position, as might be necessary.

The greatest trouble experienced in all the filling was the sinking of from 2 to 10 ft. of trestle bents during the work. This movement was usually vertical but was sometimes accompanied by longitudinal or lateral displacement. As the bottom sills of the bents could not sink, being on rock or firm clay, the explanation given is that lateral or longitudinal pressure of the fill forced the posts off the intermediate sills, so that they sank in the comparatively loose earth of the fill.

Caps and stringers will be left in place for two years, to allow for settlement and shrinkage of the fill. They will then be removed, the surface of the fill will be brought to subgrade with a width of 20 ft. and on this will be laid the ballast and ties.



BUILDING BASE OF NEW FILL AT GEORGES CREEK

Georges Creek Bridge—Near the middle of the trestle was a steel girder deck bridge 65 ft. high, over Georges Creek. This bridge was left in place, so that no culvert construction was required. It has a 56-ft. center span with two 28-ft. side spans, all carried by four steel bents. To allow for the slopes of the fill, seven 14-ft. panels of pile trestle were built at each end of the bridge, making 92½ ft. of approach. These approaches have 6-pile bents with 75-ft. creosoted piles driven to rock. A solid deck similar to that of the old trestle is used on these approaches, but the steel spans have an open deck.

Road and Stream Diversions—Under the trestle there was a separate channel for Johnnie's Creek, serving a drainage area of 2,330 acres. A 28-ft. opening was provided by seating one trestle bent on trussed beams spanning between the two adjacent bents. To avoid the necessity of building a culvert, when the fill was made this stream was diverted into George's Creek by a channel 930 ft. long, with a bottom width of 15 ft. and the old channel closed by the fill. In this way the latter creek now serves a total area of nearly 12,000 acres. A public gravel road paralleling the railway was within the limits of the toes of the new fill and 1,600 ft. of it had to be rebuilt outside of these limits. A private road passing under the trestle has been diverted to a new under-crossing beyond the fill at the end of the filled portion of the structure, through a 3-panel pile bridge with grade approaches. A telegraph line had to be shifted to put its poles clear of the new slopes.

Work on the George's Creek fill was commenced July 5 and was completed Nov. 25, 1921. It was done under the direction of E. A. Hadley, chief engineer, Missouri Pacific R.R., and A. F. Dorley, district engineer; with Robert Craig, assistant engineer, in direct charge. The contractors were List & Gifford, Kansas City, Mo.

Safe Haul for Wet Concrete for Roads

THAT strength is but little affected by time of wet-batch haul, up to the time that the concrete ceases to be workable, is indicated by tests made by the Bureau of Public Roads and described in *Public Roads*, December, 1921. Two batches of 1:1½:3 gravel concrete were hauled in six-compartment trucks giving six time-periods for testing as shown by the accompanying table.

Referring to the table it will be noted that whereas the concrete became very dry after about one hour's haul, the strength of the cylinders prepared from the various batches was about the same. In only one case was the strength much below the general average of 3,500 lb. per sq.in. This was in the case of the

RESULTS OF TESTS OF CENTRAL PLANT MIXED CONCRETE

Compartment number	Total elapsed time Hrs.	Min.	Slump Inches	Crushing strength, pounds per square inch (1)	(2)	Average
		15	2	3,620	3,510	3,565
1		45	1	3,460	3,550	3,505
1	1	30	½	2,670	2,200	2,435
2	1	50	½	3,510	2,960	3,235
3	2	10	1	3,620	3,580	3,600
4	2	25	½	3,110	3,550	3,330
5	2	45	1–16	3,840	4,230	4,035
6	3	10	1 16	3,270	3,370	3,335

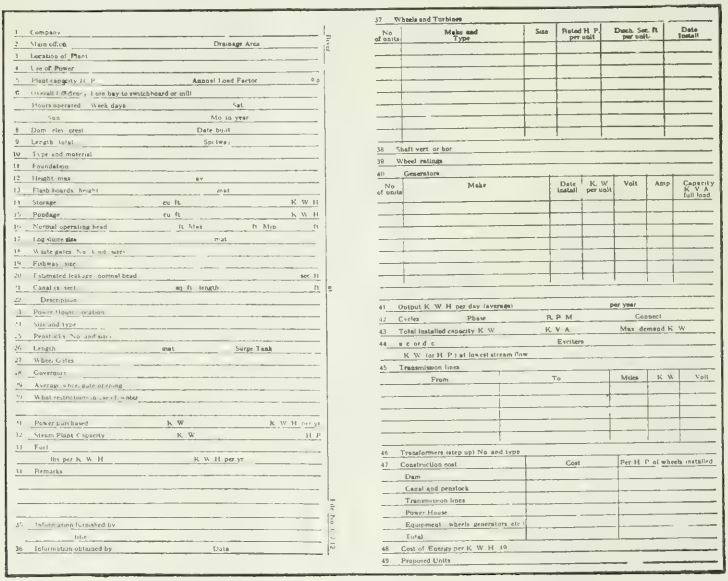
cylinders made from the concrete in compartment No. 1. Nothing in the appearance of the concrete at the time these cylinders were cast would account for the difference in strength.

The appearance of the concrete during the experiment would indicate that it could have been handled by a concrete pavement finishing machine at any period up to two hours after mixing. It became too dry for hand finishing, however, 45 min. after mixing. Assuming that a wetter mixture would have segregated more quickly, especially with a gravel aggregate, the experiment indicates that the most practical way to utilize the central mixing plant in concrete road construction is in connection with a mixer-hauler. It also indicates that so long as the concrete is workable after hauling, the strength will not be affected.

Cards and Decimal Filing System Used in Compiling Maine Water-Power Data

By George C. Danforth
Chief Engineer, Maine Water-Power Commission

During 1921 the Maine Water-Power Commission made a water-power census of the state. Estimates previously made in the form of typewritten tabulations at intervals of ten to twenty years became gradually out of date and valueless. It was felt that some system should be used whereby the record could be kept up to date with a minimum of labor and cost. A 5 x 8-in. card was therefore adopted which permitted filing under a decimal system based on geographical location. Both sides of the card are used; the back of the card for *undeveloped* sites being left for a sketch. Where necessary a blank card is attached to the cards for *developed* sites for the same purpose. All cards go into the same file, cards for undeveloped and developed sites being distinguished by white and buff colors, respectively.



WATER-POWER DATA FORM USED FOR DEVELOPED SITES

The form used for developed sites is shown herewith. That for developed sites was used last summer, and so far has appeared to be satisfactory. The form for undeveloped sites has recently been prepared and actual use may suggest possibilities of improvement.

While it would be cheaper to obtain the information desired by correspondence with the power owners an attempt to do this made it apparent that information of little value would be obtained. The cards have been prepared for the use of engineers from this office and nearly every developed site has been visited.

The filing system is that in general use in this office —parts of the Dewey decimal system with such extensions as have seemed desirable. The state has been divided into nine main drainage systems from northeast to southwest, the smaller coastal basins having numbers such as 0.1, 0.2, etc. Each drainage system is further subdivided as necessary, the main river in each case being .0 and the principal tributaries .1., .2, etc., .9 being used for the smaller miscellaneous tributaries. Card indexes are not required and up to the present time the system has appeared to be flexible and practical.

Operation Data for Three Filters Using Lake Michigan Water

Comparative results of the operation of three rapid filters at East Chicago, Whiting and Evanston, in the vicinity of Chicago, all using Lake Michigan water, as compiled by S. A. Greeley and H. E. Jordan, are given below. The East Chicago plant is rated at 8 m.g.d., the Whiting plant at 4 m.g.d., and the Evanston plant at 12 m.g.d. Coagulant costs were calculated at 2c. per lb. for alum and 0.71c. for lime. Comments on some of the difficulties with short runs at the East Chicago plant during the summer of 1921 are given by Mr. Jordan as follows:

Inspection of the comparative production summary will show a continuous improvement in the operating conditions. Part of this is due to the fact that the demand for water has decreased. The decrease in demand at East Chicago is due partly to the industrial let-down, but we feel that it is more especially due to the campaign which the company has been carrying on warning the people against waste of water, which beginning with Sept. 1 was all paid for on a meter basis.

In the earlier days of the operation our runs were very brief and various methods of washing were tried, including the Ellms "breaking" method. At that time this procedure did not give satisfactory results. The reasons were not altogether apparent but it now appears that it was due in part to the use of an insufficient amount of coagulant. The material which was deposited upon the sand layer at that time was dark in color and the "breaking" method produced incipient mud balls. On account of their formation, "breaking" was abandoned for the time being. A gradual increase in the amount of coagulant followed through the various months up to April when for four months an average of 2.2 gr. of alum per gallon was applied. At that time it was noted that the material which was washed out of the filter had a decidedly lighter color than in the earlier days. This fact would appear to mean that the material carried into the filter was more largely a pure aluminum hydrate of slow settling rate, the darker material taken from the lake water having settled very largely in the basin with the use of the increased amount of coagulant.

Beginning in the middle of June, as a result of definite indication of air entrainment in the sand layer,

a modification of the "breaking" method was again put into use. This scheme has finally resulted in a procedure along the following lines: The inlet valve of the filter is closed and the water is allowed to filter down until there is from 6 to 12 in. remaining above the sand layer. The air is allowed to exhaust itself, and the wash-water valve is then opened for an interval not to exceed 15 or 30 sec., applying wash water at a rate of about 3½ in. vertical rise per minute, producing a renewed release of air from the sand. This "breaking" is continued six or eight times until the slight application of wash water produces no more air release, when the filter inlet is opened and the unit replaced in service.

Following this operating procedure the filters were washed completely every third day. These washes are quite long, about 10 min. at a 24-in. rate. The successive air releases produce an accumulation of coagulant upon the surface of the filter that gives a somewhat fuzzy appearance when looking down through the water above the sand. It is also noted that some irregular cracks develop late in the series of partial runs, but this is, however, accompanied with no deterioration of the effluent, and the entire procedure seems to be a safe operating basis for water similar to that of Lake Michigan where the quantity of dissolved oxygen is relatively high and the suspended material in the raw water low. The bacterial efficiency of the plant was surprisingly good throughout the summer months.

COMPARATIVE PRODUCTION SUMMARY OF THREE FILTER PLANTS USING LAKE MICHIGAN WATER

East Chicago

	No. Runs	Run in Hours Av.	Min.	Max.	Yield per Run, M.G.D.	Wash Water, %	Yield, % Rated Cap	Chemical, Gr. Per Gal. Alum	Lime	Coagulant Cost per M.G.
1920										
Nov.*	885	3.1	1.4	7.0	0.180	16.4	100	0.5		$1.40
Dec.	1,100	4.3	0.5	13.0	0.294	16.7	130	0.6		1.86
1921										
Jan.	1,182	3.6	1.0	10.2	0.273	11.1	130	0.9		2.74
Feb.	625	6.2	1.7	16.8	0.406	7.8	114	2.0		5.60
March	570	7.4	2.5	15.0	0.440	5.7	101	1.9		5.44
April	611	7.7	1.2	17.8	0.372	5.2	94	2.2		6.24
May	519	8.0	1.5	27.8	0.428	4.9	88	2.2		6.26
June	281	14.8	2.8	154.2	0.795	2.8	89	2.2		6.26
July	59	71.4	51.8	135.2	4.130	1.0	96	2.2		6.26
Aug.	62	67.1	49.2	74.8	3.352	1.6	84	1.5		4.30
Sept.	60	64.5	49.2	72.3	2.680	2.1	67	0.8		2.52
Oct.	50	73.3	47.1	93.9	2.942	1.9	58	0.8		2.52
Nov.	44	78.6	44.3	161.2	3.269	2.1	59	1.7		4.84
Dec.	46	72.5	54.8	95.6	3.089	2.8	57	2.1		6.04

* Plant started 6 p.m., Nov. 11, 1920.

Whiting

1921										
Jan.		8.0	4.0	15.0			100	1.5	0.7	$5.01
Feb.	....	9.4	4.1	19.2		5.9	98	1.4	1.0	5.02
March		7.3	4.2	15.0		5.9	95	1.4	1.1	5.12
April		4.8	3.1	7.2		8.4	94	1.6	1.2	5.79
May	750	6.3	3.6	19.1	165	7.7	100	2.0	1.2	6.41
June	653	7.0	4.7	10.9	177	7.5	96	2.2	1.5	6.34
July	371	14.5	11.8	16.8	305	5.3	91	1.4	1.0	4.35
Aug.	427	10.4	8.0	14.3	247	6.5	84	1.5	1.0	4.46

Evanston

Dec.		87.2	28.3	144.0		1.2	38	0.7		$2.00
Jan.		74.9	14.1	144.0		1.6	37	0.7		2.00
Feb.		77.0	28.0	144.0		1.3	40	0.7		2.00
March		32.7	12.9	47.7		2.5	43	0.7		2.00
April		20.3	7.4	59.5		2.6	48	0.7		2.00
May	145	24.0	8.8	62.6	1.37	2.1	55	0.7		2.00
June	170	13.1	5.9	23.4	0.69	2.5	60	0.7		2.00
July	149	33.0	6.4	143.5	1.63	1.3	91	0.7		1.99
Aug.	132	37.1	12.8	71.5	2.85	1.9	52	0.7		2.00
Sept.	132	33.0	10.6	71.7	1.35	2.4	45	0.7		2.00

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Specifications for a Good Engineer

Sir—The engineering profession should thank you for publishing on page 435 of your issue of Mar. 16 the extract—too brief probably—of Prof. H. E. Riggs' address at the University of Michigan. There are many fundamental ideas pertaining to the ethics of the engineer with which everybody is familiar but which need to be clothed in fresher garb occasionally that they may be better remembered. Many of us are prone to forget that there is something beyond the mere "getting of a new job," and it should not take sixty years for one to learn that it pays to be honorable. Wendell Phillips used to say that it required that length of time for a politician to learn to tell the truth.

Unfortunately not all of the "scalawags, liars and rattlesnakes" referred to are on the bottom rung of the profession, but—let us thank "whatever gods may be"—they are in the minority. When one calls to mind the honorable course always pursued by men like the late Frederic P. Stearns or the late Richard M. Berrian, to say nothing of others still among us, one feels that the specification for an engineer as laid down by the late Chief Engineer Starling may still be filled:

"A good engineer must be of inflexible integrity, sober, truthful, accurate, resolute, discreet, of cool and sound judgment; must have command of his temper, must have courage to repel and resist attempts at intimidation, a firmness that is proof against solicitation, flattery or improper bias of any kind; must take an interest in his work, must be energetic, quick to decide, prompt to act; must be as fair and impartial as a judge on the bench, must have experience in his work, and in dealing with men, which implies some maturity or years; must have business habits and a knowledge of accounts. Men who combine these qualities are not to be picked up every day. Still they can be found. But they are greatly in demand and when found they are worth their price; rather they are beyond price, and their value cannot be estimated in dollars."

FREDERIC I. WINSLOW,
Framingham, Mass., Mar. 22. Consulting Engineer.

Sliding, Saturation Studies, and Repairs of Low Earth Dam

Sir—So little is written on the behavior of earth dams that the following may be worth publishing. The dam in question is about 30 years old, having been raised twice by adding material to the crest and lower slope.

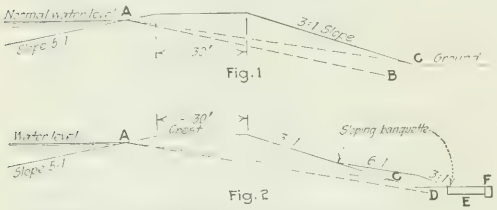
The upper limit of saturated material was probably for some years as indicated by the dotted line AB, Fig. 1. In time the slope of the line of saturation raised to the position indicated by line AC. At this stage considerable seepage appeared. Next a longitudinal crack appeared near the downstream edge of the crest and parts of the lower slope moved outward and downward.

The remedy applied is indicated in Fig. 2. A ditch parallel with the dam was made at F. Numerous laterals E from it lead in to most seepage and drain the toe of the embankment. This was intended to and did lower the line of saturation to the line marked AD, thereby strengthening the overlying material against sliding. Finally the sloping banquette indicated in the sketch was built of good clay in 6-in. layers, placed with dump wagons. The remainder of the lower slope was repaired. The result so far is that seepage is negligible. No further cracks have appeared and there is no more sliding of the lower slope.

It is believed that the strengthening of the dam is nearly

permanent and that it was accomplished with a minimum of material and labor and is safer construction, as well as more economical, than one with the whole lower slope uniform.

The straight lines here shown indicating saturation of the dam are *nearly* correct representations. The writer's



EARTH DAM SATURATION, SLIDING AND REPAIRS

experience in sounding earth dams for saturation supports the belief that the line of saturation is most often a reverse curve, the first part being above the straight average line and the lower part below it.

A good indication of the safety of an earth dam can usually be had by inspection and sounding along the toe of the lower slope to find how much solid earth is above that which is saturated and unstable.

Earth dams are worth more serious study and more extensive use. Too often elaborate structures of concrete and steel, or stone or timber, are erected at great expense when properly protected earthwork would be more economical.

Mechanical equipment and common labor can generally provide a mass of earthwork at very low unit costs. Some care will be required with either type of dam but any important dam would have about the same expense for attendance, no matter what type is adopted. If capital charges are lessened appreciably, the earth dam ought to be more carefully considered. Comparatively speaking, earth dams are easily and cheaply built anywhere by local labor and can always be strengthened or repaired the same way.

Generous proportions, protection from erosion, and intelligent supervision are requisites. GEORGE C. LOVE

Newport News, Va., March 9.

Effect of Solid and Pneumatic Tires on Soft Sub-Grades

Sir—In H. W. Slauson's letter published in the Dec. 15 issue of *Engineering News-Record*, p. 994, he mentions the fact that the unit pressure of the air within a pneumatic tire is the same as the unit pressure of the tire on the road surface. Is that correct? Suppose a water pipe full of water to be resting on the ground. Then the unit pressure of the pipe on the ground is obviously the same (neglecting the slight elasticity of the pipe and the water) regardless of the pressure of the water within it. Because the elasticity of rubber and air is greater than of iron and water the results in the case of the rubber tire are nearer to Mr. Slauson's statement, but still incorrect.

Mr. Slauson also neglects entirely the effect of impact which may amount to five or eight times the superimposed load in the case of the solid rubber tire (as shown by tests of the U. S. Bureau of Public Roads) and certainly not more than twice the superimposed load in the case of the pneumatic tire. M. P. SMITH,

Massachusetts Institute of Technology.

Cambridge, Mass.

[To Mr. Smith's letter Mr. Slauson makes the following reply.—EDITOR.]

Sir—Thank you for your favor in calling my attention to Mr. Smith's reply to my letter on solid and pneumatic tires, which was published in the Dec. 15 issue of *Engineering News-Record*, p. 994. I am glad of the opportunity to point out a peculiarity surrounding the conditions of pneumatic-tire operation which may not generally be known.

Mr. Smith's analogy of the iron pipe filled with water cannot be used in this case, for the iron pipe itself is self-sustaining and the water pressure is not used to carry any load. If we consider a pneumatic tire as primarily a collapsible tube, filled with air, which is used to sustain the load, it is obvious that the area of contact of that tire under a given load is solely dependent upon the inflation pressure within the tube. If we have a sustaining pressure of 100 lb. per square inch within the tube and carry a load of 100 lb., we will have 1 sq.in. of road contact. If the load carried by the tire is doubled, the area of contact will be doubled, for the sustaining pressure of the air within the tire which serves to keep the rim away from contact with the road will be the same. Of course, there is more or less inherent stiffness in a pneumatic tire, but this is not a point necessary of consideration, inasmuch as this stiffness is merely used to protect the air-containing tube from wear and punctures.

Were area of contact not directly proportional to the load applied, the weight carried on a tire would increase the air pressure within that tire. This we know is not true, for it is no easier to inflate a tire carrying 100 lb. pressure if the wheel is jacked up from the ground than is the case when it is carrying its full load. Applying weight to the tire does not increase the air pressure within the tire, but it does increase the area of contact.

It is for this reason that the rutting effect of a large truck pneumatic tire is greater than that of a cushion tire, inasmuch as inflation pressures of such truck pneumatics are much higher than the normal loads per square inch of contact of wide cushion tires.

Mr. Smith is correct in his remarks on impact, but such impact variations are noticeable only at comparatively high speeds of travel. My letter, to which Mr. Smith refers, discussed primarily the effect of contractors' trucks on soft sub-grades and incompleted road surfaces, in which case the speed, whether on solid tires or pneumatics, would not be above 8 or 9 miles per hour.

Another interesting viewpoint on the subject of impact has been brought to light by some road tests made in California under exceptionally heavy truck traffic. These tests have indicated that impact with solid truck tires is not a serious factor, unless obstructions of 1, 2 or 3 in. in height, or depressions of an equal depth, are encountered. This is further supported by the fact that all of the tests made by the U. S. Bureau of Public Roads were over obstructions or depressions measuring 1, 2 or 3 in. in height. A well repaired, hard-surfaced road contains no such obstructions or depressions, and consequently the matter of impact is not as serious as many of us had first supposed. HAROLD W. SLAUSON,

New York, Jan. 16. Engineering Service Manager, Kelly-Springfield Tire Co.

Torch for Submarine Metal-Cutting

Sir—In reading the description of the patented electric torch used in cutting out the broken section of the 36-in. water-supply pipe under the Narrows to Staten Island (See *Engineering News-Record*, March 2, p. 346), I was reminded of a similar apparatus which recently came to my attention. This is an ordinary autogenous welding and cutting outfit employing oxygen and a combustible gas with the addition of an annular jet of compressed air which is projected from a hood over the nozzle of the burner and surrounds the operative flame. The air is at such pressure as to create a water-free space within which the flame is kindled by means of an automatic igniter. The air jet is projected parallel to the flame and impinges on the work forming an impenetrable mantle against the water. The air wall is at such a distance from the flame that the latter is undisturbed by its action.

It is asserted that the above apparatus has been employed quite extensively and successfully in Europe in the cutting of sheet piling and the salvaging of sunken ships, operating in water to depth of 100 ft. It is claimed that this outfit will cut between 8 and 30 in. through ½-in. plate per hour, depending on the clearness of the water.

The above torch is patented and manufactured by the Deutsche-Luxemburgische Bergwerks, A. G. Dortmund, Germany. ALBERT FRIEDMANN

Wyomissing, Pa., March 9.

NEWS OF THE WEEK

New York, April 6, 1922

Probably No Present Action on Muscle Shoals

Congressional Committeemen Indicate That All Offers Will Go Over This Session of Congress

(Special Correspondence)

Members of the Senate Committee on Agriculture and the House Committee on Military Affairs have returned to Washington, after an inspection trip to Muscle Shoals, Ala., in connection with the offers made by Henry Ford, Alabama Power Co., Frederick E. Engstrum, and Charles L. Parsons, for various purchase, lease and construction methods of disposing of the government war-time nitrate projects and the future disposition of the hydro-electric developments in that region when and if completed.

Observers traveling with the party report that the net result of the inspection trip will probably be that nothing will be done at the present session of Congress toward a definite disposition of the Muscle Shoals projects. Senator Norris, chairman of the Senate Committee on Agriculture, stated to a special correspondent of *Engineering News-Record* with the party that the plan of the Senate committee, after making the inspection, will be to try to obtain from Congress at the present session as appropriation of at least $7,500,000 to have the work continued by the government for at least one year. This, he said, includes continuing the work of building the Wilson Dam and possibly Dam No. 3 and installing in the Wilson Dam power house the four units of machinery now on the ground and mostly already paid for, sufficient to produce 120,000 kw.

View of House Committee Members

On the other hand, members of the House Committee on Military Affairs express the determination that so far as they are concerned not another dollar shall be added to the $106,000,000 already expended by the government in connection with the Muscle Shoals projects until the final disposition of the present and any possible future investment is determined. This means a deadlock in Congress. In addition, Senator Norris states to *Engineering News-Record* that so far as the Senate is concerned the calendar of unfinished business in the Senate is already so great that irrespective of any other proposals such as his plan to have the government complete the dams not sufficient time remains for action on either the Ford, Alabama Power, Engstrum or other offers, and that these will have to go over until the December session.

During the inspection trip, it was plain to those traveling with the party, from the speeches of the senators and representatives, that the Ford offer was losing favor. Senators and members of the House frankly and openly criticized the real estate promotion schemes which were in evidence in connection with the attempt to bring Mr. Ford to Alabama.

There is about $5,000,000 worth of construction plant and contractor's equipment on the ground, ready for any agency to put to work, and most of it, according to the engineers, is still in good condition, and every effort is being made by them to keep it so. It was pointed out to the investigators, however, that the coffer-dam, which is of pine, will not last much longer.

On the works there is the following equipment: Seven 10-ton Terry cranes which were in use until May of last year being kept painted and in good condition; three 10-ton McMyler full circle cranes in good condition; three air-compressor plants on the south side of the Wilson dam being kept bright and polished; eleven steam shovels from Nitrate Plant No. 2, which have had hard service and are in the open but are being maintained as well as possible; 129 rock drills in good condition; seven gyratory rock crushers in fine condition; twenty-six standard-gage locomotives, boarded up and greased; [illegible] remade box cars in fair condition; sixty-five flat cars, in fair condition; sixty 20-yd. dump cars, being [illegible] painted, in fine condition, as well as fifteen standard-gage gondolas, also in good condition; twelve locomotive cranes, standard gage.

Hudson River Bridge Charter Granted

On March 31 Governor Miller of New York signed the bill incorporating the Bear Mountain Hudson River Bridge Co., organized to build a highway suspension bridge across the Hudson from Anthony's Nose, 3 miles above Peekskill, to Bear Mountain, connecting the east-shore and west-shore highways leading from New York to Albany. The project for this bridge was outlined in "Engineering News-Record" of Feb. 23, p. 236.

A 1,650-ft. span is contemplated. The crossing is to be operated as a toll bridge. Amendments to the original bill place the tolls under supervision of the Public Service Commission and fix a purchase price at either cost plus 10 per cent or stipulated sums (quoted in the articles referred to). The bridge is to become the property of the state in any event after 25 years.

Frederick Tench, of Terry & Tench, Inc., contractors, who has been one of the main promoters of the project, states that construction will begin at once, in the expectation that the required congressional authorization will be obtained. It is believed that the War Department is prepared to approve the project substantially as outlined.

Civil Engineers Fail To Choose Secretary

Action Postponed — Hovey Elected Treasurer—New Committee Activities—Federation Deferred

(Engineering News-Record Staff Report)

At its meeting in Dayton, Ohio, April 3 and 4 the Board of Direction of the American Society of Civil Engineers failed to take the long-awaited action of choosing a secretary, despite extended discussion. Various candidates were suggested and it was finally decided to postpone action until the next meeting at the June convention to give time for circulation of names within the board, and full study. Selection of an assistant secretary also was deferred. The board, however, filled the office of treasurer, Otis E. Hovey being elected.

Two other important questions—affiliation with the Federated American Engineering Societies and accepting advertising in the society's publications were taken up, but put over for fuller information. The latter question was held to require further investigation while on joining the federation the incomplete expression of views of local sections was not considered to supply sufficient information for present action.

New Committees Named

A foundation was laid for important new society activities by the creation of several committees, chief among which is a Standing Committee on Professional Conduct to consist of three members of the board to investigate and report on all cases of alleged violation of ethics. Five special research committees were authorized on steel stresses, hydraulic phenomena, irrigation engineering, highway-bridge impact and flood protection. A by-law, to be acted upon at the June meeting, was introduced to allow organization of technical divisions of the society.

Further progress in committee work was recorded through organization of two technical committees as follows:

On Fire Prevention: Chairman, B. B. Hodgman, J. F. Coleman, John Meigs, R. P. Miller, W. W. Pagon, E. L. Soule, Benjamin Thompson.

On Electrification of Steam Railways: Chairman, C. F. Loweth, Bion J. Arnold, George Gibbs, G. W. Kittredge, E. J. Pearson, Samuel Rea, Robert Ridgway.

The board accepted the invitation to joint sponsorship in organizing the International Engineering Congress at Philadelphia in 1926.

Appointment of H. H. Quimby to succeed H. J. Burt on the Engineering Standards Committee was announced by the president. The board decided to hold the fall meeting in San Francisco, Oct. 4 and 5; the chief subject of discussion will be "Power."

Am. Soc. C. E. Student Chapters

According to information contained in its *Year Book*, published February, 1922, the American Society of Civil Engineers has 45 student chapters.

Motor Vehicles Number 10,448,632

With returns received from all States, the U. S. Bureau of Public Roads reports that the motor vehicle registration in the United States for the year 1921 totaled 10,448,632. This represents an increase of more than 1,000,000 over the 1920 figures. No State reported a registration less than the 1920 figures. The total amount collected as fees of various kinds amounted to $122,478,654.

These figures supersede the preliminary statistics published in these pages March 16, p. 460.

Oppose Vehicle Weight Increase in Maryland

Chairman John N. Mackall, of the Maryland State Roads Commission, has filed a protest against a bill, pending before the General Assembly of Maryland, which provides for an increase in the maximum gross weight of motor trucks from 20,000 to 25,000 lbs. He points out that the measure would increase the load per inch width of tire from 650 to more than 800 lbs. In his protest Chairman Mackall calls attention to the fact that when the roads were subjected to the heavy loads which were carried during 1918 many of them were destroyed but since then, under a 20,000-lb. limitation, there has not been a single failure on any state highway.

Large Power Grant on Kings River, California

On March 29 the Federal Power Commission approved the granting of a license to the San Joaquin Light and Power Corporation to develop a comprehensive power project on the North and West Forks of Kings River, Fresno County, California. An ultimate installed capacity of 266,000 hp. is contemplated. The Division of Water Rights, California, has issued a permit to the applicant to use the natural flow of the streams. The project contemplates the storage of 204,000 acre-ft. of water, but a permit for this cannot be issued until the rights of water users have been established by the state. The commission, however, approved the granting of a license for the project in so far as it relates to the natural flow of the river. The estimated cost of the project is $51,000,000.

Electric System Consolidation in Los Angeles Proposed

The city of Los Angeles and the Southern California Edison Co. have joined in a petition to the California railroad commission for permission to transfer the local electrical distribution system of the Edison Co. to the city. The price agreed upon is $11,000,000. The agreement provides for the preferred sale and purchase of power between the parties, the private company retires from local service and the city protects the company from competition outside city limits. For some years the city has desired to add this distribution system to that which now distributes power from the hydroelectric plants on the Los Angeles aqueduct. Litigation preventing this has only recently been closed and bonds sold with which to complete the transaction.

Commerce Commission To Consider Railroad Consolidation

Consolidation of railroads into a limited number of systems will be discussed at a hearing to begin on April 24 before the Interstate Commerce Commission. The first sessions will be devoted to the roads in the Southeastern region. This hearing will be the first action of the commission in this matter since the adoption of its general plan last August.

Water-Supply Project for Akron Industries May Proceed

A decision of the State Supreme Court of Ohio, affirming the decision of a lower court, will permit the State Superintendent of Public Works, whose office is at Columbus, to proceed with plans for a dam on the Tuscarawas River South of Akron to supply water to industrial plants in South Akron. The storage will be additional to that now afforded by the Portage Lakes. It is expected that the industries to be benefited will buy a $750,000 state bond issue to finance the project.

Decision on Railroad Rates Not Expected Until April 15

The decision of the Interstate Commerce Commission in the matter of a general reduction in railroad rates, it now appears, will not be forthcoming before April 15. At present the case is being studied by the commissioners individually. If they should find themselves in substantial accord the decision probably could be handed down as early as April 15, but should there be important differences between them it obviously will extend the time required for the consideration of the case.

Tennessee Issues New Rules for Motor Vehicles

The following traffic rules have been adopted by the Tennessee State Highway Commission:

1. Maximum load shall not exceed 650 lb. per inch width of tire; the tire width to be taken as the inside width of tire channel.

2. Maximum gross load shall not exceed 10 tons.

3. Solid rubber tires for gross loads less than 6,500 lb. on one axle shall have a minimum thickness of ½ in.; and for gross loads in excess of 6,500 lb. on one axle shall have a minimum thickness of 1 in.

4. Maximum speeds for trucks shall be as follows:

Under 2-tons gross load, 20 miles per hour.

From 2 to 6 tons gross load, 15 miles per hour.

From 6 to 10 tons gross load, 12 miles per hour.

5. All traction engines and tractors must remove all cleats from the wheels, or by some other method protect the highway surface from damage in passing over any improved state highway.

6. Violations of these rules will be prosecuted under the provisions of this act.

7. Each maintenance patrolman is given police authority to enforce the provisions of this act as above outlined.

Arrangements have been made for the purchase of jack scales for the enforcement of the rule regulating the maximum gross loads of auto trucks.

Five Indicted in Knickerbocker Theater-Failure Case

As a result of the inquest held in Washington over one of the victims of the Knickerbocker Theater collapse (see *Engineering News-Record* of recent issues) five of the nine individuals held by the coroner's jury were indicted by the grand jury on a charge of manslaughter. The other four were exonerated of any criminal negligence in the theater failure and the resulting loss of 98 lives.

Those indicted are: Reginald W. Geare, the architect of the Knickerbocker theater; John Howard Ford, general manager of the Union Iron Works, who designed and furnished the steel roof framing; Richard G. Fletcher, at the time the theater was built Washington manager of the Hammett Fire Proofing Co., contractor erecting the hollow-tile walls; Julian R. Downman, District inspector of reinforced concrete, and Donald Wallace, general foreman for the builder of the theater.

The four exonerated were: Morris Hacker, at the time of the theater construction head of the District building department; Thomas L. Costigan, a former computer in the District building department who checked and approved the Knickerbocker plans; John L. McDonald, steel contractor, and Frank L. Wagner, the general contractor on the Knickerbocker construction.

Besides returning the manslaughter indictment the grand jury recommended that the District building code be revised to clarify ambiguous and conflicting clauses and to make specific changes regarding the construction of larger buildings particularly wherein public gatherings are to be held. The grand jury also recommended that Congress make larger financial provision for the operation of the District building department to the end that adequate salaries be allowed and a sufficient number of computers and inspectors be at all times available to perform the work required of the bureau.

As reported from Washington the theory of the prosecution is that the five men held "were engaged in a gigantic task which required that each know what the other was doing, what it was his business and duty to do, and were so related in these duties that they knew or ought to have known whether each performed properly his portion of the work, and if it was neglected or negligently performed."

New York State Assumes More Control of Water Power

Governor Miller, of New York, has signed an amendment to the state water power act which gives much more power to the state in control of water power development than it has hitherto claimed. These amendments first permit the state to recapture powers for which permits have been granted and on which no development work has been done and second, allow the state to control to whom power is sold and the price at which it is sold. The provisions apply to any water-power under the jurisdiction of the state, which broadly speaking is all power developed on navigable waters or state lands or which would affect state lands by change of flowage, etc.

A. A. E. Directors Hold Quarterly Meeting

To Improve Employment Service—Offer License Law Amendment—Officers Nominated

Improved employment service to the isolated members of the American Association of Engineers was decided upon March 24 at the quarterly meeting in Chicago of the board of directors. It was proposed to employ several field secretaries to develop the employment service, organize new units, serve old ones and facilitate co-operation among the various chapters, clubs and assemblies. To make this plan feasible the executive committee was directed to submit a budget and plan at the annual convention at Salt Lake City, June 5, 6 and 7.

The chapters were urged by the board not to send instructed delegates to the convention and also to reduce the expenses of the convention by consolidating representation in the proportion of one delegate to 250 members.

LICENSE LAW AMENDMENT

An amendment to the model license law was made which would grant a registered engineer from an outside state permission to practice for 90 days without registration or fee provided he files a copy of his home-state certificate of registration together with information as to his address, intention to practice, date and time of engagement. Another change would provide that engineers employed by partnership or corporations may sign and seal the plans prepared by the partnership or corporation.

D. W. Patton, chairman of the legislative committee, reported that from early replies in a recent study, engineers' license laws were functioning well in Arizona, Idaho, Florida, Louisiana and Minnesota. In Pennsylvania and Tennessee the laws go in effect this year. A central enforcement bureau is desired by some Louisiana engineers. The Pennsylvania law has been criticized as too stringent; under the new Arizona law, which is optional, except for state and county engineers, about 10 per cent of the engineers have already been licensed.

A recommendation was sent to President Harding that an engineer be appointed to fill the vacancy existing on the U. S. Civil Service Commission. A. B. McDaniel was endorsed for appointment to the position.

A consolidated balance sheet of 125 chapters reporting to the auditing committee, C. A. Hoglund, chairman, showed a net cash surplus of $21,240.96 and total assets of $33,320.70.

PRACTICE COMMITTEE REPORTS

The practice committee, of which H. W. Clausen is chairman, reported on seven cases. One case condemns the practice of selling companies offering commissions to city engineers and states that members should be expelled if employed or connected with the management of such a company. In another case it was held unethical for an engineering firm to accept bonds that by law must be sold at par and accrued interest in payment for engineering work where it is necessary for the engineering firm to base its charges on the sale of the bonds at less than par and accrued interest. The question of "intent to defraud" must be decided prior to determining the penalty. It was ruled not ethical for a partner in an engineering practice to sell his share to the other partner, establish a new firm and attempt to secure the clients of the old partnership.

While higher salaries for engineers in teaching service are favored, under present business conditions it was in the opinion of the board, inopportune to publish a final report on a schedule even as high as the tentative one published in 1920. Prof. C. J. Tilden is chairman of the committee.

OFFICERS NOMINATED

The following nominations for officers were announced: President, Clarence W. Hubbell, A. N. Johnson and A. M. Van Auken; first vice-president, George E. Taylor, (A. S. Morris, withdrawn); second vice-president, A. M. Knowles and O. Laurgaard; directors, District 2, C. A. Heinze; District 3, B. W. Matteson; District 8, W. S. Boyle and F. B. DeFrees; District 9, D. Q. Mercer, Frank T. Payne, W. M. Poyner and Charles F. Wheelock; District 11, C. Arthur Poole.

To Report Federal-Aid Road Bill

(Washington Correspondence)

Appropriations for a two-year highway program only will be provided in the bill which the Committee on Roads will report to the House of Representatives. The Committee has approved a bill which will carry an appropriation of $65,000,000 for the next fiscal year and $75,000,000 for the fiscal year to end July 1, 1924.

The Committee insisted on placing a proviso in the bill which will limit federal aid to $12,500 per mile of road during the next fiscal year. The limit for any year thereafter is to be fixed in the bill at $10,000 per mile of road. To this proviso there will be strenuous objection on the part of the states. It is possible that this limitation can be eliminated from the measure on the floor of the House. It is regarded as practically certain that it will be unacceptable to the Senate.

Newark Public Health Institute

A Public Health Institute under the auspices of the U. S. Public Health Service, the New Jersey Department of Health and the Health Department of the City of Newark will be held in the city just named, April 10 to 14. Among the addresses will be one by Allen Hazen, consulting engineer, New York City, on water supply, at 10 a.m., April 11, and one by M. N. Baker of the editorial staff of *Engineering News-Record* on sewage disposal, at 1:30 p.m., April 12. Dr. Charles V. Craster, health officer of Newark, N. J., is acting director of the Newark Public Health Institute.

Next A. P. H. A. Meeting To Be in Cleveland Oct. 16-19

The next annual meeting of the American Public Health Association will be held in Cleveland, Ohio, Oct. 16-19. To be sure of consideration, copies of papers which it is desired to present at the meeting should be in the hands of the Program Committee by July 1. Such papers should be accompanied by abstracts of 200 words. The secretary of the Association is A. W. Hedrich, 370 Seventh Ave., New York City.

Chicago Engineers Discuss City's Problems

Western Society and Local Sections of Eight National Societies Hold All-Day Convocation

Under the joint auspices of the Western Society of Engineers and the Chicago sections of eight national technical societies the city's numerous engineering problems were discussed March 22 in an all-day convocation. While the hall was not crowded, different groups came and went as the different topics came up. It was the first time in many years that day meetings for technical discussions have been held by the local societies. The co-operation evinced by the many prominent engineers of the city in leaving their business, was the subject of much favorable comment.

L. A. Ferguson, vice-president of the Commonwealth Edison Co., and H. H. Clark, consulting engineer of the Peoples Gas Light & Coke Co., outlined the province of their respective utilities.

Clarence W. Farrier, city planning engineer, Board of Local Improvements, gave a concise review of the work on the Chicago Plan of the late D. H. Burnham. He brought out the practical engineering features and classified the various projects according to their relative usefulness. Jacob L. Crane made a plea for a regional plan which would encompass northern Illinois, southern Wisconsin and a portion of Indiana.

"Railroad Transportation in Chicago" was handled by E. J. Noonan, chief engineer, Chicago Terminal Commission. He outlined the present situation and the numerous plans of the various groups of terminals. Among railroad officials who followed Mr. Noonan in discussion were E. H. Lee, president, Chicago & Western Indiana R.R.; A. J. Hammond, assistant chief engineer, Chicago Union Station Co., and C. H. Mottier, office engineer, Illinois Central.

URBAN TRANSPORTATION

Col. Bion J. Arnold, in his talk on "Urban Transportation" said that the keynote now is co-operation instead of competition. The startling suggestion was made that the Union Station Co., build all of its structures of the same height so as eventually to provide a landing place for aerial traffic.

Harry L. Brown, western editor, *Electric Railway Journal* and *Bus Transportation*, in discussion claimed that Chicago had one of the best urban transporation systems in the country and with municipal support instead of constant harassing could be greatly improved. Bus traffic on the north side now numbers nearly 10,000,000 passengers per year and the buses travel 1,750,000 miles per year. It is only a beginning and does not compare with other forms of transportation, in his opinion. He suggests that non-stop high-speed bus service from the loop to several outlying, thickly populated centers would doubtless soon be a reality. The great desirability of having all transportation service under a unified control was emphasized for a stabilization of financial standing.

Col. John J. Millis outlined Chicago's water-borne transport possibilities.

At the annual dinner, Reed Landis spoke on "Aerial Transportation" in Chicago and David Kinley, president, University of Illinois, on "Engineering Opportunities."

American Firm To Rebuild Louvain Library

Memorial Structure Designed by New York Architects to be Gift of America to Belgian People

Contract for the reconstruction of its famous library building which was destroyed by the Germans during their march through Belgium in 1914 has been awarded by the University of Louvain to the Foundation Co. of New York. Plant and materials are to be assembled immediately. This work which will cost somewhat more than $1,000,000 is considered to be one of the most important single pieces of reconstruction yet put in hand in the devastated area.

Warren & Wetmore of New York are the architects for the library which is to be rebuilt on a new site two blocks distant from that of the old structure. The corner stone was laid with appropriate international ceremonies July 28, 1921. The building will be in the style of the Flemish Renaissance and will be surmounted by a tower that will rise to a height of 275 ft., dominating the surrounding country. The main structure will be 220 ft. long and 150 ft. in depth. The material to be used is a local white stone together with red brick, blue slate roof and copper flashings, certain details of the facade being gilded as is usual with monumental structures in Belgium. The tower will contain *carillon*, or chimes, which will sound the national airs of the several allied nations.

In order to care for the books that are piling up in Louvain to replace those that were destroyed the first section to be begun will be the stacks, which it is estimated will be ready in about eighteen months. Ultimately the library will house two million books and will have a seating capacity of three hundred readers together with class rooms and administrative offices. It is planned to complete the library by 1925, the five hundredth anniversary of the erection of the original building.

This structure is a gift from the American people to those of Belgium. Funds are being raised in this country by the National Committee of the United States for the Restoration of the University of Louvain, of which Dr. Nicholas Murray Butler, president of Columbia University, is chairman.



NEW LIBRARY AT LOUVAIN, GIFT OF AMERICA TO BELGIAN PEOPLE

Highway Engineer Gets $10,000 for Injuries at Storm King

After having his claim in every court of record in the state, and having secured an enabling act from the legislature to prosecute, Dudley P. Babcock of Albany, New York, former engineer in the employ of the state highway department, has secured a $10,000 award from the Court of Claims for injuries received while in the discharge of his duties.

At the time of the preliminary surveys for the state highway along the Hudson River it was necessary for Mr. Babcock to be lowered in a sling from the edge of Storm King Mountain. The rope parted and he fell many feet and was severely injured.

Reconstruction Hospital Breaks Ground for Addition

Reconstruction Hospital, New York City, broke ground Sunday, April 2, for its new eleven-story addition at 100th St. and Central Park West. The total cost of the new annex will be $1,500,000.

No Truth in Rumor That New York Engineers Must Register Soon

Major Percy E. Barbour, vice chairman of the New York State Board of Licensing for Professional Engineers and Land Surveyors, announces that no foundation exists for the rumors that have been circulated in and around New York that in order to avoid examination engineers must apply for licenses before an early date. This date has varied, one of the earliest rumors having named Dec. 31, 1921, and the latest setting May 1, 1922.

As the law now stands it will be unlawful to practice engineering in New York State after May 5, 1923, without a license. The Licensing Board has authority to require examination of any applicant whose qualifications and fitness the board may consider it advisable to determine in that manner. There is no way to avoid such an examination by filing an application before any particular date.

To Honor Meade, Engineer Officer and Victor of Gettysburg

Ground was broken last week in the National Botanic Gardens, Washington, for a memorial to General George Gordon Meade, the victor of Gettysburg. The Secretary of War presided over the ceremonies, the first spadeful of earth was turned by President Harding and the second by Chief Justice Taft. Governor Sproul of Pennsylvania, George Gordon Meade, grandson and George Gordon Meade, 3d, great-grandson also participated.

The memorial, a gift of the Commonwealth of Pennsylvania, will be by Charles Grafly, a Philadelphia sculptor, and will face that of General Grant now in the Botanic Gardens.

General Meade was an officer in the Corps of Engineers, U. S. Army with the rank of Major General of Volunteers during the Civil War.

May Abolish or Consolidate Office of State Engineer

A concurrent resolution empowering the New York Legislature to consolidate the offices of state engineer and surveyor and of superintendent of public works was passed by a recent session. The resolution has to be passed by the legislature of 1923 and approved by a referendum vote of the electorate of the state before it becomes effective.

Under the terms of the resolution, the legislature may abolish either or both of the offices named. If the office of state engineer and surveyor is abolished, this action becomes effective on the expiration of the term of the incumbent of the office at that time. If the office of superintendent of public works is abolished, this takes effect at such time as the legislature may specify. With the abolition of this office would also go that of the assistant superintendent of public works.

If either of the two main offices named is abolished, then "the legislature may vest in another officer, by the same or different name, the statutory powers and duties of the officer whose office shall be thus abolished, subject to modification of such powers and duties by the legislature." The legislature of 1924 would be the first one that could take action under this concurrent resolution in case it becomes effective.

River Tunnel Costs Compared

Comparative costs of the Hudson River vehicular tunnel, for which the contracts were awarded last month, and the rapid transit tunnels under the East River, New York City, let prior to the war, are the subject of a brief report by C. M. Holland, chief engineer to the New York-New Jersey tunnel commissions, from which the following extract is taken:

"The comparative actual cost of the vehicular tunnels is only about 10 per cent greater than the tunnels contracted for in 1914. In detail, the average bid price for the vehicular tunnels for cast-iron lining is almost precisely the same as the prices received for constructing the rapid-transit tunnels. Cast-iron in the case of the vehicular tunnels will be about 27 per cent of the total cost as compared with 30 per cent in the case of the rapid transit tunnels. The estimated cost for excavation for the vehicular tunnels is about 44 per cent of the total cost of the work as compared with 50 per cent in the case of the rapid transit tunnels. The average unit cost for excavation for the vehicular tunnels is $21.30 per cubic yard in 1922 as compared with $20.40 per cubic yard for excavation for the rapid transit tunnels in 1914.

"I submit the above in connection with the query which has been made a number of times as to what relation present-day prices bear to pre-war prices in connection with the vehicular tunnels. In consideration of the above, the question arises as to whether costs on account of general business conditions and general reduction of prices have dropped nearly to pre-war level, or whether the larger tunnels are cheaper per unit of cross-sectional area. In my opinion, the extremely favorable prices received are due to a combination of conditions as just stated."

Highway Traffic Association to Hold Annual Meeting

The annual meeting of the National Highway Traffic Association is to be held at the Automobile Club of America, New York City, May 12. The afternoon and evening sessions will be devoted to a consideration of the reports of the following national committees: uniform highway signs, traffic capacity and widths of highways outside of municipalities, standards of the construction of highway curves and recommended practice to increase safety to traffic, highway-improvement creed, regulations governing speeds, weights and dimensions of motor trucks and trailers, licenses and motor-vehicle taxation, highway-transport franchises, and highway-transport clearinghouses.

An informal dinner will be served at the Automobile Club between the afternoon and the evening sessions.

Elmer Thompson, 247 West 54th St., New York City, is the secretary of the National Highway Traffic Association.

Hearings on Zoning at Detroit

The City Plan Commission of Detroit, Mich., has tentatively adopted a zoning ordinance and map after a series of conferences with various organizations in the city. Before submitting the tentative ordinance to the Common Council for final adoption, hearings are to be held in various parts of the city.

Offer Made to Operate Nitrate Plant 1 at Muscle Shoals

A proposal to operate Nitrate Plant 1 at Muscle Shoals with the first 100,000 kw. of secondary power has been submitted to the Secretary of War by Charles L. Parsons, secretary of the American Chemical Society. The offer has been sent to Congress by Secretary Weeks.

Dr. Parsons proposes to form a company to be known as the Southern Nitrate Co. which will in turn organize the Southern Nitrate Corp. whose securities will be underwritten and offered at public subscription. The company, or its successor, proposes to purchase all of the property constituting (officially) Plant 1 for $600,000 and to manufacture therein nitrogen by the Haber process or some modification of it.

For power the company would pay 0.75 of a mill per kilowatt-hour, delivered at the switchboard, for power delivered ten months per year, and a proportionate price for such a part of the 100,000 hp. as may not be available for the full period.

Dr. Parsons would also lease the carbide plant of Nitrate Plant 2 together with its physical appurtenances for $50,000 a year, and would either lease or purchase outright the Waco Quarry. That part of Plant 2 acquired would be used for the manufacture of calcium carbide, and phosphoric acid and potash. In case the government should lease the cyanamid, ammonia oxidation or ammonia nitrate portions of Plant 2, Dr. Parsons agrees to furnish the lessee calcium carbide required for cyanamid or fertilizer production at a six per cent profit, power and nitrogen gas to be furnished at cost.

Massachusetts Committee Report Favors St. Lawrence Project

A committee of nine appointed several months ago by the executive committee of the Associated Industries of Massachusetts to report on the St. Lawrence River waterway project has submitted the following conclusions: 1. That the project is feasible from an engineering standpoint; 2. That it can be constructed at a reasonable cost, considering the magnitude of the work involved; 3. That it will furnish a direct and usable water route between the ports of the Great Lakes and both foreign and domestic ocean ports; 4. That in the very near future this nation will require every possible means of transportation by water, rail, and motor, and that accordingly the St. Lawrence project will be of great assistance in reducing otherwise necessary expenditures for additions to our rail facilities, and greatly lessen the inevitable transportation crisis which will arise with a restoration of normal business and the natural growth of the country; 5. That it will give to New York and New England a very large, reliable, and cheap source of hydro-electric energy; and, 6. That the project is desirable for the country as a whole, and beneficial to New England.

The committee consisted of Charles R. Gow, chairman; Charles A. Andrews, [illegible], George I. Finch, S. Harold Greene, Henry I. Harriman, [illegible] Libby, Edgar J. Rich, and A. B. Tenney.

Indiana Water-Works Annual Meeting Is Held

Damage to Water Systems by Not Using Fire Engines—Little New Work Now—Pollution Topics

Alleging that a destructive action takes place when water pressures throughout the entire system are raised to fight fires, the Indiana Sanitary and Water Supply Association, at its annual meeting, March 22 and 23 in Indianapolis, went on record against the practice. Fire engines, for local pressure increases, were preferred. The same arguments were advanced at the recent meeting of the Iowa section of the American Water Works Association and the same records of broken services and mains and increased leakage were recounted at both meetings. Many Indiana fire departments having fire engines do not use them, thus jeopardizing the whole supply. Fire departments act on the theory that it is easier to let the water-works for the whole city do the work. Several other papers on fire service were presented at the meeting. Dow R. Gwinn, president, Terre Haute Water Co., led a round-table discussion on the subject.

Construction at Low Point. — J. B. Marvin, vice-president, Frankfort Water Co., in a round-table discussion on water-works building programs in Indiana, stated that the $800,000 being spent on the Hammond municipal plant was the largest work under way. J. W. Toyne, South Bend, had written to 30 cities asking for a record of contemplated work. Not a single city had anything but maintenance planned.

Pollution. — The Calumet district came in for much discussion, the distribution of the enormous lake pollution by the industrial plants being noted in a paper by L. A. Geupel, director water and sewage, Indiana State Board of Health. John C. Diggs, engineer, State Department of Conservation, is attempting to obtain a yardstick of pollution. He cited the population density of the watersheds of the rivers of the states as one factor.

Paul Hansen, consulting engineer, Chicago, explained the iron-removal experiments, not yet concluded, at Benton Harbor. An absorption tower, aerators, lime and alum treatment, sedimentation and reaction chambers and final filters are included.

W. C. Mabee, assistant chief engineer, Indianapolis Water Co., presented design data and unit costs on the 10-m.g. reinforced-concrete reservoir, 10 ft. deep, which was built in four months last summer at a cost of $[illegible].

J. B. Marvin was elected president and C. K. Calvert, Indianapolis, secretary-treasurer, for the ensuing year.

Exhibitors at Water Works Convention

According to a statement recently given out by John S. Warde, chairman of the Water Works Manufacturers' Association, forty-four firms have so far signified their intention of exhibiting at the American Water Works Association convention to be held in Philadelphia May 15 to 19. Two-thirds of the firms have applied for booth space. George McKay, Jr., and William D. Marshall form the exhibit committee.

Favor F. A. E. S. to Promote Engineering Congress

(*Washington Correspondence*)

A pronounced feeling exists in engineering circles in Washington that the proposed Engineering Congress to be held in connection with the Philadelphia Sesquicentennial in 1926 should be promoted in a national and international way, and that this can be done best by the Federated American Engineering Societies. Local promotion of the congress would be handicapped, it is believed, by the assumption that Philadelphia engineers naturally would be inclined by the incidental benefits to their city to represent such a gathering as certain to be a momentous occasion. If the arrangements were handled by the national machinery which the organizations in many branches of engineering have set up, it is believed a different impression will be created.

Wider Right of Way for Indiana Highways Is Sought

Owners of land contiguous to state roads, which the Indiana state highway commission wishes to widen, have been asked again to co-operate with the department by moving back property lines. Letters containing the request were sent out recently by Lawrence Lyons, director of the state highway commission. The commission, he said, wishes to have at least 50 ft. from fence to fence. Mr. Lyons said that many landowners appreciate the value of a modern highway adjacent to their land and are complying with requests previously made.

Engineering Societies

Calendar

Annual Meetings

NATIONAL FIRE PROTECTION ASSOCIATION, Boston, Mass.; Annual Meeting, Atlantic City, May 9-11.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, Philadelphia, May 15-19.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Annual Convention, Salt Lake City, Utah, June 5-7.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Annual Convention, Portsmouth, N. H., June 21-22.

The Ontario Good Roads Association held its annual convention at Toronto, March 1-3. The following officers were elected: President, W. H. Brown; vice-presidents, John Curry and George S. Henry; directors, F. A. Senecal, J. E. Jamieson, A. B. Rose, Peter Ray, F. H. Richardson, and W. H. Nugent.

The County Commissioners Association of Ohio held its annual meeting in Columbus last week, at which the following officers were elected: Allen Shale, Youngstown, president; J. J. Zmund, Cleveland, first vice-president; J. F. Booth, Akron, second vice-president; Richard Sinclair, Columbus, secretary; and John H. Hinchcliffe, Lisbon, treasurer.

The Seattle Branch, A. A. E., elected the following officers at its annual meeting: President, Major Garrison Babcock; first vice-president, J. W. A. Bollong; second vice-president, E. J. M. Gilman; third vice-president, H. J. M. Baker; fourth vice-president, W. J. Bennett; secretary-treasurer, W. B. Wolfendale.

The Denver Chapter, A.A.E., has elected the following officers for 1922: President, H. W. Gardner; vice-president, O. W. Childs; secretary, Joseph P. Arnold; treasurer, N. B. Hunt.

The Lincoln (Neb.) Chapter, A. A. E., has changed the date of the meeting at which Edwin S. Jarrett will speak from April 10 to April 11.

Personal Notes

L. P. Lessard, formerly assistant sales manager for the T. L. Smith Co., Milwaukee, Wis., has been made district manager of the Chicago territory for the H. W. Roos Co. of Cincinnati, Ohio.

K. H. Gedney, formerly a member of the Gedney Construction Co., with offices in Kansas City, Mo., and Hastings and McCook, Neb., has organized the K. H. Gedney Co. in Hastings, Neb. The firm will specialize in building construction.

Edward A. Evans, for nine years construction engineer and superintendent for the T. A. Gillespie Co., N. Y., has been made resident engineer on the Mountain Island Development for the Catawba Mfg. & Electric Power Co., N. C.

Clarence C. Brown, formerly a captain in the 12th Engineers, has been appointed superintendent of construction for Scott & White and has full charge of the construction of a 58-mile branch railroad for the Santa Fe in western Kansas.

Harold Silcox, Elizabeth, N. J., has been appointed general supervisor of bridges and structures in the construction division of the state highway commission.

Charles D. Watson has become vice-president of the Watson Engineering Co., Cleveland, Ohio, succeeding H. R. Hadlow, retired.

R. L. Harding has been made secretary of the Watson Engineering Co., Cleveland, Ohio, succeeding W. P. Brown. Mr. Harding has been with the company as estimator and purchasing agent since his return from France in 1919.

Howard M. King, Assistant Superintendent of Water-Works, Springfield, Mass., since 1910, has been appointed superintendent to succeed the late Alfred E. Martin. Mr. King was in the engineering division of these works from 1906 to 1910, on the construction of the Ludlow filters and of the additional supply from Little River.

W. A. Van Hook, cost engineer in the Bureau of Valuation of the Interstate Commerce Commission has resigned to become chief engineer of the Roberts-Pettijohn-Wood Corp., accountants and engineers, Chicago.

John W. Reid has been appointed city engineer of Detroit, Mich., and assumed his new duties on March 15 succeeding Clarence W. Hubbell who resigned on March 1 after several years in the employ of the city. Mr. Reid has been connected with the Detroit Department of Public Works for 22 years, having held positions from draftsman to chief engineer of the department of grade separations. He has been at the head of the grade separation department for several years.

Joseph L. Barton, formerly assistant grade separation engineer, Detroit, Mich. has been made grade separation engineer succeeding John L. Reid, who has been appointed city engineer of Detroit.

Cloyd M. Chapman of New York City has been appointed consulting engineer for the Freeport Sulphur Co., to design the sulphur reclamation plant to be built at Hoskins Mound, Texas, a property recently taken over by the Freeport company from the Texas Co. The Dwight P. Robinson Co., New York City, has the contract for the job.

W. H. Woodbury, valuation engineer for the Duluth, Missabe & Northern Ry. and the Duluth & Iron Range R.R., has been elected president of the Minnesota Federation of Architectural and Engineering Societies.

J. S. Hazelton, resident engineer for the Missouri State Highway Department in Webster County has been transferred to Newton County.

R. E. Spear, city engineer and assistant city manager of Ambridge, Pa., has resigned.

D. E. Harrington, assistant city engineer, Madison, Wis., has resigned to enter the engineering and contracting business.

William N. Ryerson has resigned as general manager of the Great Northern Power Co., Duluth, Minn., to enter the engineering field in New York City.

B. C. Brennan, city engineer of Kenosha, Wis., has resigned to enter the road-contracting business.

R. W. Barrow, has been chosen building inspector of Meriden, Conn., a position recently instituted.

Samuel E. Duff, consulting engineer, has been elected president of the Memphis Steel Construction Co., Pittsburg, Pa., succeeding A. C. Hunt.

Prof. C. C. Williams has been named head of the civil engineering department, University of Illinois, succeeding Prof. I. O. Baker. Prof. Williams served formerly as professor of civil engineering at the University of Kansas. He was graduated from Illinois in 1907.

Business Notes

A. P. Blackstead, formerly chief engineer of the Camden Iron Works, Camden, N. J., and prior to that hydraulic engineer with the Henry R. Worthington Co., N. Y., has joined the engineering staff of the Dayton Dowd Co.

J. W. WUNSCH and C. V. TERKUILE have organized the firm of Wunsch & TerKuile, Brooklyn, N. Y., selling agents for manufacturers of materials-handling machinery and industrial and engineering equipment.

THE LAKEWOOD ENGINEERING CO., Cleveland, Ohio, announces that the CONTRACTOR'S TRADING CO., INC. will handle their building-construction equipment exclusively.

SANDVIK STEEL, INC., announces the consolidation of its general steel and steel-belt conveyor departments, with W. D. Thomas formerly manager of New York Export Sales—American Mill Co. as president and general manager.

THE BARBER ASPHALT PAVING CO. announces that the name of the firm will after March 31, 1922 be changed to the Barber Asphalt Co. The change involves no alteration in the organization or obligations of the company.

W. C. ALLEN, former manager of the Philadelphia branch, Black & Decker Co., has been made branch manager of the Chicago territory which takes in Wisconsin, Illinois, Missouri, Iowa, Minnesota and North Dakota.

OBITUARY

DANIEL L. NORRIS, construction engineer, who has been with the George A. Fuller Construction Co. since 1900 died at his home in Newark, N. J., March 23. He supervised the building of the Commodore, Biltmore and Plaza hotels, New York City, and subsequently went to Japan where he organized the oriental branch of the Fuller Co. and built some of the first modern office buildings and hotels in Tokio, Yokohama and Osaki.

HENRY P. NAWN, president of the Hugh Nawn Construction Co. Boston, Mass., died suddenly on March 29, at Gilboa, N. Y., where he was living while his firm was constructing a large dam to furnish additional water supply for New York City. He was born in Roxbury, Mass. in 1858 and entered his father's company soon after his graduation from the Roxbury schools, remaining with the firm until his death. Among the many contracts which his company executed were the construction of East Boston Tunnel, the Cambridge tunnel and stations, and other tunnel sections in Boston subways; the shipyards and docks at Hog Island, and the government proving grounds at Scituate.

MAJOR WILBUR FISK FOSTER, retired member of the firm of Foster & Creighton, died at his home in Nashville, Tenn., March 27. He was born in Massachusetts but went to Tennessee shortly before the Civil War, where his engineering training enabled him to render valuable services to the Confederate forces in laying out Fort Donelson and planning lines of defense. After the war Major Foster became city engineer of Nashville holding that position for a number of years. In 1884 he joined with R. T. Creighton in forming an engineering partnership which lasted until his retirement in 1909.

HARRY DEAN BUSH, 64 years old, general superintendent of the Carnegie Steel Co., Baltimore, Md., died on March 15 at his home in Baltimore. He was a native of Springfield, Mass., where he had been civil engineer at the bridge works of R. F. Hawkins. Later he was bridge engineer for the Northern Pacific R.R. and served for a year as assistant engineer in the office of George S. Morrison, N. Y. He then became superintendent for the Dominion Bridge Co., Ltd., Montreal, and came to Baltimore in 1903 as vice-president and manager for the Baltimore Bridge Co.

ALBERT W. MOORE, 64 years old, a resident of Indianapolis and widely known in Indiana for his work on state and county bridges, died recently at the home of his son at Fort Worth, Texas. Mr. Moore was director of the Lafayette Engineering Co. and had been in the contracting business for more than twenty years.

EQUIPMENT AND MATERIALS

Oxy-Acetylene Torch Welds Cast-Iron Tar Kettle

The Oxweld shops in Chicago call attention to the welding of a 13-ton cast-iron tar kettle, 8 ft. in diameter by 8½ ft. in height, with a flange and wall thickness of 2¾ in. There were two ruptures, one break extending through the rim down into the body of the kettle for a distance of 18 in., and one, similar in character, about 26 in. long. The position and nature of the fractures were such that ordinary procedure in preparing the casting for welding could not be followed. The application of pre-heat presented an unusual problem, owing to the necessity for keeping the kettle in an upright position. To afford a base for a temporary furnace, empty carbide cans were piled up to a point just below the lowest zone requiring pre-heat, a thin covering of



light-gage steel sheets was provided, and the furnace of fire brick was set up on the scaffold. Had it been possible to employ customary preparation, it is estimated that there might have been a saving of approximately 10 per cent in time on the job as a whole. The entire weld was welded in 8 hours and the heats done by a crew of three. The net saving to the roofing company was [illegible]. The job took three days

Batch-Box Car of New Design

A new design of industrial railway car to carry two batch boxes of 33 cu.ft. capacity for concrete road construction, has been developed by the Koppel Industrial Car & Equipment Co., Koppel, Pa. Two particular features are the V-shaped separator between the seats for



the boxes, and a locking device which prevents the uncoupling of the cars without the removal of the coupler pin. A brake acting on all four wheels is operated by a treadle or foot lever. The car has a frame of 6-in. ship channels mounted on 14-in. cast-steel wheels.

Gasoline Lift Truck

A gasoline elevating-platform truck is being manufactured by the Clark Tructractor Co., Buchanan, Mich. The loading platform is 26 x 54 in. and will elevate its load of 4,000 lb. from a minimum of 11 in. to a maximum of 16 in. from the floor in eight seconds. Automatic stops provide for both up and down limits and elevation can be stopped by hand control lever at any



point. The lifting mechanism is operated by hydraulic pressure. Power for locomotion and for elevating the load is derived from a 15-h.p. 4-cylinder tractor engine. The engine is mounted at the rear in a closed compartment containing transmission, governor, vacuum tank, radiator, etc. The total weight of the truklift ready for service is 2,500 lb.; the over-all length is 107 in., the width 35½ in. and height 51 in.

Out-of-the-Ordinary Trade Publications

An instruction book for centrifugal pump users and operators has been prepared by the WORTHINGTON PUMP & MACHINERY CORPORATION, of New York. Erection and installation are described and curves are given of head, capacity, and efficiency. A new curve shows the maximum water temperature allowable for different suction lifts.

A notable pamphlet on wood car construction is published by the SOUTHERN PINE ASSOCIATION, New Orleans, La. Car development, storage and handling of car lumber, preservative treatment of car lumber and the properties of Southern yellow pine as car material are treated separately.

A manual for storing and seasoning cross-ties, both treated and untreated, has been published by the [illegible] published by the CREOSOTED WOOD PRESERVING CO., Pittsburgh, Pa.

Business Side of Construction

Facts and Events that Affect Cost and Volume

March Contracts Largest in Two Years

Total of $191,782,262 Represents Double the Volume of Work Contracted for in March, 1921

The value of contracts let during the month of March, as reported in *Engineering News-Record*, attained the high total of $191,782,262, the largest figure that has been recorded since April, 1920. This figure is the actual money value of the contracts let. If converted into volume of construction it represents double that put under contract during the corresponding month of 1921 and also double the volume for a representative month of 1913. In actual money value March, 1922, exceeded March, 1921, and March, 1920, by approximately $78,000,000 and $44,000,000, respectively.

Three large contracts swelled the total considerably, these being the contract for the construction of the vehicular tunnels under the Hudson River in New York City, a $19,000,000 job; a $4,000,000 highway job in Maricopa County, Arizona; and a contract let by the federal government for the reconditioning of the steamship "Leviathan" which is estimated to cost in excess of $6,000,000.

However, the amount of street and road work put under contract during the past month—$46,369,788—has only been exceeded once since Jan. 1, 1920. The only figure exceeding that within the past two years was recorded in June, 1921—about $56,000,000.

Another class of building which has shown remarkable gains is miscellaneous buildings, which includes churches, educational buildings, bank and office buildings, lofts, apartment houses, etc. The total money involved in contracts for this class was $89,648,848, a figure which has not been approached, except in April of 1920, since Jan. 1, 1920. The figure for April, 1920, was then only $1,000,000 more than was recorded during the past month.

Another feature of the analysis of contracts let during the past month is the fact that industrial construction is coming to the front. The money involved in this class of construction is in excess of $16,000,000, a figure which has not been reached since December, 1920. There is a particular trend in this class of construction toward the building of large plants.

Of particular interest in analyzing street and road contract figures is the fact that an unusual amount of construction is being put under contract in the southern states. The southern states have crystallized their road-construction ideas within the past year and it is apparent that well-balanced programs are being put under contract early in the construction season.

The road-construction season promises the greatest activity that has yet been seen, for but few of the larger road-building states have really started letting their contracts. Volume this year will probably double 1921 contracts.

CONTRACTS LET IN MARCH OF 1920, 1921 AND 1922

Classification	March 1920	March 1921	March 1922
Waterworks	$2,213,262	$2,028,055	$1,199,221
Sewers	1,283,227	2,862,131	3,440,556
Bridges	2,238,661	1,443,060	1,151,391
Excavation, dredging	3,151,151	1,625,690	608,034
Streets, roads	26,220,967	25,880,109	46,369,788
Industrial	48,861,832	15,032,130	16,179,957
Buildings	47,541,078	56,520,231	89,648,848
Federal government	1,483,605	3,590,617	7,796,122
Miscellaneous	15,129,378	4,231,823	25,388,345
Total	$148,123,161	$113,213,846	$191,782,262

Engineering News-Record Construction Cost Index Number

April, 1922	**164.72**
March, 1922	162.04
April, 1921	213.07
Peak, June, 1920	273.80
1913	100.00

Engineering News-Record's Construction Cost Index Number is 2.68 points higher than last month, due to the recovery in steel and to a slight adjustment in the cement price in the Middle West. Structural shapes now sell for $1.50 per 100 lb., against $1.40 a month ago. Although the tendency of lumber is down, a new price has not yet been announced in the New York market. Average hourly rate for common labor remains at 43c. Thus, general construction cost is 23 per cent cheaper than one year ago and 40 per cent under the peak; it is 65 per cent above the 1913 level.

Engineering News-Record Construction Volume Index Number

Monthly	
March, 1922	**202**
February, 1922	100
March, 1921	88
1913	100
Yearly	
1921 (entire year)	88
1920 (entire year)	91
1913	100

Engineering News-Record's Construction Volume Index Number is 202 for the month of March, and 88 for the whole of 1921, as against 100 for 1913. This means that the actual volume of construction in 1921 (not the mere money value of the contracts let that year) is 12 per cent under the volume of construction for 1913. Our monthly volume number, 202 for March, 1922, is really the increment of construction, and indicates the rate at which contracts are being let as compared with 1913 awards. It must be borne in mind, however, that contracts awarded in March include the New York-New Jersey vehicular tunnels, about $19,000,000.

Car Surplus, Shortage and Freight Loading

Loading of revenue freight continues to show improvement, the total for week ending Mar. 11 being 829,128 cars, a gain of 25,873 cars over the preceding week. Contrasted with corresponding week in 1921 it is an increase of 128,688 cars, and with 1920 of 9,799 cars. In making comparisons with 1921, however, it should be stated that loading remained at a comparatively low figure during the first three months of that year due to the prevailing industrial depression, while in 1922 there has been a consistently upward trend.

Miscellaneous loading, which includes manufactured products, fertilizer, and construction and building materials, continues to show the largest improvement, showing an increase of 11,707 cars over the week ending Mar. 4, and 25,796 cars compared with the week ending Feb. 11.

Serviceable surplus cars totaled 216,661 for the week ending Mar. 15, a reduction of 7,185 cars from the previous week. Classified, there were 89,356 box cars and 79,803 coal cars; balance miscellaneous. Coal car surplus decreased 6,661 cars from the preceding week, while box cars increased 382. This is the first increase in box-car surplus since early January.

North Carolina Lets Road Work Costing $3,329,000

During February the North Carolina State Highway Commission placed under contract eight bridges and 212.14 miles of state highway at a total cost, (exclusive of the usual 10 per cent for engineering, contingencies, etc.) of $3,328,950. Of this 72.88 miles were of hard-surface type, i.e., plain concrete, reinforced concrete, or some type of asphalt on a 5-in. concrete base. The pavement widths were about equally divided between 16 ft. and 18 ft. These 72.88 miles will cost $2,160,380 to construct, the average cost per mile being $29,643, which includes all necessary grading, draining, clearing, small bridges and culverts, etc. There were 12.71 miles of penetration macadam, to cost $253,640 or $19,956 per mile.

The remaining 126.55 miles consisted of earth, sand-clay and gravel roads, and will cost $709,050 or $5,603 per mile. These roads will be hard-surfaced, probably in 1923. The eight bridge projects let will cost $205,880.

The above work comprised 34 projects for which 391 bids were received.

Arkansas County Plans Road Work

Road-construction plans for District 10, Pulaski County, Ark., have been completed by D. A. MacCrea, engineer for the board, and it is expected that work will begin in the late spring. The completion of the roads in this district will connect Little Rock with adjoining counties in six directions. Two other

Labor Rates and Conditions Throughout the Country

Despite certain local adjustments the average common labor rate for the entire country remains at 43c. per hr. In localities where common laborers are unorganized wages have reached a minimum of 15c. per hr. Residence building in Atlanta is particularly active at present; building permits aggregating $2,000,000 for the month of March, including a $900,000 apartment house. Pick-and-shovel men in Atlanta receive a flat rate of 20c. as against 20c.@25c. per hr. last month. In Dallas common laborers have been reduced to 25c., from 35c.@45c. per hr. St. Louis quotes a revised wage scale effective April 1, or 95c., for carpenters as against $1.25; 69c. for hod-carriers, reduced from 85c., and $1.06¼ for pile-drivers and structural ironworkers as compared with $1.25 per hr. last month. San Francisco common labor rates have dropped from 47½c.@56c. to 47½c.@50c. per hr. Philadelphia reports present rates for common labor in building operations at 25c.@35c. per hr. for non-union men; the union wage scale remains at 50c.@60c. per hr. for this grade of work. Cleveland wage rates are nominal pending settlement of strike difficulties.

The New Orleans wage schedule remains unchanged, but all classes of labor show a tendency to work for less than the standard rates. On small construction jobs carpenters will accept 70c. @75c. per hr. as against the regular scale of 88c. The big contractors maintain the union scale and the three crafts that the general contractors direct are carpenters, hoisting engineers and piledrivers; other crafts being handled by sub-contractors.

Minneapolis reports unemployment still prevalent and common laborers willing to work at considerably less than the established rate of 40c.@50c. per hr.; employment in such cases being short and intermittent. County Commissioners have fixed labor rates for the season as follows: common labor on county roads 50c., foreman 65c., teams 90c. per hr.

The lowest current pay scale for unorganized common labor is that obtaining in Birmingham. Hod-carriers receive 15c.@25c. as against 25c. per hr. and common laborers 15c. as compared with 15c.@25c. per hr., one month ago. Although the union scale for carpenters is 75c. the open shop range of pay is 50c.@60c. and down to 35c. per hr. The union rate for structural ironworkers is $1, but men are obtainable at 50c. per hr. under open shop conditions.

A somewhat slow but steady improvement, in general business conditions, is under way in New York. Although wage agreements between the Building Trades Employers' Association, the Building Trades Council and those representing the public have not as yet been entered into, building activities this year are somewhat better than normal. Gradual improvement in unemployment is also noticeable, particularly in the iron, steel and metals industries.

Labor rates in Syracuse, applying on the eight building trades recently under arbitration, have been established for the year 1922 as follows:

(Per Hour)	1921	1922
Carpenters	$1.00	$0 90
Lathers	1.00	0 85
Bricklayers	1.12½	1 05
Cement finishers	1.00	0 85
Hoisting engineers	1.00	0 85
Sheet metal workers	1.00	0 90
Steamfitters	1.12½	1 00
Marble workers	1.06¼	1 00

Current wage rates in Cincinnati expire May 1, 1922. Cincinnati is experiencing a shortage of hod-carriers and plasters with other trades plentiful.

Favorable weather conditions during the month just past, have visibly increased the number of employed in Denver and vicinity.

Detroit reports an increase in the number of employed in the building trades and a general revival of construction activities.

Labor plentiful, all classes.—Higher rates indicated by +, decreases by—

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$0 [illegible]	$0 70	$1 00	$0.30		$1 00	—$0.20
Baltimore	1 25	80	.87	.54	$0 74	1 00	.30
Birmingham	1 00	75	50@1 00	15@ 25	.....	1 00	.15
Boston	.90	75	.90	.60	.90	.90	.40
Cincinnati	1 25	95	95	.72½	77¼	95	.40
Chicago	1.10	1 00	1 10		1.10	1 05	.72½
Cleveland	1 04	1 04	1 04	.60	91	1 04	.57½
Dallas	1 00	1 00	1 00	.60	1 00	1 00	—.25
Denver	1 12½	1 00	1 00	75@ 81¼	1 00	1 00	.35@ 40
Detroit	1 00	80	50@ 60	50@ 60	1 00	.60@ .80	.50
Kansas City	1 06¼	1 00	1 00	80	1 06¼	1 06¼	.70
Los Angeles	1 [illegible]	1 00	1 00	1.12½	87½	1 00	.50@ 62½
Minneapolis	1 00	80	.80	.65		.80	.40@ 50
Montreal	50	60	50	3 @ 3	50	55	2 @ 30
New Orleans	1 00	88	90	40	90	1 00	.30
New York	1.25	1 [illegible]	1 25	87½	1 00	1 12½	.75
Pittsburgh	1 [illegible]	1 00	1 00	80	1 00	1 00	30
St. Louis	1 25	—.95	1 [illegible]	[illegible]	[illegible]	[illegible]	.30
San Francisco	1 [illegible]	1 00	1 00	75	1 00	1 12½	[illegible]
Seattle	1 00	80	90	.70	1 00	80@ 90	.50
Philadelphia	1 00	90	90	[illegible]	[illegible]	[illegible]	[illegible]

county roads are already paved and one more partly finished, giving the capital city, in the center of the county and the state, a hub-like appearance on the map of paved highways, with nine paved roads to the county line as spokes.

Recommend Paving in Indianapolis

Recommendations for paving 46 streets and 122 alleys in Indianapolis at an estimated cost of more than $1,000,000 has been made to the board of public works in a report submitted by Martin J. Hyland, street commissioner. The cost would be met by the owners of property on the streets and alleys improved.

John L. Elliott, city engineer, estimated that the cost of improving the alleys in the list recommended would be about $732,000, while the cost of improving the forty-six streets would be about $460,000.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for in Construction News, pp. 151@166, are the following:

A high school at Hartford, Conn., $1,500,000.

A college addition at New York City, $1,000,000.

An apartment building at Philadelphia, Pa., $1,000,000.

An office building at Lafayette, Ind., $1,000,000.

Cost Distribution on Cleveland House Construction

This tabulation of labor distribution was computed by The Cleveland Housing Co. from costs of more than one hundred five- and six-room frame dwellings built during 1920 and 1921 in Cleveland. W. W. Dibrell, superintendent of construction for the company, calls attention to the fact that the masonry and carpentry items are noticeably higher in 1921 than in 1920, despite the wage cuts in the building crafts early in 1921. Mr. Dibrell says: "This is accounted for by the severe letting up of work early in 1921 and the fact that sub-contractors, keen for new work, bid on a very small margin, much lower than in 1920."

	1920			1921		
Trade	Total Per Cent	Per Cent Material	Per Cent Labor	Total Per Cent	Per Cent Material	Per Cent Labor
Excavating	2.8		2.8	2.3	....	2.3
Masonry	11.4	7.4	4.0	13.8	8.6	5.2
Carpentry	46.0	25.0	21.0	50.0	28.0	22.0
Roofing	1.4	.9	.5	1.4	.8	.6
Plaster	8.5	4.1	4.4	6.6	2.6	4.0
Painting	5.0	1.4	3.6	4.8	1.3	3.5
Plumbing	13.6	11.8	1.8	10.4	9.0	1.4
Electrical Work	2.8	2.3	.5	1.8	1.4	.4
Heating	3.4	2.5	.9	2.9	2.1	.8
Sheet Metal	.8	.5	.3	1.3	1.2	.1
Decorating	1.3	.3	1.0	1.2	1.0	.2
Miscel.	3.0	2.7	.3	3.5	3.0	.5
Total	100.0	58.9	41.1	100.0	59.0	41.0

Rehearing of Hardwood Case Asked

Rehearing of the open-price association practice or a modification of the decree in the hardwood lumber case to permit of the collection and dissemination of production, sales and stock reports has been requested of the U. S. Supreme Court in a petition filed by the American Column and Lumber Co., the defendants in the recent suit in which the Court decided the practice was illegal because in violation of the anti-trust law. The lumber interests base their request on misinterpretation of certain phases of the case, and make general denial of the conclusions of the court that the purpose of the practice employed by the lumber interests was to curtail production or enhance prices.

Large Contracts Let

Among this week's announcements of contracts awarded in Construction News, pp. 151@166, are the following large projects: A 15-story hotel at Philadelphia, Pa., to J. R. Wiggins & Co., Otis Bldg., $3,000,000; a 17-story office building at Indianapolis, Ind., to the Bedford Stone & Constr. Co., Fletcher Savings & Trust Bldg., $1,225,000; a 21-story office building at Chicago, Ill., to Thompson-Starrett Co., 175 West Jackson Blvd., $2,000,000; a hotel at Berkeley, Cal., to Lindgren & Co., Monadnock Bldg., San Francisco, $1,000,000.

Monthly Prices of Construction Materials

Ups and Downs of the Market

Pig Iron—Slight advance in No. 2 foundry iron in several important centers. Market firmer in tone.

Railway Supplies—Maximum quotations on light rails down $1 per ton f.o.b. Pittsburgh; downward tendency in the Chicago market. Standard spikes, section angle bars and track bolts down at Pittsburgh and Birmingham mills.

Pipe—Cast-iron pipe, 4-in., down 20c. in New York and $1 in Birmingham. Drop of $2.50 in 4-in. and $3.50 per ton in 6-in. pipe in St. Louis. Market expected to stiffen unless pig iron prices decline. Slight drop in sewer pipe in Birmingham, Boston and Cincinnati; up in Philadelphia.

Road and Paving Materials—Road oils down ¼c. per gal. in New York. Asphalt in packages down 50c. in Detroit, $1.50 in Chicago and $4 in Cincinnati; advance of $3.50 in Seattle and $1 per ton in Atlanta. Bulk asphalt down 55c. in Minneapolis, $1 in Detroit, $1.50 in Chicago and $4 in Cincinnati; up $5 per ton in St. Louis. Dressed paving stone, 4x8x4, $3.20 as against $3.25 in Chicago and $3.35 as compared with $3.25 per sq. yd. in St. Louis. Wood blocks down 21c. in Atlanta and 20c. per sq.yd. in Cincinnati.

Sand, Gravel and Crushed Stone—Gravel up 25c. in Dallas and down 12½c. per cu.yd. in Cincinnati. Sand down 20c. in St. Louis and 26c. per cu.yd. in Cincinnati. Crushed stone, 1½-in., quoted $1.65; ¾-in. at $1.75 in New York as against $1.75@$1.85 per cu.yd., one month ago. Crushed stone, ¾-in., down 20c. in Dallas and 33c. per cu.yd. in Cincinnati.

Lime—Common lump lime quoted in New York at $2.75@$3.18 as against $2.75 @$3.48 and lump finishing lime at $3.68 as compared with $3.68@$3.98 per bbl. (280-lb. net) one month ago. Hydrated finishing lime down $5 in Montreal; hydrated common down $1 in Boston and $3.50 per ton in Atlanta. Lump finishing lime down 5c. and common lump 10c. per bbl. (180-lb. net) in Boston.

Cement—Natural cement (Utica) $1.77 as against $1.93 per bbl. in Cincinnati; Rosendale cement at 80c. compared with 85c. per bag in Boston, last month. New York quotes portland cement at $2.30 as against $2 alongside dock and at $2.40 as compared with $2.30 per bbl. delivered, one month ago. Cement down 20c. in New Orleans and 15c. per bbl. in Dallas. Mill prices unchanged.

Structural Material — Structural shapes, plates and bars quoted at $1.50, f.o.b. Pittsburgh, quotations of $1.40@$1.45 per 100 lb. having almost disappeared from the market. Shapes and plates quoted in New York at $2.48 as against $2.63, and in St. Louis at $2.57½ as compared with $2.72½ per 100 lb. at warehouse. Reinforcing bars in New York $2.38 as against $2.53 per 100 lb. Structural rivets and wire nails decline in Pittsburgh and St. Louis. Expended metal lath down in Chicago; up in St. Louis. Steel sheet piling quoted at $1.75 as against $1.80 per 100 lb. f.o.b. Pittsburgh.

Brick and Hollow Tile—Common brick in New York $16@$16.50 as against $18 per 1,000, wholesale, alongside dock, one month ago. Down $1 in St. Louis and Birmingham and $2 in Denver and Cincinnati; up 15c in Dallas and 75c. in Atlanta. Hollow tile advances slightly in Cincinnati and Seattle; declines in Boston, New Orleans, Montreal and Birmingham.

Lumber—Drop of $1 per M. ft. b. m. in Douglas fir No. 1 common at San Francisco and $2 in long leaf yellow pine at Chicago; fir advances $1, spruce $2, pine $3 and hemlock $3.50 per M. ft. in Philadelphia. Lumber prices decline in Cincinnati, New Orleans, Atlanta, Montreal, Minneapolis, Dallas and Seattle.

Scrap—Advance of $1.50 per ton on iron and steel scrap in New York market. St. Louis prices advance $1@$1.50, excepting cast borings, which drop 25c. per net ton.

Manila Rope—Advance of 1c. in Atlanta; drop of 1½c. in New York, ¾c. in Philadelphia and New Orleans and 1c. per lb. in St. Louis.

Explosives—Dynamite, 40 per cent gelatin, down 2c. in Los Angeles, 1c. in Birmingham and 1¼c. per lb. in Philadelphia; 60 per cent. gelatin declines 3c. in Los Angeles, ¾c. in Cincinnati, 3c. in Birmingham and 1¾c. per lb. in Philadelphia.

Linseed Oil—Prices again declining. New York quotes 82c.@83c. as against 87c. and Chicago 90c. as compared with 91c. per gal. (5 bbl. lots) one month ago.

Price advances since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Per Gross Ton—Quotations compiled by The Matthew Addy Co.:

	Current	One Year Ag
CINCINNATI		
No. 2 Southern (silicon 2.25 @ 2.75)	$20 50†	$30.50
Northern Basic	21.02†	27.52
Southern Ohio No. 2 (silicon 1.75 @ 2.25)	21 52†	30 50
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25 @ 2.75)	**28 16†**	36 51
BIRMINGHAM		
No. 2 Foundry (silicon 2.25 @ 2.75)	*15.78†*	26.50
PHILADELPHIA		
Eastern Pa., No. 2X, (2.25 to 2.75 sil.)	21 ..3†	27 00*
Virginia No. 2 (silicon 2.25 @ 2.75)	27 74†	28 00*
Basic	**21 00†**	26 25†
Grey Forge	20 50†	27 00*
CHICAGO		
No. 2 Foundry Local (silicon 1.75 @ 2.25)	20 00†	25 00 27
No. 2 Foundry Southern (silicon 2.25 @ 2.75)	*21.67†*	32 92
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley (silicon 1.75 @ 2.25)	*19.00†*	26.96
Basic	*18.00†*	26.86
Bessemer	*19.50†*	27.00

*F.o.b. furnace † Delivered

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh			
	Current	One Year Ago	Birmingham	Chicago
Standard bessemer rails	$40 00	$45 00		$40.00
Standard openhearth rails	40 00	47 00	$40 00	40 00
Light rails, 8 to 10 lb.	28 00@29.00	2.20@2 55*	1 60*	1 65*
Light rails, 12 to 14 lb.	28 00@29 00	2 15@2 50*	1 60*	1 65*
Light rails, 25 to 45 lb.	28 00@29 00	2 10@2 45*	1 60*	1 65*
Re-rolled Rail	1 45@1 50*			

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold

	6 In. x 8 In. by 8 Ft.	7 In. x 9 In. by 8 Ft.
Chicago, White Oak	$1 35	$1 50
Chicago, Hardwood and Red Oak	1 20	1 30
Chicago, Empty Cell Creosoted (gum-fill)	45	50
San Francisco, Creosoted Douglas Fir	85	1 10
San Francisco, Empty Cell Creosoted Douglas Fir	1 86	2 30
St. Louis, White Oak*	1 10	1 30
St. Louis, Red Oak*	97	1 17

*Standard specifications 38c. per tie additional. Zinc chloride process 27c. per tie additional.

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named

	Pittsburgh						
	Current	One Year Ago	Chicago	St. Louis	San Francisco	Birmingham	Dallas
Standard spikes, 6-in. and larger	$ [illegible]	$3 00@3 65	$2 35	$ 37	$4 25	$ 70	
Track bolts	[illegible]	4 00@5 50	3 65	3 45†	5 25	4 75	
Standard section angle bars	[illegible]	2 45@2 75	2 40	2 35	4 00	3 65	

PIPE

WROUGHT PIPE—The following discounts are to [illegible] for carload lots at the mills, Pittsburgh being used

BUTT WELD

	Steel Black	Galv.		Steel Black	Galv.
Inches			Inches		
to 3	71	58½	¼ to 1	44	29½

LAP WELD

2	68	54½	2	40½	27½
2½ to 4	68	55	2½ to 4	43	31½
7 to 8	65	51½	7 to 12	35½	23½
9 to 12	64	50½			

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1½	69	57½	¼ to 1	44½	30½
2 to 3	70	58½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	62	50½	2	40½	27½
2½ to 4	66	54½	2½ to 4	43	31½
4½ to 6	65	53½	4½ to 6	42½	30½
7 to 8	61	47½	7 to 8	35½	23½
9 to 12	55	41½	9 to 12	30½	18½

STEEL—From warehouses at the places named the following discounts hold for steel pipe

	Black		
	New York	Chicago	St. Louis
1 to 3 in. butt welded	66%	62%	59%
2½ to 6 in. lap welded	61%	59%	56%

	Galvanized		
	New York	Chicago	St. Louis
1 to 3 in. butt welded	53%	48½%	45%
2½ to 6 in. lap welded	47%	45½%	42%

Malleable fittings, Class B and C, from New York stock sell at list less 10%. Cast iron, standard sizes, *32-5%* off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	New York					
	Current	One Year Ago	Birmingham	Chicago	St. Louis	San Francisco
4 in.	*$50 30*	$73 30	$36 00	47 10	$48 50	$52 00
6 in. and over	47.30	63 30	33.50@33.00	43.10	46 50	48 00

Gas pipe and Class "A," $4 per ton extra; 16-ft. lengths, $1 per ton.

CLAY DRAIN TILE—The following prices are per 1000 lin.ft.:

	New York					
Size, In.	Current	One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	$40 00	$50 00	....	$50.00		$55.00
4	50 00	60 00	$80.00	60 00	$90 00	65 00
5	80.00	90 00		80.00	115 00	84 00
6	100 00	115.00	140.00	100.00	150 00	110 00
8	150.00	185.00	200.00	150.00	250.00	181.00

SEWER PIPE—The following prices are in cents per foot for carload lots f.o.b.:

Size, In.	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3	$0 14	$0 087		$0 10	$0 12	$0 12	
4	14	087	$0.[illegible]	10	12	15	$0 18
5	21	1305	10	14	18	18	165
6	21	1305	[illegible]	14	18	21	25
8	35	203	[illegible]	295	28	30	35
10	52	3045	26	315	42	42	
12	67	3915	[illegible]	405	54	54	80
15	1 15	522	[illegible]	285	72	90	
18	1 55	725	[illegible]	765	1 00	1 32	
20	1 98	87	[illegible]		1 20		
22	2 64	1 16	1 40		1 60		
24	2 97	1 305	1 [illegible]	1 35	1 80	2 16	2 40
27	4 50	1 885		2 25	3 75	3 00	
30	5 00	2 088		2 70	4 75	3 60	
33	6 55	2 61		3 35	5 50		
36	7 50	2 9725		3 85	6 00		

	3	5	8	12	24	36
Boston	$ [illegible]	$ [illegible]	$ [illegible]	$ [illegible]	$ [illegible]	$ [illegible]
Minneapolis			40	77	2 55	5 66
Denver	135*	18*	27	47	1 70	
Seattle	145		36	72	2 59	
Los Angeles	11*	15*	225	495	1 65	
New Orleans		108	27	459	1 755	
Cincinnati	099	144	[illegible]	[illegible]	[illegible]	4 382
Atlanta	078*	111*	1 [illegible]	[illegible]	2 [illegible]	
Montreal, *delivered*	30*	45*	70*	1 35	4 50	6 50
Detroit	105	1575	245	4725	2 115	5 4325
Baltimore	1225	2275	35	[illegible]	2 25	1 25
Kansas City, M	15*	21*	336	[illegible]	2 41	4 74
Philadelphia	105	1575	245	4725	1 575	3 5875

*4-in., 6-in., 9-in. respectively.

ROAD AND PAVING MATERIALS

ROAD OILS—Following are prices per gallon in tank cars of 6,000 gal. minimum f.o.b. points named

		Current	One Year Ago
New York, 40° asphalt	tank bottoms	$0 [illegible]	$0 07
New York, 65° asphalt	tank bottoms	[illegible]	07
New York, blended	tank bottoms	[illegible]	07
New York, tar	tank bottoms	[illegible]	07
[illegible]	[illegible]	08	08½
[illegible]	[illegible]	04½	11
[illegible]	[illegible]	05	08
[illegible]	[illegible]	05	06½
[illegible]	[illegible]	10	10
[illegible]	[illegible]	13	13
[illegible]	[illegible]	11	11
[illegible]	[illegible]	1 00†	15 00

*[illegible] † [illegible]

ASPHALT—Price per ton in packages (350-lb. bbl., or 425-lb. drums) and in bulk in carload lots:

	Package	Bulk
New York (Bayonne, N. J.)	$25.00	$15.00
Boston	No quotations	
Chicago	*24.35*	*18.00*
San Francisco, *f.o.b. refinery*, Oleum, Cal.	19 50*	13.50*
Dallas	35 00	27.00
Seattle	**28 90**	....
Denver	40 00	....
Minneapolis	.. ..	*19 95*
St. Louis	30 00	**30 00**
Baltimore	25 00	20.00
Los Angeles, *f.o.b.*	22 50	15.00
Montreal	28 00	21.00
Atlanta	**28 00**	....
Detroit (petroleum asphalt)	*25 00*	*19.00*
Cincinnati	*32.00*	*28.00*
Maurer, N. J. (natural asphalt)	36.00	33 00
Maurer, N. J. (artificial asphalt)	22.00	20.00
Philadelphia	24.00	17.50
Kansas City	28 83	22 83

*Freight to San Francisco, 80c. per ton.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums. Rebates of about $1 per bbl., no rebate for drums.

PAVING STONE—

New York	5-in. granite, 28@29 blocks per sq.yd.	$130.00 per M
Chicago	About 4x8x4 dressed	*3.20* sq.yd.
	About 4x8x4 common	3 00 sq.yd.
San Francisco	Basalt block 4x7x8	70.00 per M
Boston	5-in. granite	125.00 per M
Atlanta	Granite	2.00 sq.yd.
Detroit	Granite, 26½ blocks per sq.yd.	3.05 sq.yd.
Baltimore	Granite	2.00 sq.yd.
Montreal	Granite	125.00 per M
New Orleans	Granite, 4 x 8 x 4	3.25 sq.yd.
Cincinnati	Granite	3.84@4 sq.yd.
St. Louis	4x8x4 dressed	**3.35** sq.yd.
	4x8x4 common	3.00 sq.yd.
Kansas City	No. Granite	3.95 sq.yd.
Philadelphia	Granite	125.00 per M.

FLAGGING—

New York	Bronx	$0.25	sq.ft.
	Manhattan, 4 ft.	.26	sq.ft.
	Queens, 5 ft.	.26	sq.ft.
	6x20-in. cross-walk	1.00	lin.ft.
Chicago	18 in. wide	.99	lin.ft.

CURBING—Bluestone per lineal foot, in New York, costs 77c. for 5x16 in., 88c. for 5x18 in.; in cargo lots.

WOOD BLOCK PAVING—	Size of Block	Treatment	Per Sq.Yd.
New York (*delivered*)	3	16	$2 04
New York (*delivered*)	3½	16	2.17
New York (*delivered*)	4	16	2.36
Boston	3	16	2.17
Chicago	4	16	3.00@3.25
Chicago	3½	16	2.50@2.75
St. Louis	3½	16	2.50
St. Louis	4	16	3.00
Seattle	4	16	Off market
Minneapolis	3½	16	2 13
Atlanta	3½	16	*2 09*
New Orleans	3	16	1.60
New Orleans	3½	16	1.80
New Orleans	4	16	2.00
Dallas	4	18	3.90
Baltimore	3½	16	3.44
Montreal	4	16	4.50
Detroit	3	16	2.84
Detroit	4	16	3.00
Cincinnati	4	16	*2.10*
Kansas City	4	16	2.15
Philadelphia	3½	16	3.50

CONSTRUCTION MATERIALS

SAND AND GRAVEL—Price for cargo or carload lots to contractor is as follows, per cu.yd.:

	Gravel 1½ In. Current	Gravel 1½ In. One Year Ago	Gravel ¾ In. Current	Gravel ¾ In. One Year Ago	Sand Current	Sand One Year Ago
New York	$1 75	$2.50	$1.75	$2.50	$1.00	$1.25
Denver	2 50	2 00	2 50	1 80	1.10	1 60
Chicago	2 00	2.75	2.00	2.75	2.00	2.75
St. Louis, *per ton*	1 25	1 65	1.30	1 70	*1.10*	1 70
Seattle	1 50	1 50	1.50	1.50	1.50	1 50
Dallas	**2 25**	1 75	**2 25**	1.75	**2 25**	1 75
Minneapolis	1 50	2 00	1 50	....	1.00	1 00
Cincinnati	*1.87½*	2.00	*1.87½*	2.00	*1.43*	1.30
San Francisco	2 25	2.50	2.25	2.50	1.50	1 65
Boston	2 40	2 65	2 40	2 65	1.65	2 00
New Orleans	2 08‡	2 85	2 08‡	....	1.35	1 65
Los Angeles, per ton	1 50†	1 55	1 50†	1 45	1 35†	1 00
Atlanta, per ton	1 85	2 80	1.85	1.15	1 15	1 50
Detroit	2.00	1.85*	2.00	1.85*	2.00	2.50
Baltimore, per ton	1.40	1.40‡	1.60	1.60‡	2.00	.70
Montreal, per ton	1 25	1 50‡	1 50	1.75	1 25	1 40
Birmingham, per ton (Crushed slag used instead of gravel)					1.25	1.25‡
Philadelphia	1.50	....	1.55	....	1.60	....
Kansas City	2 00	3.25	2 00	3 75	1 20	1 25

* Fine white sand: Pacific, $4 per ton; Ottawa, $4.50

† Freight from quarry to Los Angeles is 85c. per ton, and is included in above price.

‡ Per cu. yd.

CRUSHED STONE—Price for cargo or carload lots f.o.b. city, unless stated otherwise, is as follows, per cu.yd.:

	1½ In. Current	1½ In. One Year Ago	¾ In. Current	¾ In. One Year Ago
New York	*$1.65*	$1.90@2.00	$1.75	$2 15
Chicago	1.60	2.75	1.60	2.75
St. Louis *delivered*	1 65	1.85	1.65	1.85
Dallas, *delivered*	*2.73*	2.10	*2.73*	2.10
San Francisco	2.25	2 50	2.25	2.50
Boston, *delivered*	3.00*	3.00* del.	3.00*	3.00* del.
Minneapolis, *at plant*	2 00	2 00	2.25	2.25
Kansas City, *at plant*	2 10	2.35	2.10	2.35
Denver	3.50	....	3.50	....
Seattle *delivered*	3 00	3 50 de.	3.00	3.50 del.
Atlanta	1.90*	2 50*	1 90*	....
Cincinnati *delivered*	*1.75*	2 30	*1.75*	2.15
Los Angeles	1.75*	1.75*	1.85*	1.80*
Detroit	1 90*	2.00	1.90*	2.00*
Baltimore	1.75*	1.75*	1.65*	1.75*
Montreal	2.00*	2.00*	2.10*	2.10*
Birmingham *delivered*	3.20	....	3.10	....
Philadelphia	1.70*	....	1.55*	....

*Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plants:

	1½-In.	¾-In.	Roofing	Sand
Youngstown District	$1.30	$1.30	$2.00	$1.30
Steubenville District	1.40	1.40	2.00	1.40
Ironton District	1.40	1.40	2.00	1.40
Emporium, Pa.	1.25	1.25	....	1.25
Easton, Catasaqua, Pa	1 00	1.00	2.00	0.90
Birmingham, Ala.	1 05	1.15	2.05	0.80
Buffalo, N. Y. and Erie, Pa.	1.25	1.25	2.25	1.25
Cleveland, Ohio	1.20	1.20	....	1.00
Eastern Pennsylvania and Northern New Jersey	1 20	1.20	2.00	1.20
Western Pennsylvania	1.25	1.25	2.00	1.25

LIME—Warehouse prices:

	Hydrated, per Ton Finishing	Hydrated, per Ton Common	Lump, per Barrel Finishing	Lump, per Barrel Common
New York	$15.70@$16.80	$12 50	$3.68	*$2.75@$3.18**
Chicago	18.00	....	....	1.40†
St. Louis	23.20	20.00	2.50†	2.50†
Boston	23 00	*19.50*	*3.80†*	*3.00†*
Dallas	25 00	....	....	2.50†
Cincinnati	15 10	12 50	10 75	12.50‡
San Francisco	22 00	18 00	....	1.75†
Minneapolis	29.00	22.00 (white)	1.70†	1.40†
Denver	24.00	....	..	2.70†
Detroit	18.00	16.00	....	17.00‡
Seattle	27 00	....	3.00†	2 75†
Los Angeles	30.00	30 00	....	3.00*
Baltimore	15.00	13.00	....	12.00‡
Montreal	*21.00*	21 00	15.00‡	11.00‡
Atlanta	18.00	*18.50*	2.00†	1.25†
New Orleans	....	17.25	1.75†	....
Philadelphia	13.00	11.50	10.50‡	9.50‡

*280-lb. bbl. (net). †Per 180-lb. bbl. (net). ‡Per ton—Refund of 10c. per bbl.

Minneapolis quotes brown lime; Kelly Is. white is $1.70, Sheboygan $1.55. Seattle quotes hydrated finishing lime in cloth sacks; paper sacks, $24.00 per ton.

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, f.o.b., exclusive of bags:

	Current	One Year Ago
Minneapolis (Rosendale)	$2.80	$2.80
Kansas City (Ft. Scott)	1.60	1.60
Atlanta (Magnolia)	11.00 ton	11.00
Cincinnati (Utica)	*1.77*	2.25
Boston (Rosendale) per bag	*.80*	2.35

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b. points listed *without bags*. Cash discount not deducted.

	Current	One Month Ago	One Year Ago
New York*	**$2.40**	$2.30	$3.10
New York, alongside dock to dealers	**2 30**	2.00	2.40
Jersey City	2.12	2.12	2.64*
Boston	2.50	2.50	2.87
Chicago	**1.97**	1.94	2.17
Pittsburgh	2.02	2.02	2.17
Cleveland	2.26	2.26	2.43
Detroit	2.17	2.17	2.51
Indianapolis	2 21	2.21	2.31
Toledo	2.20	2.20	2.51
Milwaukee	**2.18**	2.13	2.39
Duluth	1.95	1.95	2.10
Peoria	**2 08**	1.98	2.43
Cedar Rapids	**2 21**	2 11	2.51
Davenport	**2 16**	2.06	2.47
St. Louis	2 20	2 20	3.40
San Francisco	2.73	2.73	3.09
New Orleans	*3.00*	3.20	3.36
Minneapolis	2.24	2.24	2.41
Denver	2 90	2.90	3.10
Seattle	2.94	2.94	3.10
Dallas	*2.25*	2.40	2.85
Atlanta	2 39	2.39	3.00
Cincinnati	**2.35**	2.32	2.57
Los Angeles	3.30	3.30	3.21
Baltimore*	2.50	2.50	3.58*
Birmingham	2.27	2.27	....
Kansas City	2.40	2.40	2.76
Montreal	2 40	2.40*	3.44
Philadelphia	2.21	2.21	....
St. Paul	2 24	2.24	2.41

NOTE—Bag 10c. each, 40c. per bbl.;

Current mill-prices per barrel in carload lots, without bags; to contractors:

Buffington, Ind.	$1 70	Mason City, Ia.	$1.95
Universal, Pa	1 75	Hudson, N. Y.	1.90
Steelton, Minn.	1.75	Leeds, Ala	1.95
Fordwick, Va	1.95	Hannibal, Mo.	1.85
Mitchell, Ind	1 95	Lehigh Valley District	1.70
LaSalle, Ill.	1.70	Kingsport, Tenn.	1.95
Iola, Kan.	1 95	Richard City, Tenn.	1.95

*Delivered by truck at site of work.

TRIANGLE MESH—Price per 100 sq.ft. in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh, Mill	Warehouse: New York	Chicago	Dallas	San Francisco
032	22	$0.68	$1 08	$0 76	$1.15	$1 15
049	28	87	1 33	98	1 46	1 48
068	35	1.05	1 58	1 18	1 80	1 80
093	45	1.35	1 99	1 52	2.30	2 32
126	57	1.65	2 43	1 87	2.86	2 87
153	68	1 97	2.88	2 23	3.40	. .
180	78	2 26	3.28	2 56	3.93	. .
245	103	2 99	4 29	3 38	5.15	. .
282	119	3 45	4 95	3 90	5.96	6 01
336	138	4 00	5.72	4 52	7.32	. .
395	160	4 64	6 61	5.20	8.00	. .

PAVING

036P	17	$0.52	$0 83	$0 58	$0 88	. .
053P	24	.73	1 14	.82	1 24	. .
072P	31	.91	1 40	1 00	1 57	. .
097P	40	1 18	1 77	1 29	2 02	. .
049R	24	.73	1 14	.67	1.24	. .
067R	31	91	1 40	1.00	1 57	. .
084R	40	1 18	1 77	1.29	2.02	. .

In rolls 16-, 20-, 24-, 28-, 32-, 36-, 40-, 44-, 48-, 52-, and 56-in. wide and in 150-, 200- and 300-ft. long lis Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in wide x 150 ft. long, or 600 sq. ft.

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted are as follows:

Gage	Weight	*New York	Chicago	St. Louis	San Francisco	Dallas
27BB	2.3	$21 20	$21 38	**$21 25**	$23 87	$25 50
26BB	2.5	22 65	22 90	**22 75**	26 21	27 56
25BB	3.0	25 30	.	27 10		30 71
24BB	3.4	27 10	27 38	**29 25**	27 90	33 16
22PO	4.33	31 75	29 56	31 75		35 10

* Price to contractors at warehouse or delivered on job in Manhattan, Bronx or Brooklyn.

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Inches	Pittsburgh Mill	Birmingham Mill	Warehouse, Uncut: New York	Chicago	St. Louis	Dallas	San Francisco
½ and larger	$1 50	$1 60	$2 08	$2 28	$2 50	$3 50	$2 75
⅝ and larger	1 55	1 65	2 13	2 33	2 55	3 55	2 80
¾ and larger	1 60	1 65	2 18	2 38	2 60	3 60	2 85
⅞ and larger	1 75	1 70	2 33	2 53	2 85	3 75	3 00
1 and larger	2 00	1.70	2 58	2 78	3 00	4 00	3.25

Includes 15c charge for cutting to lengths of 2 ft and over. Twisted bars cut to length take extra of 27½c. per 100 lb.

ROLLED FROM RAILS

	Chicago	St. Louis	Dallas		Chicago	St. Louis	Dallas
½ and larger	$1 50	$2 25	$3 25	½	$1 75	$2 60	$3 50
⅝ in.	1 55	2 30	3 30	¼	2 00	2 75	3 75
1	1 60	2 35	3 35				

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common: Current	One Month Ago	One Year Ago	Paving Block: 3-inch*	4-inch*
New York (del.)	$19.40@19.90	$21.40	$21 70	$44 50	$49 50
New York (at dock)	16.40@16.50	18 00			
Chicago	11 00	11 00	15 00	34 00	42 00
St. Louis, salmon	16 00	17 00	15 00	37 50	37 50
Denver, salmon	12 00	14 00	14 00		
Dallas	11 15	11 00	18 50	no market	
San Francisco	15 00	15 50	18 00		44 38
Los Angeles	15 00	15 00	15 50	(not used)	
Boston (del.)	16 00	16 00	25 00	46 50	52 60
Minneapolis (del.)	15 00	15 00	18@20		43 00
Kansas City	14 50	14 50	22 00		
Seattle	14 00	14 00	19 00		
Cincinnati	17 00	17 00	21 00	41 00	36 50
Montreal (del.)	16 00	16 00	18 00		
Indianapolis	16 50	16 50	18 00		
Baltimore (del.)	20 00	20 00	20@25	36 00‡	
Atlanta	9 00	8 25	12 00	34 00	
Memphis	12 50	12 50	21 50		
Birmingham	9 50	10 50			
Philadelphia	16 00	16 00			42 00

* Top paving blocks 3 x 11 x 3 and 3 x 8 x 4 respectively. † Delivered at plant, Baltimore.

HOLLOW TILE—Price per block in carload lots to contractors for 12-in. load-bearing tile:

	New York: Current	New York: One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Perth Amboy, N. J.	
	Top	Arch						Top*
4x12x12	$0.11120	$0.1895	$0 0821	$0 095	$0 08	$0 09		
6x12x12	.16070	.2526	.0950		.11	.116		
8x12x12	.20840		.1295	.175	.145	.244	$0 17800	
10x12x12			.1584		.16		.22000	
12x12x12			.1611	.255	.22		.27370	
8 in. partition								
			4x12x12		8x12x12		12x12x12	
Boston			$0 [illegible]		$ [illegible]		$ [illegible]	
Minneapolis (del.)			.0672		.115		.155	
Minneapolis (cash)			.0757		.1125		.155	
Cincinnati			.0670		.1263		.173	
Kansas City			.085		.167		.274	
Denver			.08		.14		.21	
Seattle			.12		.25		.35	
Los Angeles factory			.095		.17		.24	
Cost f.o.b. yard			.1				.3	
Detroit, f.o.b. yard			.070		.135		.275	
Memphis							.24	
Birmingham			.14					
Atlanta			.0657½		.1013			
Dallas			.115					
Birmingham								

San Francisco, Philadelphia and New York quote on hollow partition tile.

STRUCTURAL MATERIAL—Following are base prices f. o. b. mill, Pittsburgh and Birmingham together with quotations per 100 lb. from warehouses at places named:

	Pittsburgh, Mill	Birmingham, Mill	New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in.	1.50	$1 65	$2.48	$4 00	$2 57½	$2.38	$3 10
Channel, 3 to 15 in.	1.50	1.65	2.48	4.00	2 57½	2.38	3.10
Angles, 3 to 6 in., ¼ in. thick	1.50	1.65	2.48	4.00	2 57½	2.38	3.10
Tees, 3 in. and larger	1.50	1.65	2.48	4.00	2 57½	2.38	3 10
Plates	1.50	1 65	2.48	4 00	2 57½	2.38	3 10

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Pittsburgh, Mill	New York—Current	New York—One Yr. Ago	Chicago	St. Louis	San Francisco	Dallas
½ in. and larger	$2.00@2.10	$3.35	$5 08	$3 00	$2.60	$4.50	$5.50

CONE HEAD BOILER

½ in. and larger	2.10@2.20	3.45	5 18	3.10	2.70	4.60	5 65
⅝ and ¾	2.25@2.35	3.61	5.33	3.25	2.86	4 75	5 80
⅞ and 1	2.50@2.60	3.85	5 58	3.50	3.00	5.00	6.05

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in. take an extra of 25c.

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh, Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire	$2.40	$3.15	$3 90	$5.00	$2.70	$4 95
Cut	2.25	5.80	5.90	7.75		5 00

PREPARED ROOFINGS—Standard grade rubbered surface, complete with nails and cement, costs per square as follows:

	New York: 1-Ply Incl.	New York: 2-Ply Incl.	New York: 3-Ply Incl.	Philadelphia: 1-Ply Incl.	Philadelphia: 2-Ply Incl.	Philadelphia: 3-Ply Incl.
No. 1 grade	$2 02	$2 38	$2.80	$1 92	$2 28	$2 70
No. 2 grade	1.77	2 08	2 45	1 67	1 98	2.35

Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs $1.95 per roll in carload lots and $2.20 for smaller quantities f.o.b. Philadelphia.

Shingles, red and green slate finish, cost $5.50 per square in carloads; $5.75 in smaller quantities, in Philadelphia.

ROOFING MATERIALS—Prices f.o.b. New York:

Tar felt (14 lb. per square of 100 sq.ft.) per roll of 432 sq.ft.	$2 00
Tar felt, on 400-lb. basis, per 100 lb.	1 60
Asphalt roofing (in barrels), per ton, f.o.b. plant*	47.50
Asphalt felt (light), per ton, f.o.b. plant*	67.00
Asphalt felt (heavy), per ton, f.o.b. plant*	68.50

* Delivered in Metropolitan Dist., $3.00 additional.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill.

Blue Annealed	Pittsburgh, Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10	$2.25	$3 47½	$3.38	$3 95	$3 28
No. 12	2 30	3 52	3 43	4 00	3 33
No. 14	2 35	3 57	3 48	4 05	3 38
No. 16	2 55	3 67½	3.58	4.15	3.48
Black					
Nos. 18 and 20	2 85	3 55	3 95	5 25	3 80
Nos. 22 and 24	2 90	3 70	4 00	5 30	3 85
Nos. 26	2 95	3 85	4 05	5 35	3 90
*No. 28	3.00	4 15	4 15	5 45	4 00
Galvanized					
Nos. 10	3 00	4 15	4 15		
Nos. 12	3 10	4 25	4 25	5 40	
Nos. 14	3 10	4 25	4 25	5 40	
Nos. 17 to 23	3 40	4 45	4 45	5 70	
Nos. 24 and 25	3 55	4 70	4 70	5 85	
Nos. 26 and 27	3 70	4 85	4 85	6 00	
Nos. 28	4 00	5 15	5 15	6 30	

* Two gauges heavier than No. 28 gauge. Less than carload lots, 24 gauges and heavier, 48 gauges.

WHITE AND RED LEAD—Base price in cents per pound:

	Red				White	
	Current		1 Year Ago		Current	Yr. Ago
	Dry	In Oil	Dry	In Oil	Dry or In Oil	Dry or In Oil
100-lb. keg	12 25	13 75	13 00	14 50	12.25	13 00
25 and 50-lb. kegs	12 50	14 00	13 25	14 75	12.50	13 25
12½-lb. keg	12.75	14 25	13 50	15 00	12.75	13 50
5-lb. cans	15 25	16 75	16 00	17 50	15 25	16 00
1-lb. cans	17 25	18 75	18 00	19 50	17 25	18 00

LUMBER

Prices wholesale to dealers in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in more than carload lots. To contractors, $2 per M ft. additional.

Lumber Prices to Contractors in Yards at San Francisco

	6–8 and 12 Ft.	10–16–18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$26 00	$26 00	$27 00	$32 00
3x6 and 8	27 00	27 00	28 00	33 00
4x4–6 and 8	27 00	28 00	29 00	34 00
3x10 and 12	27 00	28 00	29 00	34 00
3x14	31 00	32 00	33 00	35 00
4x10 and 12	27 00	28 50	29 00	34 00
4x14	31 00	32 00	33 00	35 00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft
6x10	$29 00	$32 00	$34 00
6x14	31 00	34 00	36 00
8x10	29 00	32 00	34 00
8x14	31 00	34 00	36 00

New York, Chicago, St. Louis and Detroit—Wholesale prices to dealers of long leaf yellow pine.

	New York*		Chicago	
	20 Ft. and Under	22–24 Ft.	20 Ft. and Under	22–24 Ft.
3x 4 to 8x8	$38 00	$39 00	$37 00	$39 00
3x10 to 10x10	41 00	42 00	39 00	41 00
3x12 to 12x12	44 00	45 00	41 00	43 00
3x14 to 14x14	47 50	48 50	45 00	47 00
3x16 to 16x16	52 50	53 50	50 00	52 00
3x18 to 18x18	60 00	61 00	56 00	58 00
4x20 to 20x20	70 00	71 00	63 00	65 00

* Wholesale price to dealers; to contractors on lighters or cars, about $5 additional. Short leaf pine up to 14 x 14 costs $15 per M. less

St. Louis: Yellow pine, 100 20 ft long, 3 x 4 to 6 x 6, $20 00; 3 x 8 to 8 x 8, $19; 3 x 12 to 5 x 12, $25; 3 x 14 to 5 x 14, $28; 3 x 16 to 4 x 16, $32; 12 x 14 to 14 x 14, $27; 3 x 10 to 10 x 10, $21; 3 x 18 to 4 x 18, $38; 12 x 16 to 16 x 16, $31.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12 x 12 and under, for sizes over 12 x 12 add $2, for merchantable add $2 to sizes 10 x 10 and under. For pine add $2 to the price of merchantable for all sizes.

Other Cities

	8 x 8-In. x 20 Ft. and Under			12 x 12-In. 20 Ft. and Under	
	P.	Fir	Hemlock	Spruce	P.	Fir
Boston	$50.00	$52 00	$55.00	$45.00	$54 00	$52 00
Seattle		20 00				20 00
New Orleans	20 00				25 00	
Baltimore	36 45				38 50	
Cincinnati	39 00	50 00			40.00	64 00
Montreal		47 00	35.00	35 00		47 00
Los Angeles		44 00	43 00			44 00
Denver		33 75	33 75	33.75		34 75
Minneapolis	40 00	38 00	38 00		47 00	37 00
Atlanta	30.00				36 00	
Dallas	33 00				33 50	
Kansas City	33 00	34 00			36 00	35 00
Birmingham	20 00				26 00	
Philadelphia	35 00	36 00	39.00	44.00	44.00	36 00
Detroit	40 00	43 00			45 00	44 00

	1-In. Rough, 10 In. x 16 Ft.		2-In. T. and Gr. 10 In. x 16 Ft.	
	P.	Fir and Under	Hemlock	P.	Fir
Boston	$47 00	$48 00	$32 00	$45 00	$48 00
Seattle		16 00			19 00
New Orleans, at mill	63 00			32 00	
Baltimore	35 00			36 45	
Cincinnati	62 50	80 00		33 50	
Montreal	66 00	48 00	35 00		45 00
Los Angeles		37 00	36 00		65 00
Denver		29 25	29 25		30 25
Minneapolis	38 50	36 25	34 25	36 00	34 75
Atlanta	17 00			21 00	
Dallas	32 00	30 00		36 00	
Kansas City	35 00	34 50		20 00	31 00
Birmingham	18 00			18 00	
Philadelphia	28 00	31 00	40.50	30 00	34 00
Detroit	42 00	33 75		38 50	36 25

Montreal—Up to 32 ft.: over which, $3.00 per M. increase up to 30 ft.
Birmingham—Quotes carload lots, f.o.b. sidings. $2 additional per M. ft. to contractors.
Boston and Cincinnati—Prices to contractors in carload lots, f.o.b.
Denver—Quotes dealers prices to contractor on large projects.

FREIGHT RATES

On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

Baltimore	$0 33½	Detroit	$0 32½
Birmingham	76½	Kansas City	81½
Boston	40½	New Orleans	51½
Buffalo	29½	New York	38
Chicago	38	Pacific Coast (all rail)	1 66½†
Cincinnati	325	Philadelphia	35
Cleveland	24	St. Louis	47½
Denver	1.35*	St. Paul	66½

* Minimum carload, 40,000 lb.
†Minimum carload, 50,000 lb., structural steel only; 80,000 lb. for other iron steel products.

CONTRACTORS' SUPPLIES

STEEL SHEETPILING—The following price is base per 100 lb. f. o. b. Pittsburgh, with a comparison of a month and a year ago:

Current	One Month Ago	One Year Ago
$1.75	$1 80	$2.25

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern Territory New York and East of Missouri River
Hercules red strand, all constructions	30%
Patent flattened strand, special and cast steel	30%
Patent flattened strand, iron rope	15%
Plow steel round strand rope	45%
Special steel round strand rope	40%
Cast steel round strand rope	32½%
Round strand iron and iron tiller	15%
Galvanized steel rigging and guy rope	17½%
Galvanized iron rigging and guy rope	+2½%

California, Oregon, Nevada and Washington Discount 5 points less than discount for Eastern territory.
Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.
Arizona: Discount 10 points less than discount for Eastern territory.
Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.
North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ¾-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ¾-in., 8 ft., ½-in., 6, ¼-in., 4½; 1-in., 3½; 1½-in., 2 ft. 10 in.; 1¼-in., 2 ft. 4 in. Following is price per pound for ¾-in. and larger, in 1200-ft. coils:

Boston	$0 20	New Orleans	$0.17½
New York	17	Los Angeles	16½
Chicago	19	Seattle	16½
Minneapolis	19½	St. Louis	15
San Francisco	17	Montreal	30
Atlanta	20	Detroit	19
Denver	20	Baltimore	20
Cincinnati	20	Kansas City	18½
Dallas	29	Birmingham	20½
Philadelphia	17		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0.2950	$0.3250
Boston	.24	.275
Kansas City	.24	.2750
Seattle	.1575	.1875
Chicago	.2450	.2750
Minneapolis	.2144	.2347
St. Louis	.2475	.2775
Denver	.2250	.2550
Dallas	.29	.375
Los Angeles	.23	.26
Atlanta	.2575	.2925
Baltimore	.2550	.27
Cincinnati	.2350	.255
Montreal	.215	.255
Birmingham, *delivered*	.155	.175
New Orleans	.2725	.3075
San Francisco	195	.23
Philadelphia	.24	.27

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York.

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in	30 to 50 ft.	$0.14	$0 19
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	0.18½	0.25
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	0.21	0.27½
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	0.24	0.32½
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	0.26	0.34½
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	0.33	0.42

SCRAP—The prices following are per gross ton paid to dealers and producers in New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

	New York	Chicago	St. Louis
No. 1 railroad wrought	$12 00	$11 50	$12 00
Stove plate	12 00	12 00	13 50
No. 1 machinery cast	18 00	16 50	14 50
Machine shop turnings	5 50@6 50	4 00	5 00
Cast borings	9 00@9 50	5 50	6 75
Railroad malleable cast	10 00	12 50	10 25
Re-rolling rails	11@11 50	13 00	15 00
Relaying rails	28 50@29.50	30.00	15.00

SHIP SPIKES—Current prices per 100 lb.:

In.	San Francisco Galv.	San Francisco Black	Seattle Black
½	$9 10	$7 40	$8 55
⅝	8 65	6 65	8 25
¾	8 50	6 50	8 30
½			

Pittsburgh base in lots of 200 kegs or more $2.15@2.25

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. McGRAW, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

Volume 88 — NEW YORK, APRIL 13, 1922 — Number 15

Dayton Meeting a Success

IN THE record of gratifying success made by the American Society of Civil Engineers in its Dayton meeting there lies far more than an isolated fact in the society's career. The meeting marks an epoch in the life of this great professional body. Long tied up in rather rigid and routinized practices, the society broke away from these and for the first time held a regular meeting away from headquarters. It took the meeting to the members out in the field. The response was a surprisingly large attendance and an intense interest. No one who was there entertains the slightest doubt that there will be similar response to other meetings of the kind. Thus Dayton ushers in a period of new vigor and vitality in the society's existence. There is no longer the doubt that for some time maintained itself, as to whether the common or garden member is or is not interested in the society's doings. He is; and he will respond with stimulating activity on his part to all genuine activity on the part of the society. In view of this manifest desire for leadership it is unfortunate that the board of direction was unable to reach definite conclusions as to any of the important administrative questions now before the society.

End of Miami Construction

DURING the current season the last work will be done on the Miami Conservancy District construction. The Dayton meeting was a fitting and quietly impressive valedictory, as was remarked by the most energetic and resourceful promoter of the project. So quickly has the work run along during the four-year construction period that it has attracted far less notice than it deserves. As a detail, it progressed to completion without incident or accident. One of its greatest distinctions, however, is that virtually every element of the work embodies new methods, research discovery, or development of better practice, to a degree that makes this one enterprise a splendid model. As it has been a great school for the chosen group of engineers who were engaged in it, so it will long be a school for all concerned with hydraulic engineering in any phase, and flood-protection in particular.

Flood Problem Appreciated

DURING the nine years since the disastrous flood in the Miami Valley the shadow of the great flood problem throughout the country has ever been discernible. But various obstacles prevented its full and general recognition; at first, perhaps, the newness of the problem, and later the distraction of the war. At Dayton, however, the flood problem came to occupy at least its true place of importance, and those who attended the meeting quite evidently received a lasting impression of what they had neglected to notice in the past. More truly today than ever, floods and protection against them constitute one of the great problems [illegible]

ties confronting the civil engineering profession. As yet the public at large has not come to realize the gravity of the situation. When engineers appreciate it, however, there is good foundation for the coming public understanding; and this foundation has now been laid.

Scientific Concreting

IT IS rare enough that over 400,000 cu.yd. of concrete is placed on one construction job to make the detailed story of how and where that concrete was placed worth while. For that reason the articles in this and the last issue on the Queenston-Chippawa project are valuable records. But the important feature of this Ontario concreting job is not its magnitude but the remarkable uniformity of concrete that was obtained over a stretch of thirteen miles with different materials and with nearly a score of concreting plants. These varied from the large central plants at the power house and Whirlpool turning out as much as 800 yd. a day to the little pavers which ran along under their own power on the canal bottom. All operations, however, were controlled by a single head who was concerned just as much with the source of material as with the mixing and placing and finally the testing. This central control is common enough nowadays but not often has the actual placing of the concrete been so responsive to the testing and investigative activity. The high degree of strength uniformly achieved justifies such scientific control.

Construction Federation

IT IS regrettable that the men of the construction industry did not turn out in large numbers at Chicago last week in order to profit by the excellent review offered at the meeting of the National Federation of Construction Industries of the factors entering into a construction revival. Had there been a large and enthusiastic assemblage it is possible that the conference might have had some influence on the construction situation. As it is, the only general benefit would seem to be the demonstration that the National Federation of Construction Industries as now formed cannot be made truly representative of the industry. It has been looked upon by architects, engineers, and contractors as a federation of materials manufacturers. Consequently, despite the earnest efforts of the officers of the federation these three classes have held aloof. Yet it was very apparent from the Chicago meeting that there is felt a widespread need for some body that will, as occasion demands, be able to bring together on a footing of equality all of the interests concerned with construction. In fact, it is understood that out of the Chicago meeting will come discussions aimed at either the re-organization of the federation or the constitution of a new body that will win the support of all parties. Should these projected discussions result in an effective organization there will be lasting benefit, though indirect, from the small meeting of last week.

Ultrademocracy or Mobexpertocracy?

POPULAR defiance of the advice of the California State Board of Health, of the city engineering department of Los Angeles and of eminent consulting engineers has resulted in the sewage-disposal complications that are set forth elsewhere in this issue. Three times in the last six years have the people of Los Angeles defeated proposed bond issues to meet a sewage disposal situation that was constantly growing more serious. A fourth vote has recently been ordered for Aug. 12. Its outcome will be awaited with interest. Meanwhile, the city is under an injunction against the discharge into a creek of excess sewage, beyond the capacity of the ocean outfall. The State Board of Health, the court that issued the injunction, and a committee of the local section of the American Society of Civil Engineers have each given advice, largely conflicting, designed to meet the emergency. This entire series of events at Los Angeles is without parallel in the whole history of sewage disposal in America. Could one delve widely and deeply enough into local conditions it might be found that quite other than engineering factors are responsible for the fact that a city that prides itself on its large and growing population, its blessings of nature and its democracy should make such a spectacle of itself as has Los Angeles. Can it be that the trouble is ultra-democracy—a distrust by the little-informed many of the specialized knowledge of the few? Or is it a case of "mobexpertocracy" such as was displayed in another California city not long ago (see *Engineering News-Record,* June 14, 1917, p. 563) when for some years Sacramento citizens preferred their own ideas rather than those of competent engineers as to what was the best plan for a new water supply but had so many different ideas that they could agree on none of them?

Menace of County Control

INDICATIONS are found in various sections of the country of an attempt to wrest control of highway construction from the states and return it to the counties. While the movement has not been organized, it has cropped out frequently enough to warrant concern on the part of state highway officials. County politicians have looked with envious eyes upon the large sums of money that are being spent under state control. With a slice of these funds at their own disposal opportunities for the distribution of patronage and for work by their contractor constituents would be rich indeed. During recent years the whole trend of highway legislation has been toward a centralization of control in the state highway departments and the organization of a properly qualified engineering corps to direct design and construction. Counties, as a general rule, are not in a position to give to highway work the efficient administration and skilled technical supervision which the state department can furnish. It has taken years to build up our state highway departments to their present point of efficiency, and action is now needed to forestall any movement having for its object the reversion of control from the state to its lower political subdivisions. The Federal Highway law, enacted last year, recognized the principle of a connected system of highways—as against the piecemeal construction of former years—and made the supply of federal aid dependent upon adequate state control. It would be a severe blow to highway development if the state control which it has taken so long to build up were weakened. The highway program of the states today involve such large sums of money that honest, impartial control of them is demanded. The state, not the county, is the agency to administer these funds and supply the skilled engineering supervision which road-building now demands.

Continuity of Construction Required

PREVIOUS cost records may prove highly unreliable as a guide to the cost of new work unless the relative efficiencies of the directing organizations are evaluated. If the work being taken as a guide was conducted by experienced foremen and crews and a new organization has to be assembled for the contemplated work, the old costs will be too low. These facts mean more than a warning to contractors to use caution in compiling bidding prices from the figures of costs kept on previous operations. Repeated creation of new organizations to direct construction is one of the cost-penalties of present contracting practice. Except for large construction companies, with country-wide operations, the foremen, machine operators and skilled workmen are assembled anew for each season's work. This will continue as long as six months of the year are idle time with most contractors. Winter construction is only an occasional practice. Also contracting is too specialized to permit many contractors to shift from their usual summer operations to the kind of work that can be done well in the winter. This is especially true of highway contracting. Few paved road contractors have the equipment or the experience to do winter building or tunneling or heavy excavation, and they, therefore, break up their organizations every fall and assemble new organizations every spring. Extension of the construction season and continuity of employment are contributions toward the revival of industry which engineers and contractors are called upon to undertake.

Mid-West Cement Boycott Off

ROAD building in the Middle West on a larger scale than ever before is assured. State contracts for cement which have been pending for a month or more have now been let and contracts for the individual mileages are being opened rapidly. The boycott, so called, of Wisconsin, Illinois, Indiana and Michigan against cement has been dropped, and that without material price concessions.

Michigan has signed up for 1,120,000 bbl., which will build about 340 miles. Illinois on April 6 announced the placing of 2,700,000 bbl., bringing the total purchase to 3,600,000 bbl., enough for its 1,000-mile program. On March 31 Illinois received bids on 95 miles of road. Indiana on April 6 added 110,000 bbl., to the 212,000 bbl. purchased in March and has yet to apportion an additional 200,000 bbl. to the various cement companies, enough to build about 150 miles. Wisconsin last month bought 1,500,000 bbl. for its 450-mile quota, of which more than 220 miles have been let to the individual contractors.

As these states, which are the principal ones that buy cement and furnish it to the contractors, each have as large or larger programs than ever before the road building stage in the Middle West is set for an unprecedented program.

The effect of the boycott on prices has been insignificant, but we may hear from it later. The price con-

cessions which were announced as the object of the boycott have not been secured. Where there have been sizeable concessions, they have been offset by the condition that the cement must be taken in large quantities early in the season and warehoused at the State's expense.

But there may be another result, shortage of cement in the late summer or fall, or a number of mills shut down part of their capacity on account of the boycott. We may, therefore, hear echoes of the boycott some months from now.

Just now the interesting fact is that the boycott has been lifted and that four of the states with large road programs are not to hold up their work any longer.

New Developments in Rock Tunneling

WITHIN recent years new conditions have developed in the West that have brought about a readjustment of hard rock tunneling methods. For the most part the changes have not been along the line of refining and perfecting old methods, the outstanding factors, rather, being the more positive call for speed arising from the economic demands of hydro-electric service, the advent of the mucking machine and the increase in size of tunnel heading sections. The demand for speed is doubtless the most important of these. While in some cases favoring speed over cost is fully justified, there is a fair chance through the use of modern methods and equipment that speed, the all important consideration, can be greatly increased without excessive cost, as is pointed out in the article by R. C. Starr in this issue. With both cost and speed thus involved by new conditions, the whole subject of hard rock tunneling methods comes up for readjustment.

The demand for speed is especially great in hydro-electric practice because tunnels are often the limiting factor in the time required to get new power projects into service. The need for water power has become more urgent in the West as oil prices have increased and rapidly growing communities and industries have created a power demand that brooks no delay. Agricultural development of the San Joaquin Valley in California, for example, was being held back because power for pumping irrigation water was not available. The Kerckhoff tunnel was the limiting factor in getting water on the land and the result was remarkable speed in driving that tunnel. A bonus was offered for all shots that pulled over 16 ft. and during the last ten days of the work a larger bonus was offered for the best record in an 8-hour shift. These inducements produced results; rounds over 20 ft. deep were pulled and the work was completed quickly enough to attain certain highly important objectives. Even so, the total costs on this tunnel were no more, according to Mr. Starr, who had charge of the work, than on other tunnels of the same size and driven under the same conditions but without the means used here to speed up the work.

Not all engineers will agree with this method of offering bonuses. It is pointed out, for example, that a bonus for special shots, or even for the best shift record, is apt (1) to breed carelessness in the amount of powder used, (2) to cause overbreakage, and (3) to encourage the endeavor to make a spectacular shot at the expense of progress on the following shift. The substitute suggested is a bonus for the highest monthly average or any plan that would encourage teamwork among the three shifts.

In the last year or two mucking tunnels by power shovel has gained popularity so rapidly that it is now standard on tunnels 17 ft. square or larger. Even steam shovels with cut-down booms and dipper sticks cannot be used to advantage in tunnels of less than 17 x 17-ft. section, and if the section required approaches this size it is not infrequently increased for the express purpose of permitting the use of power shovels. The moving of the larger yardage thus entailed is justified by the lower cost per yard. While this practice of making the tunnel larger than necessary works out very nicely in hard rock, it would unduly increase the cost if applied in formation that required timbering. The situation therefore suggests the need of something in between the present mucking machine and the steam shovel. Various types of mucking machines in common use are advantageous for tunnel sections up to about 12 ft. square. Beyond that and until the section becomes large enough for two machines or for steam shovels, there is a gap in which mechanical mucking is not now being applied to good advantage. In fact, in this range of 12 to 17 ft. hand mucking has occasionally been used as the most expeditious means available.

The mucking machines used in Western power-tunnel work are the same as those built for the mining field, where large tunnels are not common; in other words, the civil engineer is using equipment developed to suit the requirements of the mining engineer. In view of the amount of large power-tunnel work to be done in the West within the next few years—$250,000,000 worth, Mr. Starr says—attention to this need should be a profitable venture.

With good teamwork, now less common than formerly, crews are able to work to best advantage on short rounds, but with inefficient labor longer shots are more economical. Standard practice in Europe has been toward much shorter rounds than are used in this country. In the Loetschberg tunnel, for example, the practice was to use 4-ft. rounds. This is in striking contrast to the 20-ft. rounds in the Kerckhoff tunnel. Although the Kerckhoff job probably represents an extreme, yet the tendency is unmistakably toward long rounds. In the South Fork heading, the hardest rock on the Hetch Hetchy tunnels, where the tunnel width is slightly over 13 ft., the average pull is 12 ft. or a little more. As tunnel sizes increase, deeper holes can be drilled without making the central angle of the V-cut too sharp for the best powder effect. The large-size power tunnels now being built or projected are introducing new problems in drill design and the manufacture of drill steel.

With the present high mucking costs (whether by hand or machine) it is more important than ever to place and load holes so that the muck will be well broken up but at the same time piled close to the heading, where it can be handled economically. On this score a well known Western tunnel builder recently said, "It is a great mistake to fill drill holes with powder; the most economical basis is to load them for six-tenths of their depth. If the character of the rock is such that a hole of a certain depth cannot break it when six-tenths full of powder, the depth of the holes should be decreased until they can be so pulled."

Until recently rock tunneling was mainly a railroad operation and like most railroad engineering it tended to become over standardized. New requirements and new thought came with the big water tunnels and they are beginning to reflect on practice.

Modern Practice in Driving Western Hard-Rock Tunnels

A Discussion of Factors Affecting Size, Progress and Cost in Large Power Tunnels; Depth and Relation of Drill Holes, Heading and Mucking Methods

By R. C. Starr
Construction Engineer, San Joaquin Light & Power Corp.

IN THE construction of the large mileage of hard-rock tunnels that have been built for power purposes in the West within the last few years, no radically new methods of driving have been developed, but modern conditions and equipment have changed the importance of various factors bearing on cost and speed. The substitution of mechanical for hand mucking, for example, has changed the problem of determining economic sizes. Mucking with machines has affected the depth and relation of drill holes by placing a premium on that combination which would most effectively prevent the muck from scattering; while the expense attaching to extra movings of drill carriage or mucking machine has placed new penalties on "boots" that require re-shooting. Altogether, with the large savings that can now be effected by driving tunnels at high speed, good practice in hard-rock tunneling methods is now very different from what it was five years ago. In this article it is the author's purpose to record ways and means that have been found advantageous under present conditions and to discuss reasons for using certain methods in certain cases.

Power Intake Tunnels.—In the early development of the water-power resources of the West, many open ditches and flumes were constructed to carry the water from the intake to the head of the penstocks, but nearly all the water conduits built during the past ten years are tunnels, and tunnels will be built in the future in connection with hydro-electric development.

Five factors are largely responsible for this: (1) Nearly all economical hydro-electric projects yet undeveloped are in mountainous country, where slides, rolling rocks, and damage from forest fires make open ditches and flumes costly to maintain, and the uncertainty of their operation makes a higher percentage of reserve steam power necessary than is the case with hydro-electric plants whose water conduits are underground. (2) Due to the fluctuating daily load and the wide variation in summer and winter stream flow, a considerable part of the friction losses in the water conduits is saved by the use of pressure tunnels. (3) To decrease the amount of steam reserve power, which is steadily increasing in cost, due to the increasing price of oil, future hydro-electric developments will largely consist of plants with large storage reservoirs, which will store the flood waters and make them available during months of low stream flow. The entire available fluctuating head of the reservoir is made available at all times by the use of pressure tunnels. (4) Due to the length of time required for water to travel from the intake to the forebay, it requires considerable time for the load dispatcher to change the load on an open-conduit plant, and in case of trouble a considerable amount of water is wasted. Moreover, this type of plant cannot be used as a governing plant without a large forebay, which ordinarily is impracticable in mountainous country. (5) Due to advances in tunnel driving, the cost per foot of tunnels for given capacities has not increased so rapidly as the cost of flumes and open conduits.

Practically all important power companies of the Pacific Coast now have tunnels in service, under construction or proposed, in some cases all three. The amount to be spent in the next ten years in California alone for hydro-electric power development is conservatively estimated at $250,000,000 and it is safe to say that one-third to one-half of this will be expended on tunnels. In view of this situation, tunnel-driving methods warrant careful consideration.

All of the proposed tunnels on the Kings, Kern and San Joaquin Rivers, as well as those already built or under construction, have been in hard rock. The material encountered, almost entirely granite, required practically no timbering. The size of these tunnels is determined primarily by hydraulic conditions, but the relative cost of lined and unlined tunnels for equal capacities has caused the adoption of unlined pressure tunnels in every case where hard rock of good quality and not too badly fractured was encountered.



FIG. 1. TYPICAL HORSESHOE SECTION
Pneumatic mucking machine at work in 13½ x 14-ft. Kern River Tunnel, San Joaquin Light & Power Corp.

Fig. 2 gives curves showing comparative costs of lined and unlined tunnels for equal capacities in hard granite. The enormous saving to be made by adopting the unlined tunnel section is evident. The two curves shown are for tunnels in hard granite acting as pressure conduits, figured for the same friction losses. For the lined tunnels the value of n in Kutter's formula was taken as 0.015, while the corresponding value for unlined tunnels was 0.035. Actual tests showed that the value n increases slightly with the increase in size of conduits and varies from 0.012 to 0.015 for lined tunnels and from 0.030 to 0.033 for unlined sections.

Shape of Cross-Section.—The shape of the cross-section of lined pressure tunnels is based upon two considerations: (1) Cost of concrete lining and (2) economy in driving. As a result, two sections have been



FIG. 3. RADIAL DRILLING FROM PIONEER HEADING

largely adopted; the circular section, which requires no reinforcing in hard rock, and the horseshoe section, which does require reinforcing. The horseshoe section is more easily excavated with mucking machines, and for that reason is now being generally adopted.

Nearly all unlined rock tunnels used as water conduits are built with a comparatively flat arch, nearly vertical side walls, and a flat bottom, as this section is most easily drilled and mucked. To decrease the friction losses in unlined tunnels, it is very important that the drill holes on the top, bottom and sides of the tunnel be placed as nearly parallel with the finished walls as possible, and it is also important that as few "boots" as possible be left in the tunnel. Other things being equal, friction losses are usually less in tunnels where the drilling was done in a direction opposite to the flow of water. Uniformity in cross-section area throughout the tunnel also tends to lower the friction losses.

Face Methods.—All tunnels in hard rock which are over 14 ft. high and 10 ft. wide and require practically no timbering can be driven most economically and most rapidly by the heading-and-bench method, using steam shovels operated on compressed air. Two other methods, the straight-face method and the pioneer-heading method, were tried when the Kerckhoff power tunnels were driven in 1919 and 1920, and after six months' trial of all three, the heading-and-bench method was adopted at all headings. The pioneer-heading method was used by the Southern California Edison Co. in its large hard-rock tunnel on the Big Creek No. 8 power project; but it also is now adopting the heading-and-bench method in all tunnels as being the most rapid and economical.

Heading-and-Bench Method.—With the heading-and-bench method, the bench used should have a length of about two-thirds the tunnel width and should be about 10 ft. from the roof. The drillers, two to four in number, depending upon the size of the tunnel, and an equal number of chuck tenders (all of these should be able to run a drill, at least in an emergency) drill the heading holes with drills mounted on cross-bars or columns, while the muck from the preceding shot is mucked out. A steam shovel operated on air, if properly designed as to size of dipper, length of boom and dipper stick, will muck out any round in 5 to 8 hours, if proper electric locomotives and cars and track facilities are provided. The proper number of drills should therefore be operated in the heading so that the drilling of the heading will be completed by the time the mucking is done.

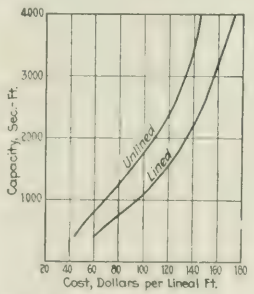


FIG. 2. COST OF LINED AND UNLINED TUNNELS IN HARD GRANITE

As soon as these two operations are completed, the bench is drilled from cross-bars with sufficient horizontal holes to insure the breaking to grade of the entire section drilled, and particular care should be taken in the location of these holes, as a high bottom delays the shovel progress materially. The drilling of the bench holes and the loading and shooting of the heading occupy from 8 to 16 hours, depending upon the difficulties encountered in "pulling" the cut shots. In hard rock, especially granites and trap rocks, it is necessary to shoot the cut shots at least twice, as it is essential that the cut holes be broken to the bottom of the holes, as the length of the round broken out depends upon this factor almost entirely.

The most successful shooting in large hard-rock tunnels is accomplished with what is called the double V-cut, which is made by drilling four vertical rows of holes at such an angle with the face that the two center rows meet on the vertical center line of the tunnel, and the two outer rows divide the distance between the nearest holes drilled parallel with the tunnel and the converging center rows.

The cut holes in solid granite are usually loaded with 60 per cent gelatin powder and are shot simultaneously by 440-volt alternating current and electric detonators before the side and bench holes are shot. Delay exploders are used for the later holes, and holes on opposite sides of the cuts in pairs are shot at the same instant, in order to prevent the scattering of the muck. It is very important that the numbers attached to the delay exploders properly represent their relative time of firing, as the explosion of the charges at the proper time is the



FIG. 4. STEAM SHOVEL MUCKING IN [illegible]
Tunnel No. 7 of Southern California Edison Co. [illegible]
lost to shovel and 2-in. plank housing

most important factor in insuring a good clean-breaking round and preventing the scattering of the rock far back from the face. The electric detonators are connected in parallel to two copper wires (usually No. 8) forming a bus strung up in front of the face. Particular care must be taken to see that all wires have good contacts and to see that the two wires leading from each detonator are connected to separate bus wires; to assist in this, two different-colored wires should be provided with all detonators.

The shooting line should be a separate line used for no other purpose and should be kept on the opposite side of the tunnel from all other electrical circuits. Before the bus wires are connected to it the shift boss should personally inspect all connections to see that everything is right. In this way, errors made in connecting the wires, due to haste, are often discovered and a poor shot is avoided.

Straight-Face Method.—With the straight face method, the entire heading is drilled after the mucking of the previous round has been completed, the drills being mounted upon cross-bars or columns which are often carried by a drill carriage. The drill carriage consists of a flat-car with working platforms for the drillers and chucktenders and racks for the drill steel. It also supports the columns and cross-bars while the car is moved up to the heading before drilling operations are begun. The drill carriage has permanently fastened to it all air and water pipes and manifolds, and very little time is required for setting up. With this method the drillers have no "mucking back" to do and there is no interference by the mucking crew to contend with. On the other hand no mucking can go on while the drilling is being done, and any delay in the mucking delays the commencement of the drilling, and vice-versa.

With the drill carriage, each round must be shot almost perfectly and a uniform vertical face left, so that the columns and cross-bars mounted upon the car can be placed within a reasonable distance of heading at all times. With this method, the double V-cut extending from top to bottom of the tunnel is used to the best advantage.

It is necessary to clean up practically all the muck in the bottom of the tunnel before the carriage can be moved into place, and no corners can be left in the face. As a result, before almost every mucking operation is completed, it is necessary to shoot one or two "boot" holes, with consequent delay. On the average, this method requires six hours more per round than the heading-and-bench method, and the saving in drilling costs is overbalanced by the additional mucking costs.

Pioneer-Heading Method.—With the pioneer-heading method, a small tunnel, large enough to permit the use of mucking machines, is driven ahead of the full-size heading, usually with its bottom grade coinciding with the bottom grade of the tunnel, and in a second operation the remainder of the tunnel section is drilled, shot and removed by steam shovels. All of the holes required for blasting out the full section can be drilled radially from the pioneer, and thus only a short time is required to remove the great mass of muck shot down from the radial holes. However, with this method the progress of the pioneer is very little faster than the progress which can be made by the heading-and-bench method when removing the entire section at one operation. Moreover, the cost of the pioneer bore is so great that the ultimate cost of the large tunnel is much greater than when the heading-and-bench method is used.

Costs and Comparisons.—In the adjoining Table I, which shows the relative costs of the various items (including all overhead) making up the tunnel costs on the Kerckhoff development, it will be noted that drilling and mucking make up more than 60 per cent of the total tunnel cost.

The cost of drilling per lineal foot of tunnel is less with long rounds than with short rounds. This is because the cost of drilling per lineal foot of heading

TABLE I—DIVISION OF TUNNEL COSTS ON KERCKHOFF DEVELOPMENT

Item	Percentage of Cost
Drilling, including depreciation on drills, drill steel, sharpeners, oil furnace, cost of sharpening steel, etc.	29.33
Powder, caps and fuse	10.00
Mucking, including depreciation on shovels, cars, etc.	33.66
Shooting, labor only	4.00
Drainage	0.67
Track work, labor only	2.00
Light and power	4.00
Ventilation, including depreciation on blowers and blower pipe	3.00
Depreciation on rails, ties, etc.	5.00
Depreciation on electrical equipment including wiring, electric locomotives, motor-generator sets, etc.	7.67
Clerks, etc.	0.67

TABLE II—SIZES AND METHODS ON SOME WESTERN

No.	Location of Project	Company and Contractor	Length, Ft.	No. of Headings	Cross Section, Size in Ft.	Date of Completion	Kinds of Rock	Timbering
1	Skagit Project (Newhalem Tunnel)	City of Seattle (Day labor)	2,675	Two	6x7	Aug., 1921	Hard granite	None
2	Skagit Project (Gorge Cr. Tunnel)	City of Seattle (R. C. Storrie & Co.)	10,978	Two	Horseshoe, 21 wide	Started Dec., 1921	Granite	
3	Bridge River Project	Bridge River Power Co.	Two, 12,800 each		Horseshoe 136 sq.ft. each	Started July, 1920		
4	Pit River Project Pit Riv. No. 1	Pac. Gas & El. Co. (F. Rolandi)	10,111	Three	12½x14 14 dia. circular (1,800 sec.-ft.)	Jan., 1922	Basaltic lava	25% length
5	Don Pedro Dam	Turlock and Modesto Irrig. Dists.	600	Two	24x24	July, 1922		
6	San Pablo Dam to Oakland	East Bay Water Co. (Bates & Borland)	14,553	Four	Horseshoe 5½x6½ inside lining	Early in 1920	Serpentine, sandstone schist, shale	70% length
7	Caribou Project (Feather River)	Great Western Power Co. (Stone and Webster)	21,900	Nine	12-ft. circular Horseshoe, 9x9	July, 1921	Slate varying greatly in hardness	All timbered
8	Hetch Hetchy	City of San Fran. (Const. Co. of N. Amer.)	18 miles	Ten	10-3—106 sq.ft. 13-4—153 sq.ft.	Mar., 1923	Slates, quartzite, granodiorite	Infrequently
9	Big Creek Tunnel 8	So. Cal. Edison Co.	About 5,800	Four	20x20	June, 1921	Gray granite	None
10	Big Creek No. 3	So. Cal. Edison Co.	30,000	Eight	21x21	About April, 1923	Gray granite	None
11	Kaiser Crest (Hunting on Lake)	So. Cal. Edison Co.	13.6 mi.	Six	15x15	About Mar., 1926	Hard gray granite	None
12	Shaver Lake Tunnel	So. Cal. Edison Co.	15,000	Four	8x11	May, 1921	Hard gray granite	None
13	Kern River No. 3	So. Cal. Edison Co.	60,000	About Forty	8½x9½ 600 sec-ft.	Jan., 1920	Shale and decomposed granite to hard granite	About 15%
14	Kerckhoff Tunnels	San Joaquin Lt. & Power Corp.	18,000		17x17	May, 1920	Seamless blue granite	None
15	Kern Canyon	San Joaquin Lt. & Power Corp.	8,361	Ten	13½x14 unlined 8½x10½ lined	July, 1921	Gray granite broken formation	50%

depends upon two factors; namely, (1) the cost of setting up and tearing down cross-bars and columns, drills and air hose, and (2) the cost of drilling per foot of hole.

It is obvious that the first item is dependent upon the number of set-ups required in the total length of tunnel. The cost of drilling per foot of hole is slightly greater with long holes than with short holes, but the total length of holes drilled in short rounds per unit length of tunnel is considerably less with long rounds than with short, on account of the fact that each round does not break to the bottom of the hole.

The cost per yard of mucking with air-driven steam shovels depends almost entirely upon the quantity of muck to be removed per round. Nearly one-half of the cost of handling muck with steam shovels is the cost of



FIG. 5. TYPICAL CIRCULAR TUNNEL: DIAMETER 12 FT.

moving the shovel to and from its work and mucking up the scattered muck on the tracks after a shot so as to get the shovel up to the main body of muck. This cost is entirely independent of the total amount of muck to be handled at each round.

Advantage of Long Rounds.—It therefore follows that great economy can be obtained by lengthening rounds in large tunnels, especially where the cost of powder used in the cut shots is not excessive with long rounds. This statement is borne out by the fact that in large tunnels the most economical set-up can be made on the basis of one round per day, with all crews having regular hours. It is impossible to complete two rounds a day, and attempts to increase progress to more than one round per day can only be made by using swing shifts, which are admitted to be very unsatisfactory.

The practical average depth per round is approximately 80 per cent of the tunnel width. On the Kerckhoff tunnels, 18 x 18 ft. in blue granite, the economical average depth was found to be 15 ft. The cost of driving large tunnels per cubic yard decreases quite rapidly for sections larger than 16 ft. in width, as larger cars and larger dippers can be used.

Drills having power to drill deep holes with great rapidity must be provided, so that the drilling will not delay the tunnel progress, to get the greatest speed with greatest economy. The selection of drill steel is likewise of greater importance as tunnels increase in size, on account of the tremendous strain on the long steel and its tendency to crystallize under such conditions. Up to the present time the manufacture of special drill steel for this kind of work has not been attempted in this country, but now that such a large mileage of power tunnels is definitely scheduled for construction in the next few years, drill-steel manufacturers should immediately take steps to make better steel, if foreign steels are to be kept out of the local markets.

Importance of Speed.—On most hydro-electric power developments the length of time required to drive the tunnels is the factor which puts the minimum limit on the construction period of the entire development. This has been true on the Big Bend, Big Creek, Kerckhoff, Kern Canyon, Caribou, Hetch Hetchy, and many other developments. Water power developments are nearly always made at times when load demands require additional power resources. A 50,000-hp. development at the present time in California costs approximately $7,500,000; with interest at 8 per cent this represents a charge of $600,000 per year, or $1,640 per day. Every thirty days by which the construction period can be reduced on such a project therefore represents a saving in investment alone of $50,000 or $1 per horsepower. Often such a hydro-electric development is built to realize steam power generated by oil, which costs approximately 1c. per kilowatt-hour for oil alone. In such a case there is an additional saving in cost of oil amounting to $216,000 per month, or $7,200 per day, based on an 80 per cent load factor. It is in consequence of these conditions that progressive engineers are continually studying new methods in tunnel construction.

ROCK TUNNELS UNDER WAY IN 1920 AND 1921

	Methods of— Working Headings	Mucking	Depth Of Holes, Ft.	No. of Shots Per Round	Maximum Progress (One Heading), Ft. Per Mo.	Remarks
1.						No lining; lower end of tunnel under head of 266-ft.
2.						Conc. lining throughout (contr. $2,203,865)
4	Heading & Bench	Hand mucking Stge. Bat. Locos	Heading— 8 to 10 Bench—10 to 22	Heading—16 to 22 Bench—5 to 7 ft.	524 ft. in month of July	Conc. lined throughout.
6	Full Face	Hand mucking	6—8	7—10		
7	Full Face	Hand & Ushovelcleer	6—8	8—10	597	Excessive water flow
8	Full Face throughout	Several makes motor and air driven mucking machines	8—12 small 8—14 large	25—35 small 30—60 large	758 at Priest Portal	620 sec. ft. Large section unlined—small section conc. lined
9	Progress Bore & Full Face	Steam Shovels	6—12	40—50	After 8x9 pioneer 1,260 (Started Nov. 1, 1921)	
10.	Heading & Bench	Steam Shovels			(Started Oct. 15, 1921)	
11.	Heading & Bench	Steam Shovels and shovelcleers	Average 10 to 15	50—60	526	No lining
12	Full Face	Shovelcleer	Average 8	20—40	470	Concrete lining throughout
13	Full Face	Hand mucking	6—12	15—35	441 (April)	No lining. Labor and powder $43 per ft.
14	Heading & Bench and Full Face	Steam Shovels (Marion 40		Shovel capacity 60 to 80		
15	Enlarging old tunnel and to center loading	Shovelcleer	12	12		

Land Drainage Developments in a Canadian Province

Large Field for Drainage—Double Levees To Hold Floods—New Drainage Board—Government Control of Maintenance

DITCH maintenance as a government responsibility, extension of land drainage to promote agricultural development, revision of the present law and appointment of a permanent board to administer the law free of political considerations, are high points of recommendations in the recent report of the Manitoba Drainage Commission, appointed to consider the present conditions and needed improvements. John G. Sullivan, consulting engineer, Winnipeg, is chairman of the commission, with H. Grills and J. A. Thompson as the other members. An abstract of this report is given below:

With 2,000,000 acres in organized drainage districts, less than $4,000,000 of bonds have been issued against these lands. Half of this area is under cultivation and with effective drainage more than 90 per cent could be put under cultivation. Drained lands in general are superior to lands that do not require drainage. Development of farming in this province depends largely on irrigation in the southwest and drainage in the north and east. The opportunities and cost of irrigation are such as to afford little encouragement. But possibilities of drainage are almost unlimited and future agricultural development depends largely upon how the matter is handled at the present time.

The people in the drainage districts have suffered more from inefficient drainage than from excessive or inequitable taxation, in spite of the fact that about 600,000 acres have paid drainage taxes for which they received little benefit. The major causes of this latter condition have been defective laws and the lack of any central controlling body free to execute and administer the provisions of these laws. Distribution and assessment of drainage taxes is an entirely different problem from the assessment of revenue taxes. The latter are based on valuation and power to pay. The former are based on benefits received and relief from liability of damage, as well as on the ability to pay. This responsibility for tax distribution should not be placed upon any officer of a department, as at present, or upon a government officer whose position is dependent upon the popular vote.

Among the vital defects of the present act is that it is susceptible of different interpretations, owing partly to the lack of proper classification of clauses relating to construction and to maintenance. Under existing conditions, the lands within a district are liable for the cost of all drainage work, just as much as if the district had a corporate existence. Although taxation in proportion to benefits is contemplated by the law, the method prescribed for applying this principle is not practicable. It actually places all responsibility on the government engineer, who should not be asked to assume such responsibility.

Drainage Board—A permanent drainage board should be appointed in order to relieve the chief engineer of the responsibility noted above, to protect the taxpayers in the formation of new districts and to insure efficient administration of the law. Its principal duties would be to levy drainage taxes, to approve of work to be done (both construction and maintenance) and to approve plans for such work. The carrying out of the work should be in the hands of the Department of Public Works, as at present, since an increase in executive organizations is not desirable. The expense of maintaining the board should be charged in equal proportions to the drainage districts and the general expenses of the province.

Drainage Districts—No new districts should be formed where the development and demand for land will not fully warrant the expenditure. The boundaries of any district should be extended to include all lands whose surplus waters drain into that district and are carried by any artificial channel through it to a natural outlet. This is a natural division of lands; any other division leads to disputes. But it is not contemplated that all lands within the new boundaries would be taxed.

A plan of forming new districts on the basis of individual watersheds or drainage areas, thus breaking up some of the older districts, has many good points. But the difficulty of allotting to each watershed its proper portion of the existing debts, together with the resulting dissatisfaction, outweighs the beneficial features.

Distribution of Taxes—Lands should be classified according to wetness. Lands worthless without drainage would be in the highest class. In the lowest class would be land that is liable only because water from it damages the lower lands or increases the cost of protecting them. Since the "ability to pay" is a factor in all taxation levies the ability of the lands to produce must be taken into account.

In justification of the principle of taxing lands on the higher levels, it may be said that if people on the high lands have the right to do as they please on their own property, the same should be true of those people within a drainage district, who would thus have a right to dam against the waters from the higher lands. Several road and drainage ditches are now discharging water into drainage districts, which is unjust. If the people whose lands are drained by these ditches should be compelled to provide an artificial channel to carry off their waters, the cost might be many times that of an equitable tax for the use of the district ditches.

The government should pay taxes on benefited land owned by the Province. Municipalities should pay an amount equal to the benefits derived from highways built in connection with ditch construction.

Some of the ditches need to be enlarged since they drain more land than was contemplated. New capital should be raised for this work, collecting the money finally by taxing the lands liable for the excess water as well as the lands benefited.

Ditch Maintenance—This work consists of clearing out material which may slide or be blown in, or may be deposited by the water. It includes also the cutting of weeds and underbrush, the care of levees, and the repair and renewal of culverts and bridges. In some of the older districts this has been neglected so long that it would be almost impossible for the municipalities to do all this deferred work. Instead of this maintenance being in the hands of the officers of the various municipalities, it should be assumed by the government, as agent for the drainage districts. A substantial tax to cover the expense should be levied on the lands in the same proportion and manner as the tax for capital account.

An exception to this is that the government cannot accept responsibility for the removal of snow and ice from any ditch or stream. Such work must be attended to by local authorities. Consideration should be given to the economy of windbreaks along ditches in light soil, to prevent the soil from being blown in. When the annual cost of clearing the ditch is greater than the interest on the cost of an efficient wind break, including the land required, the government should have power to order the construction of such works.

In certain districts the main dredged channels should be double-diked, a levee being built 250 to 300 ft. from the spoil bank to confine the flood waters. During the spring break up the channels, when full of snow and ice, will not carry off the waters that come from the higher lands. These levees would also be a protection against extraordinary floods during the summer.

Building Roads on Gumbo Fills in the Arkansas Bottoms

Constructing 100 Miles of Surfaced Road in Two Years—District Co-operation Expedites Progress—Territory Previously Without Highways

By Charles T. Fisher
Engineer in Charge for the Morgan Engineering Co., Memphis, Tenn.

CONTRACTS of unusual form and a number of structural details and construction methods designed to meet the conditions of road building in the Mississippi bottom lands, make the road building of 1920-21 in Crittenden County, Arkansas, a matter of interesting record. Practically all of the road had to be put on embankment to keep it out of the water. Precast concrete culverts were employed as much as possible to reduce hauling over the gumbo fills made from side ditches. With several districts combining to purchase gravel, spur tracks, local stockpiling and district-owned railway equipment were practicable and economical. Contracts for graveling were devised which avoided the disadvantages of the "ton-zone" form. A new "silica" surfacing was employed successfully, instead of gravel, on a large mileage.

Engineers in private practice build the roads of Arkansas.

The state highway department engineers have little control except when Federal aid is involved.

There are no county engineers or city engineers or public works departments.

Every public work—road, sewer, bridge, etc.—is constructed by an "Improvement District," created, under the law, for this specific purpose.

The engineers are appointed by the commissioners of the district; their fee, established by law, is 5 per cent of the cost of the improvement.

Some three or four hundred improvement districts, each with its engineer, are constructing the improved road system of Arkansas.

The work outlined in the accompanying article is an example of highway development under the system indicated.—Editor.

In 1919 six road improvement districts were organized in which the entire area of nearly 600 square miles of Crittenden County, Arkansas, was included. The two most important districts were 7 and 9, Fig. 1, which conducted their roadwork together under the supervision of the Morgan Engineering Co., Memphis, Tenn. Approximately 16 miles of earth roads, 66 miles of gravel roads and 14 miles of concrete roads have been completed in the two districts in 1920-21. The work has been road building rather than road improvement, for in most cases there was not even a trail on the location of the new road.

Roads Built on Fills.—The finished road grade was fixed at not less than 1.5 ft. above the general surface of the ground, and not less than 2 ft. above local high water. This rule made the yardage of embankment high, averaging about 11,000 cu.yd. to the mile. It was necessary, however, because of the difficulty of obtaining perfect drainage in the flat lands and because of the marked capillary action of the soil. Practically none of the road system is in cut. The embankments were built 24 ft. wide at the top, with 1.5 to 1 side slopes. They were formed from side borrow pits which were dug to grade and carefully drained.

Dragline machines, elevating graders, wheeled scrapers and blade graders were all used in building the fills, but by far the greater part of the dirt was handled with fresno scrapers and mules, a combination which gave the most satisfactory results under the conditions. Negro labor was used on all parts of the work. In both districts there were 1,050,000 cu.yd. of embankment. There were also numerous brakes of cypress and gum to be crossed, and clearing and grubbing, Fig. 3, amounted to 278 acres.

Precast Culverts Reduce Hauling.—It was difficult and expensive to haul over the unfinished roads, Figs. 2 and 4. The alluvial soil, when dry was rough and rutted, and when wet, was a mire. Materials for culverts and bridges cost much time and trouble to get onto the ground. However, a considerable saving was effected by the use of precast concrete culverts, where only small openings were required. These were made in 2-ft. lengths, having a horseshoe section which was well reinforced, and were set in a reinforced concrete base, which was poured in place. About 9,200 lin.ft. of culvert between 12 and 36 in. in diameter were used. Box culverts, which were comparatively few, were built of reinforced concrete according to the standards of the Arkansas State Highway Department. There were 25 bridges of concrete or plate-girder construction, and 1,850 lin.ft. of trestle.

Joint-District Gravel Supply.—Preparations for surfacing were commenced as soon as the grading contracts were let. No local materials were obtainable. Districts 7, 8 and 9 of Crittenden County, and the Ozark Trail District, of Poinsett County, therefore, united as the Crittenden-Ozark Joint-Project to import surfacing material. Under this arrangement 17 spur tracks, each about 20-car capacity, were built for unloading materials, and 10 cranes were purchased, with the intention of stockpiling sand, stone and gravel as rapidly as possible. The freight in Districts 7 and 9 alone amounted to over $338,000.

Stockpiling was well under way when the federal embargo issued in June, 1920, shut off the supply of open-top cars. For a time it seemed that it would be necessary to suspend operations entirely. Surfacing with gravel had, however, already been commenced, and the commissioners, determined that the work should not be stopped, purchased 105 20-cu.yd. standard gage air-dump cars which had been built for the government during the war. Arrangements were made with the St. Louis & San Francisco Ry. to operate these cars between a gravel pit near Wittenberg, Mo., and points on its line in Crittenden County, an average distance

of 170 miles. With this equipment gravel was hauled in solid trains of 35 cars, a train making a round trip in three days so that a train-load of 700 cu.yd. could be delivered each day.

In building up a stockpile with dump-cars, the spur was first raised to the desired height by jacking up the track and working underneath it the gravel dumped from the cars. The pile was then widened by throwing the track over on the fresh material after each train-load was deposited. From 12 to 14 laborers were required for the work. Contracts for unloading dump-cars, which included shifting and maintaining the stockpile tracks, were let at prices much lower than the cost of unloading by crane. Eight piles of gravel and two of stone were built up in this manner. About

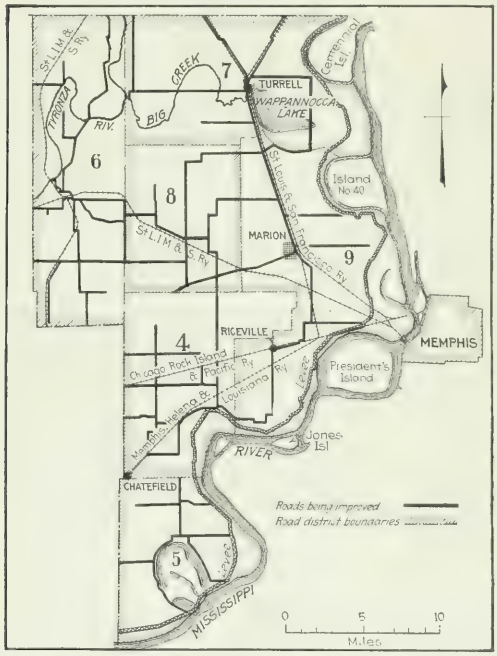


FIG. 1. NEW ROAD SYSTEM, CRITTENDEN COUNTY, ARK.

190,000 tons of road material were handled in the dump-cars, which were sold by the road districts soon after the shipments of material were completed.

New Form of Graveling Contract.—A general contract for gravel hauling and surfacing was entered into early in 1920, under which the districts rented 36 3½-ton trucks, purchased other necessary equipment and paid for all labor and supervision. Four ten-ton rollers, eight tractors, a number of blade graders and the small tools required were purchased at this time. A few miles of gravel road were completed during the season, but the arrangement proved unsatisfactory and was discontinued in the fall. District 8 withdrew from the joint project in November. Work in Districts 7 and 9 was continued, and contracts covering the gravel surfacing were let in November, 1920, and in May or June, 1921.

The form of contract differed somewhat from that in



FIG. 2. GRADE RUTTED WHEN DRY

common use in gravel road work in the delta states. Ordinarily the work is divided into one-mile "zones," beginning at the railway siding or gravel pit. A price per ton is paid for gravel incorporated in the finished road within the limits of the first zone, and an additional price per ton for each succeeding zone beyond the first. This system has serious disadvantages. Unless the loads are actually weighed, the tonnage of gravel hauled from a pit or stockpile into any particular zone can only be guessed at. So much of the inspector's attention is needed in trying to keep track of the number and size of the loads hauled and the zones in which they are placed that he has no time left to see that the surfacing is properly constructed. Consequently he spends his days counting wagons and his nights arguing with the contractor's superintendent over the count, and the hauling comes to be regarded as the important part of the job, with the construction of a smooth and durable surface a secondary matter.

As a compromise between the "ton-zone" and "cubic yards in place complete" method of payment, the surfacing contracts let in 1921 contained two pay items, "gravel hauling" at a price per cubic-yard-mile, which included the hauling and nothing more, and "gravel surfacing," at a price per cubic yard, which included loading the gravel, preparing the sub-grade, gravel manipulation and building and trimming shoulders, in short, everything except the haul. Estimates and payments for the hauling item were based on average haul and cubic yards measured in place on the road. The



FIG. 3. WAY CLEARED THROUGH CYPRESS BRAKE



FIG. 4. GRADE MUDDY WHEN WET

gravel was measured before rolling, the spreading being gaged with blocks and with dump-boards set at the edges of the trench—like forms for concrete pavement. This scheme of paying for the work left the inspector free to supervise the construction of the surface, and proved satisfactory to both contractors and engineers.

Gravel was furnished by the districts, stockpiles being located at ten unloading points. The arrangement of contracts was such that all the material in each stockpile was used by a single contractor.

Gravel Surface Construction.—In constructing gravel surfaces, the finished embankment was trenched to a depth sufficient to provide earth for the shoulders and the gravel was spread in two courses, starting at the point most distant from the stockpile. Heavy caterpillar tractors, scarifiers and blade graders were generally employed for cutting the trench, though in lighter soils teams were sometimes used. A few trucks were used for hauling gravel, but because of soil conditions most of the hauling was done with teams. At the stockpiles the wagons were loaded both by cranes and by hand labor. The spreading was done by blade graders, using as much hand labor as might be necessary to get a uniform surface. Ten-ton rollers were used for compacting the surface.

On the main roads the surface is 16 ft. wide, and was built in two courses each 6 in. thick, before rolling. On the lateral roads the surface is 14 ft. wide and a 6-in. bottom course and a 4-in. top course were used.

Silica Surface Roads.—On 13 miles of road, a gravel composed of fairly hard pebbles, but containing a large amount of red clay, was used. Until thoroughly compacted this material ruts easily in wet weather, but it eventually forms a very durable surface. On the remaining 53 miles of gravel road a material known as "Silica" obtained from a pit near Wittenberg, Mo., was used. Silica can hardly be classed as a gravel, though it contains varying percentages of a flinty stone similar to novaculite. The binding material is a fine yellowish substance which has the property of becoming very hard if compacted when moist.

In building the silica roads each load was saturated with water at the stockpile, and was spread and rolled while still very damp. If properly manipulated, a hard and compact surface resulted, which compared favorably with the best waterbound macadam. Rolling dry silica was found to be a waste of labor. The silica surfaces have worn evenly under traffic, without the formation of ruts and potholes. Prolonged dry weather will doubtless cause more rapid wear, and a surface treatment to retain moisture will be necessary. Because of the large proportion of fine material present, treatment with bituminous material is unsuccessful. A mile of excellent silica road was ruined by an oiling experiment. No penetration could be obtained, and the "picking up" of the oiled surface produced a rough road in a few days' time.



FIG. 5. PRECAST CONCRETE PAVEMENT



FIG. 6. BROOMING CONCRETE PAVEMENT

The construction of concrete road followed usual methods and there was nothing unusual in equipment or results. For the Morgan Engineering Co., Charles T. Fisher was in general charge of the work, with J. S. Sager, J. E. Fontaine and E. W. Earle as principal assistants.

Suspension Bridge Belt Conveyor

A belt conveyor 500 ft. between centers, and supported by a suspension bridge has been constructed to convey coal from the headhouse of the Gauley Mining Co. in Logan County, Virginia, to the tipple house located on the opposite bank of the Guyandotte River. The bridge consists of two 2½-in. steel cables 204 ft. in span, with ¾-in. suspender rods every 5 ft. which support 4 x 6-in. cross-timbers. On the platform so erected a housing for the conveyor and for a footway. The conveyor is 20 in. wide. The plant was installed by the Stephens-Adamson Mfg. Co., of Aurora, Ill.

Can The Railway Engineer Become An Operating Officer?

Opinions of Opportunities, Qualifications and Results—Promotions from Different Branches of Service

HAS the railway engineer much opportunity for entering the operating department? Is he considered in appointments to that department? Does he make a successful operating officer? These questions have been put to a number of representative railway men. The replies indicate that in general there is no particular encouragement or inducement offered, but that an aggressive man can break through. Although engineering training is an assistance in the new work, personality and a special aptitude for operating service are much larger factors in the success of the engineer who desires or elects to become an operating officer. One reason why these opportunities are limited seems to lie in the fact that relatively few of the higher operating officers appreciate the advantages which technical training give to the man who has the other necessary qualification. Speaking generally, therefore, it may be suggested that the railway service might benefit materially if greater opportunities were open to the engineer who has a predilection for the operating department.

Opportunities for Engineers.—Some of the replies to these questions indicate that engineers are given some consideration when appointments to the operating department are made. They appear to make it plain, however, that as a general thing the engineer must not only possess the qualifications, but must take the initiative and be an aggressive applicant if he desires to enter operating service. There are, of course, men in the engineering department, as in other departments, who have special aptitude for operating service, but even for them the transfer or promotion is not easy to secure. Four or five replies refer specifically to certain high operating positions held by former engineers, but reading between the lines it would appear that in most cases these men had exceptional capacity or determination, but still have to make their own opportunities for entering the desired department and attaining the desired position.

It is pointed out, also, that the number of men available for appointment is small as compared with the number of men available in other branches of service, For instance, where the engineering department has 20 men available for consideration, there are likely to be 200 men available among the train dispatchers, clerks, master mechanics and trainmen.

It is evident from the replies that much more depends upon the man himself than upon the fact of his technical training or knowledge. One officer, himself a former engineer, states with regret that because of their education, their line of work and their line of thought, engineers as a rule are not qualified to take up the more complex duties of the operating department.

Ability to handle men is an essential which assumes large proportions under present conditions.

In one reply it is stated that it is natural to select as trainmaster a chief dispatcher, a road foreman of engines or a superintendent's chief clerk, since the duties are essentially transportation duties and these men are more familiar with the details of transportation work than are engineers or roadmasters. Similarly, it is considered appropriate to promote a trainmaster to the position of superintendent. For this reason, the relative lack of consideration given to the engineer is due to natural selection rather than to discrimination.

Engineers in Operating.—In answer to the general question as to whether many engineers do actually enter operating service, most of the replies are in the negative. Individual examples are given of engineers who have become identified with the operating department, but these seem rather an exception to prove the rule. Some of the writers state that few engineers show any desire for such a change of departments. But in reply to this it seems fair to note the very slight inducement or encouragement offered. If an engineer has such a desire it is up to him to break into the operating department, since there is no open door before him.

That a course of experience in the operating department would broaden and benefit the men in the engineering department is the opinion of two chief engineers, one of whom regrets that so few engineers show an interest in this important part of railway service. This opinion is a little aside from the main subject, however, since it relates to men who would return to the engineering department instead of remaining permanently as operating officers. It is in line, however, with another suggestion that locating and construction engineers would be better fitted for their work if they should serve for a time on maintenance work, since they would then appreciate that there was something beyond an easy or cheap location and construction.

Engineers as Operating Officers.—Do engineers make good when called to serve as operating officers? Here the replies are largely in the affirmative, though qualified by the reference to the necessity for particular aptitude and ability. In other words, promotion to the operating department is given to engineers whose executive ability has been measured by individual fitness due not to experience in one branch, but to a broad view of the requirements of railway operation. One reply points out that there are undoubtedly good engineers who would not make a success in operating service.

That the technical training of the engineer who has the other necessary qualifications tends to make him a better operating officer than many men who came up from other departments, is the opinion expressed by several writers. One of these refers to engineers placed recently as assistants to high operating officers. This view is qualified in one case by the suggestion that the engineer must be taken while young and before he has become set in his ways. Another aspect of the situation is presented by one writer who considers that the extent to which engineers are given opportunities to work in the operating department depends to a great extent upon whether the higher operating officials have any material knowledge or experience of engineers and engineering.

There appears good reason to suggest greater regard for the engineering department as a source of good operating officers, and greater opportunity for the young engineer who desires to transfer his activities to the operating department.

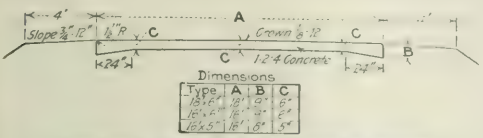
Pavement with Thickened Edges Takes Heavy Loads

New Concrete Road Section Adopted by Maricopa County, Arizona, Carries Very Heavy Traffic with Slight Damage

By C. L. Jenken
Construction Engineer,
Maricopa County Highway Commission, Phœnix, Ariz.

SUCCESSFUL service has been given by the new design of slab used for the 130 miles of concrete roads, recently completed, under the first contract, of the 309-mile hard-surfaced road system planned by Maricopa County, Arizona. All roads, some of which were laid on swelling soils, are in good condition, and 3½ miles, now over 15 months old, subjected at a very early age to the travel of material trucks, do not show indications of failure. Methods of construction were described in *Engineering News-Record* May 26 and June 16, 1921, pp. 882 and 1026.

As shown by the accompanying drawing the slab is a modified, inverted-curb section designed to strengthen the edge and at the same time permit simple construc-



CONCRETE ROAD WITH THICKENED EDGES

tion of the sub-grade. The thickened edges add structural strength as the area of load distribution and sub-grade resistance decreases, thereby securing a paving slab with a more uniform resisting strength. It is also considered that the section forms better drainage between the slab and the sub-grade, maintaining a more uniform moisture content and a more uniform contact. Due to its inverted cup-like shape it is believed that it also retards swelling or squeezing out from under the pavement edges.

The section permits the use of simple methods in preparing the subgrade. The ordinary subgrade cutting machine can be used with only slight adjustments of the cutting blades and, prior to the final trimming, the entire width can be rolled with the common macadam type roller.

No indication of failure is apparent on the 130 miles of completed pavement. No crow-foot cracks at expansion joints or at transverse cracks have been noted. Longitudinal cracks are very rare and the few observed are at expansion joints and only a few feet in length; none is of a serious nature. Transverse cracks or temperature cracks average less than 50 to the mile and not more than eleven have been found in any 500-ft. section.

A section 18 ft. wide having a 6-in. center and 9-in. edges, 3½ mi. long, was one of the first laid and now is over 15 months old. It was laid on a heavy soil, considered to be one of the poorest, where [illegible] fill or sand cushion was used. Before the last mile of road was four weeks old it was subjected to the travel of material trucks, which were heavy five-ton trucks equipped with batch-compartment dump bodies and loaded with four batches, which consisted of 16 cu.ft. of rock and 8 cu.ft. of sand each. The trucks and material weighed approximately 23,400 lb. These trucks average a total of 70 round trips daily in 8 hours for about 280 days, traveling at a speed varying from 12 to 18 miles per hour. During this time two low places were completely submerged from a break in a canal bank for a period of six hours, and due to insufficient culverts on side roads this water stood for several days on both sides of the roadway and well up on the shoulders so as to thoroughly saturate them.

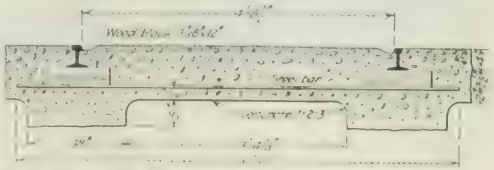
During this time the materials trucks kept to the extreme edge of the pavement practically for its entire length, in many cases the rear tires would extend over the edge of the pavement. A careful watch was kept during this heavy traffic, and later, an accurate survey of cracks was made and it was found that no visible wear or cracks could be attributed to the overloading, which is considered to be equal to several years of normal traffic.

Design of Street Railway Includes Tie Bars as Concrete Reinforcing

By Julian Montgomery
City Engineer, Wichita Falls, Tex.

IN THE accompanying sketch are shown details of a railway track recently laid through part of the business and residential section of Wichita Falls, Texas. The track was laid on a street paved for the most part with 6-in. two-course concrete reinforced in the bottom course with light hog wire. It was therefore necessary to remove a 7-ft. strip without injuring the pavement as a whole before the track could be laid.

As approved by the city the design for the track included the use of tee rails supported on combination steel-and-wood ties. Each tie has two asphalt-coated blocks to support the rails, the blocks being connected



STEEL TIES REINFORCE BETWEEN-RAIL PAVING

by pairs of light angles 8 in. apart, which form reinforcement for the 1:2:3 concrete paving. The ties are spaced 30 in. c. to c. A concrete beam is built under each rail and a 9½-in. concrete pavement between the rails.

After the contractor had shaped the subgrade the traction company laid the track to line and grade and welded the rail joints. As sections of track were completed concreting was undertaken. The surface was floated and troweled after first being dried with a liberal sprinkling of 1:1 dry sand-cement mixture. A thin wooden strip was tacked to the wood blocks of the ties to hold them in line. When concreting was begun a strip of prepared asphalt joint-filler was placed alongside this wood strip. The completed concrete was covered with 2 in. of dirt and kept wet for eighteen days. The dirt was then removed, but no traffic was allowed upon the track for an additional ten days.

The work was done under the direct supervision of Julian Montgomery, city engineer, with J. B. Upchurch, assistant in charge of paving. The contractor was I. H. Roberts, Wichita Falls, Tex.

Broad Problems Analyzed in Design of Winnipeg Bridge

Two-Span Concrete Structure Raises Interesting Economic, Æsthetic and Structural Questions—Elements of Design Carefully Proportioned To Insure Pleasing Appearance

By J. F. Greene,
Consulting Engineer, Winnipeg, Man.

Abstract of paper read before the Winnipeg Branch of the Engineering Institute of Canada.

THE Maryland St. bridge is a reinforced-concrete arch structure provided to carry traffic across the Assiniboine River between the business section and the best residential section of the city of Winnipeg. The deck consists of a roadway 50 ft. wide and two sidewalks each 7 ft. wide, and provides for four lines of vehicular traffic including street cars, with a maximum grade of 2 per cent. While the structure, as an example of the standard barrel-arch type of concrete bridge is not an object of special interest, the proportioning of its parts to form a harmonious whole, and the mental processes involved in that proportioning may be of interest to men engaged in the solution of similar problems.

The determination of the number of spans was not left to the designers. While comparative estimates disclosed that a three span bridge would be slightly cheaper than one of two spans, and while æsthetic precedent demanded three spans rather than two, the Department of Public Works objected to the location of the south pier in the navigation channel and intimated that a two span bridge only would be acceptable. The elevation of the crown of the south span was fixed by the clearance set by the Government for navigation; so the curves for the arches were pre-determined closely enough to enable the making of preliminary sketches in order to work out the most effective treatment for the abutments, piers, spandrel walls and approaches.

Æsthetics of Concrete Design.—A slight digression into the architectural limitations of concrete as applied to bridges, may not be amiss. A concrete bridge presents all exposed faces of one color, a dull monotonous gray. These faces in turn, disclose various irregularities, due to the method of constructing concrete structures. Each lift, or day's run of concrete is distinctly outlined in any exposed concrete surface. Board marks differ in shade, some being of dark gray, and others lighter, due probably to the different absorptive capacities of the several boards. Any yielding of forms, however slight, produces offsets or waves, and occasionally rock pockets appear which must be covered by disappointing patches. All such appearances are irregularities, and are displeasing to the eye. It is incumbent upon the designer so to proportion the major members of the structure that it will be pleasing and dignified, while at the same time he accentuates the minor members by the use of pilasters, inserts, and grooves that will divert attention from the unavoidable defects of concrete surfaces.



GENERAL VIEW OF MARYLAND STREET BRIDGE

Here is seen the illusion of height produced by carrying the piers and abutments above he level of the handrail, by using vertical form boards and decorative lines and by imposing pilasters on the spandrel walls. This view illustrates also the pleasing effect obtained by breaking up the uniformity of the spandrel surfaces and arch rings.

Development of Æsthetic Features.—It has been assumed as axiomatic that the dimensions and proportions of the several parts should be indicative of the service that each part contributes to the stability of the whole. The abutments, marking clearly the river banks and the limits of the arch spans, should impress the observer as having sufficient mass to withstand successfully the horizontal thrust from the adjacent arch spans. The pier, although of sufficient mass to carry the vertical loads from the arches, should present faces so proportioned as to offer the least obstruction to the passage of water and ice.

With these limitations and axioms in mind, preliminary sketches were made. In one sketch an excessive use of horizontal lines, and in another an equally exces-

sive use of vertical lines, disclosed the proper basis of treatment for this structure. As outlined, the bridge appeared to be squatty, this quality being exaggerated by the excessive use of horizontal lines and relieved greatly by the appearance of vertical lines. Proceeding from the assumption that the structure lacked height, abutments and piers were increased in height to a level above that of the handrails; the surfaces were relieved with deep vertical grooves, and even the form boards were placed vertically to further the illusion of height. The spandrel wall surfaces were broken up by pilasters of which the relief was exaggerated by means of inserts at both edges to accentuate vertical shadow lines, thereby contributing further to the illusion of height.

To conceal the effects of yielding forms and the outlines of each days run, grooves were left in the concrete at regular intervals, both in the arches and in the walls. Each days run ended in a groove, which concealed the joint and, in addition, cast a shadow that tended to relieve the monotony of the large flat gray surfaces. In proportioning the exposed parts of the sidewalk slabs and brackets it was expedient to exceed the structural requirements of the design, lest the parts should appear too light for stability. By breaking the sloping under sides of the brackets into several vertical faces, an illusion of breadth and strength was produced and the impression that would have resulted from the monotonous succession of plain brackets gave way to one more definite and pleasing.

Treatment of Deck.—So much for the proportioning of those parts of the structure, which would be visible to observers standing either upstream or downstream. The treatment of the deck of the bridge presented a separate and a different problem. Smooth, easy approaches from connecting streets with the least possible grades were desirable. The elimination, or failing this, the subordination of all trolley and light poles on the deck of the bridge, was adopted as a policy to be followed consistently.

The design of the handrail, the outstanding portion of the structure visible from the deck, remains. Since the observer views the handrail, not from a distance, as he views the arches, piers, and abutments, but at close range, the appeal to the imagination lies not so much in the composition, the grouping of the parts into a well balanced whole, as in the excellence of the parts themselves, the intricacy of the fabric and the quality of the texture. It is essential, therefore, that special methods of handling the concrete be adopted in order to eliminate air-holes, water-holes, form marks and the other surface irregularities of commercial concrete. This may be accomplished in various ways, either by the dry process, by the use of sand molds, or by scrubbing the surface of green concrete with steel brushes thereby exposing a specially prepared colored aggregate. On the Maryland St. Bridge the third method was adopted, and the colored aggregate consisting of red granite, crushed to pass a 1-in. screen, was exposed by [illegible] with steel brushes, and cleaned by several washings of muriatic acid and water.

The bridge is lighted by four-light clusters, set on combination light and trolley poles, standing in the center strip and located about 90 ft. apart. Each light is diffused by wide-angle refractors and the lights have been set high enough on the poles to obviate dangerous shadows from passing cars. So much for the principles and methods involved in the æsthetic phase of the design.

Design of Structural Elements.—The adoption of a solid barrel, earth filled arch, rather than an open spandrel reinforced-concrete deck bridge, rested primarily on economic grounds and secondarily on structural considerations. With an average fill of 10 ft., the earth-fill arch showed a saving of 25 per cent as against an open spandrel arch. On the approaches the saving was greater, since the increase in the cost of the deck was not offset by reduction in the substructure due to reduced dead-loads. Further, the earth-fill type, exposed only at the intrados, is less subject to movement and cracking caused by extreme temperature changes than is the open spandrel. The solid barrel type, in addition, offered greater mass and at the same time less obstruction to the passage of ice.

In the design of the approach retaining walls, a radical departure from standard practice was made in that the foundations were carried down through more than 20 ft. of excavation, and bonded into the rock. This exceptional treatment was brought about by the exceptional conditions at the site. Just east of the north end of the bridge, the Cornish baths had shown a strong tendency to move toward the river, and a few hundred feet west of the bridge, several apartment blocks had actually moved and tilted. One section of one of these blocks had been condemned and demolished. It was clearly evident that the bank was not stable and that structures resting on this bank would be equally unstable; so recourse was had to the unusual foundations here described.

Each arch was designed for a maximum live-load of four 50-ton cars with a 20 per cent impact allowance. The arches have been so proportioned that under all conditions of loading the line of resistance lies within the middle third, resulting in a maximum compression of 453 lb. per square inch. The maximum for combined live-load, dead-load, rib shortening, and a temperature drop of 40 deg. is 682 lb. per sq.in.; and for a temperature drop of 60 deg., the maximum combined stress is 750 lb. per square inch. To provide for tensile stresses due to rib shortening and temperature, steel reinforcement has been provided.

The bridge rests on solid rock foundations. The abutments were designed with the line of resistance within the middle third and with a maximum pressure on the rock of 9½ tons per square foot. The rock was excavated to a depth of 6 ft. to provide additional resistance to sliding. The maximum bearing pressure from the pier on the rock is 11 tons.

The spandrel walls were designed as cantilevers resting on the arches, the moment from the sidewalk brackets being transmitted through counterforts to the arch rings. Expansion joints at the haunches provide for lateral movement resulting from the fall of the arches due to a drop in temperature, and at the third points expansion joints predetermine the cracks resulting from the rise of the arches due to a rise in temperature. All joints have been continued to the handrails and appear to be working satisfactorily. Those at the junctions of the handrails with the piers and abutments have opened approximately ¾ in. at this writing. All joints in the walls and sidewalks have been sealed by folded strips of sheet lead to prevent the escape of water through the joints with attendant discoloration of the concrete.

Proportioning of Concrete Mixtures.—The engineering department had been instructed to use the gravel and rock provided by the Greater Winnipeg Water District at a price of $3.85 per cu.yd. for gravel supplied during the winter, $3 per cu.yd. for gravel furnished during the summer, and $4 per cu.yd. for crushed rock. The problem, stated simply, was to determine the economical proportions of cement, sand, rock, and water, combined to form concrete, that would give an assured compressive stress of 2,250 lb. at 28 days, i.e., three times the maximum stress in the arches. Preliminary investigations disclosed the fact that there were wide variations in the physical characteristics of different samples of gravel from the same pit. Tests of the gravel showed that the weights per cubic foot varied from 98 to 115 lb., and that the coarse retained on a ¼ in. screen varied from 21 to 48 per cent. Two series of tests were carried out, each embracing the making and testing to destruction of 60 cylinders, each 6 in. in diameter and 12 in. long. In the first series, the lighter, coarser gravel, weighing approximately 100 lb. per cubic foot was used. The materials were combined in one group to make 1 part of cement to 6 parts of the aggregate such as 1:1½:4½, 1:2:4, 1:3:3, 1:3½:2½, and 1:4:2; and in another group to make 1 part of cement to 7½ parts of the aggregate, as; 1:2:5½, 1:2½:5, 1:3:4½, 1:3½:4.

In the second series similar proportions were used with a gravel that weighed approximately 114 lb. per cubic foot. While no mechanical slump test for consistency was employed, the amount of water used was the least consistent with proper workability. The quantity of water used in the first series varied from 6 to 8 per cent by weight of the cement and aggregate, and the water cement ratio from 0.58 to 0.86 by volume. For the second series, the quantity of water varied from 7 to 9 per cent, and the water cement ratio from 0.76 to 1.05.

Final Tests.—Compression tests at 28 days showed cylinders of the first series to be about 22 per cent stronger than those of the second although composed of the same proportions by volume. In order to assure satisfactory results under the most adverse conditions, it was assumed that when it came to work in the field the aggregate might be of the grading used in the second series showing the poorer results. Revising the proportioning to meet the contract specifications of 5 sacks of cement per yard for foundation concrete and 6 sacks per yard for superstructure concrete, and running confirming tests, revealed that the best results at the least expenditure were obtained with the proportions of one of cement, four of gravel, and two of rock for foundation concrete; and one of cement, three of gravel and two and one-half of crushed rock for superstructure concrete. Complete records of the properties of the ingredients and of the concrete, were filed.

In order to be sure that the concrete in the structure was of the quality anticipated as a result of the tests, sample cylinders made of the concrete actually placed, were taken daily and tested at 28 days. The concrete placed in the substructure, containing 5 sacks of cement per yard, was very dry and would just quake under tramping. The average of the tests run during the months of February, March and April for this class of concrete was 2,100 lb. per square inch at 28 days. The concrete in the approach walls, containing 6 sacks of cement per yard, was wetter than the foundation concrete, but with only enough water to permit of spading and consolidating the mass in the thin walls. The average of the tests for this class of concrete placed during May and June was 2,300 lb. per square inch. The concrete in the arches containing 6 sacks of cement per yard would not flow, although it contained sufficient water to enable its being worked up to a quaking consistency. The average of the tests for the concrete in the arches at 28 days was approximately 2,800 lb. per square inch. The importance of keeping the water content of the concrete at a minimum consistent with workability was emphasized and impressed upon the construction organization, with the result that we were able to obtain results beyond our anticipations. The increase in strength from 2,300 to 2,800 lb. per square inch for concrete with the same combinations of solids but of different consistencies, is significant.

The mixture for the handrail was proportioned by cut and trial methods. Sample slabs were prepared with different combinations of the aggregates, and, after having been scrubbed and washed, these samples were placed side by side and compared. The proportion adopted was 1 cement : 2½ broken red granite : 1 granite dust : 1½ torpedo sand.

Construction Methods—The execution of this work involved no spectacular operations. The prescribed task was to construct the new bridge with a minimum disturbance of the dense traffic over the steel bridge, the center line of which lay west of the new bridge with the floors of the old and new bridges overlapping.

The substructures of the abutments and pier were constructed as units; the superstructure, including arches, walls, sidewalks, and fill, was constructed in two parts, the east half of the bridge having been completed and thrown open to traffic before the removal of the steel bridge, and the commencement of construction upon the west half. This plan was adopted on the ground of economy, and because operations might be conducted with the least interference with traffic.

Excavation for the abutments was commenced in December, was carried out with the usual derrick and skip or bucket equipment and because of the seasonal cold was expensive work. In preparing the foundations for the pier, an orange-peel bucket was used to remove a surface layer of rocks and boulders. A line of Wakefield sheetpiling was driven from leads suspended from a derrick boom and this piling backed by a puddle, the combination affording an adequate water seal whereby the water within the dam was kept down by a single centrifugal pump. In excavations for the abutments and approach walls, sufficient water was encountered to necessitate continuous pumping.

The concrete plant for the foundations included a paving mixer with a side-loading hopper for which extension leads had been prepared. In concreting the pier, this mixer was placed on cribbing at an elevation high enough to permit of dumping directly from the mixer to the pier. The cement, gravel and rock were placed in the loading hopper with wheel barrows at ground level, and elevated to the mixer over the extension leads. In concreting the abutments, the mixer was placed on the ground near the edge of the excavation, the aggregate placed in the side-loader with wheel barrows, and the concrete conveyed through chutes to place.

The water and aggregate for concrete placed during cold weather were heated and the spaces containing con-

crete were housed and heated for a considerable period after the placing of the concrete. Every effort was made to give the concrete the advantage of being cured under conditions as nearly normal as possible.

Sand and stone for the superstructure concrete were hauled to the site in automobile trucks and dumped into receiving pits from which they were raised into storage bins by a bucket elevator. This plant was so located in the west half of the north approach that it was possible to complete all concrete work without relocating the plant. The concrete was dumped from the mixer into side-dump cars and drawn to place over a light wooden trestle by a small gasoline dinky, the engine for which had been taken from a mixer. In placing the concrete for the sidewalk and spandrel walls, concrete buggies were drawn to place by the dinky on flat cars made in part of trucks from side-dump cars. The plant was cheap and eminently satisfactory; the results excellent.

The falsework was conventional, except perhaps, in the method employed to obtain the arch curve. In place of the standard practice of cutting the curves from the stringers, wedges and waste blocks and planks were added to build up the curves on plain stringers. Under this method much lumber otherwise worthless was used, and the stringers of new stock after having been used were available for further use thereby saving new lumber. Cinders for the fill were accumulated during the first half of the year in an adjacent vacant lot where they were loaded into dump carts with a light electric shovel and hauled to place on the bridge.

Construction began in December, 1920; the east half of the bridge was opened to traffic in August, 1921, and the west half in November. The street car traffic commenced on Dec. 1, 1921. The bridge was constructed under the direction of City Engineer W. P. Brereton, whose estimate of $250,000 was low in a competitive bidding. The bridge has been completed well within the contract price. A. L. Cavanagh was superintendent, Allan Cotman, chief draftsman, and J. F. Greene, consulting engineer.

Austral Super Dam or Dew Ponds Projected

Utilization of the principle underlying the ancient "dew pond," remains of which are still to be seen on the Downs of Sussex and Hampshire, England, is proposed on a large scale in Queensland, according to a correspondent of *The North Queensland Register* (London office, 22 Basinghall St., London, E.C. 2). The principle involved is that of condensing water from the air by bringing the water-laden air in contact with colder ground surfaces properly inclosed by embankments or by a dam across a valley. The promoters, of whom E. E. Kennedy of Brisbane, Queensland, is the leading spirit, have copyrighted the term "austral super-dam" as the name for their storage project. Supplementary to the information given in the journal quoted, it may be stated that some years ago there was published in England a book entitled "Neolithic Dew-Ponds and Cattle-Ways," by A. J. and G. Hubbard, (London and New York; Longmans, Green & Co.) A second edition of this book was reviewed in the Engineering Literature Supplement of *Engineering News* for Feb. 20, 1908. These ancient dew-ponds are also described by Richard Jefferies in his "Wild Life in a Southern County" (London, 1879); also an American edition under the title, "An English Village," published by Little, Brown & Co., Boston.

Experience in Treating Bridge Timber on the Santa Fe

40-Year Life Possible for Creosoted Ballast-Deck Bridge—Repair of Rotted Members—Value of Air Seasoning—Field Tests on Caps

By A. F. Robinson
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Paper presented before the Western Society of Engineers in joint Meeting with American Wood Preservers Association.

THE first creosoted piles on the Santa Fe System were used in 1875 in an open-deck pile bridge across Galveston Bay. It was rebuilt in 1895. When the Causeway was finished the piles in the later bridge were removed and the larger portion of them were used again in pier foundations. The first creosoted ballasted-deck pile bridges were put into service late in 1899. The same season we used creosoted timber flooring on a ballasted-deck steel bridge at Los Angeles. When the joint track elevation bridges were built in Chicago creosoted timber flooring with waterproof covering was used for supporting the ballast. From 1900 the use of creosote increased rapidly and by 1908 almost all timber used in bridges was creosoted.

Creosoted ballast-deck timber bridges from 16 to 20 years old seem to be in perfect condition and give promise of 15 to 20 years more. These may, therefore, be considered as permanent structures. Some 38 per cent of all our bridges, which have a total length of 188 miles, are ballast-deck and almost 50 per cent are considered permanent structures. Based on main lines, only 68 per cent of all bridges have ballast decks. No open-deck bridges of any kind have been built on our main lines during the past 10 years, except after washouts or burnouts.

Creosoted-timber bridges had not been in service long before we found that there were many things to be learned about cutting, handling and curing before treatment; also handling the treated material and building the bridges.

Some of our troubles and the method of overcoming them may be worth recording. During 1909-1910 we had many complaints about rotten piling on our Beaumont division where timber seems to decay more readily than on any other part of our lines. A few miles east of Cleveland, Tex., is an experimental section, where we are trying out all kinds of treatment on ties, fence posts, etc. This section was taken because the soil and climate seemed to be especially adapted to produce rot in timber, both treated and untreated. I spent about four weeks going over this division, examining every pile bridge in the closest detail. The complaints were well founded. I found at least 2,000 piles that were rotting badly. The piling and timber used were treated in commercial plants from 1900 to about 1907. Up to that time no rules had been made covering the time the material was to be left in the woods after cutting and the time it was to be cured before treating. Many piles were treated which should have been culled. They were left in the woods several months and the material had commenced to decay before it was taken to the treating plant. In cases of this kind treatment is wasted. In many cases perfectly green piling and timber were treated.

Piles after driving in the bents are sawed off for capping. Our plans called for the application of hot creosote to these freshly-cut surfaces before the caps were applied, but a large percentage of the piles had begun to fail at the caps. Inside a layer or ring of sound creosoted sapwood would be a ring of untreated sapwood which was rotting very rapidly. The caps were 12 in. wide and the piles varied from 12 to 18 in. in diameter, leaving a portion of the pile head projecting beyond the sides of the caps. In some cases I could put a 4-ft. rod down in the rotten sapwood between the outer creosoted ring and the inner heartwood. In many cases much of the load was being carried by the outer creosoted ring of sapwood and but little load by the heartwood. In other cases, not started at or near the ground surface, decay also commenced in holes bored for [illegible] brace bolts and for other purposes. It would start wherever the creosoted surface was scratched or bruised deeply.

Our men had the unfortunate habit of chamfering the sides of the piles at the cap so that they would drain. Frequently they would cut out large chips or sections from the side of a pile in order to make the swaybraces draw straight. In every case of this kind decay seemed to start very promptly as the cut in the timber usually extended through the creosoted layer. Careful study seemed to show that the cause of decay was due to leaving the heads of the piles or some other portions unprotected or untreated.

Another source of trouble was the driving of the piles. I found many cases where the heartwood had been broken loose from the sap, due to the fact that the blow from the hammer was being delivered into the pile over an area of less than one-half its surface. We overcame this difficulty by providing a driving head which rested squarely on the head of the pile and was so arranged that the blow from the hammer must be distributed over the entire surface of the pile. (See *Engineering News-Record*, Feb. 23, p. 314.)

As a remedy for the above troubles we cut down the decayed piles to good solid material and inserted framed bents or blocking of varying heights. When the piles were sawed the freshly-cut surfaces were treated with three or four coats of hot creosote mixed with heavy road oil. A sheet of some kind of prepared roofing was then applied over the fresh coating and the creosoted-timber bent put into position and drift-bolted to the piles. These repairs were made more than ten years ago and up to the present we have not been able to detect any more indications of decay.

When we cut these piles the cross-sections were examined very carefully and it was found that the creosote had penetrated the piles irregularly. On one side the treatment would be almost as thin as a sheet of paper and on the other side it might be 2 in. thick. We concluded that this unevenness was due to moisture in the piling, which resulted from the steaming and the improper seasoning.

When we opened our own treating plant at Somerville, Tex., all material was carefully air cured and no steaming of any kind was done in the treating process. As a result we have been able to get a very uniform penetration of the creosote. On the other parts of the system we have had very few piles fail at the caps, but where the trouble has occurred it has been overcome in the same manner as noted for the Beaumont division.

Examination of the stringers in ballast-deck bridges, which had been steamed in the treatment, showed a similar condition to the piling, but it was not so extensive. We have in a very few cases found some of the outer stringers decayed on the upper surface, as a result of the irregular penetration of the creosote. Where the timber is air seasoned and the treatment is applied without heating we have not had any trouble from decay in southern pine.

As the result of our trouble from rotting of piles at the caps we made quite an extended test on a field treatment of piles when cut for caps. With our first apparatus we were able to get ⅜-in. end penetration of the creosote. Several first-class creosoted piles were cut into lengths of about 3 ft. and also a similar number of untreated piles which were reasonably well seasoned. A part of these short creosoted specimens received the end treatment with our pressure apparatus. The other samples were painted with various kinds of preserving material and also several kinds of R. I. W. paint. After the coatings had properly dried these short pieces of piling were set up in a trench in the ground on our right-of-way 2 miles east of Cleveland, Tex. These pile butts were set 18 in. out of the ground, in an exact line and at the same elevation. A cap 12 in. wide and 4 in. thick was placed on top of the row of pile butts so that the test would be relatively the same as in the bent of a pile bridge.

We have examined these pile heads annually for eight years past. At present the samples of creosoted piles having pressure treatment on the ends and several of those receiving brush coatings on the ends are still in good condition. These investigations lead me to feel that a brush coating of hot heavy creosote, of Reeves Wood Preserver and Koch's R. I. W. paint will protect the freshly-cut head of creosoted pile for a long time. As yet I am not certain as to whether it will be necessary to use the pressure treatment for the ends of piles since the brush coating seems to be giving extremely good results. The application of the brush coating will cost considerably less than the pressure treatment.

Investigations made seem to show that the following rules in handling timber at the treatment plants must be adhered to absolutely:

1. Treated timber must not be cut, bruised or handled in a rough manner. Grab hooks or dogs should not be used in handling the material, unless the holes made by the hooks are carefully plugged with creosoted pins.

2. The driving of piles must be done with a hammer which will not split them or break the sap loose from the heartwood.

3. Any cut surfaces or bored holes must be carefully treated with hot creosote and the holes plugged.

Where solid stringers are used in a ballast-deck bridge without any cross planking it is necessary to make end cuts on some of the sticks on account of the variation in panel lengths of bridges due to driving of piles. These freshly cut ends must be thoroughly coated with creosote before the stringer deck is placed. A few years ago the Southern Pacific Lines in Louisiana and Texas removed the decks from 15 or 20 pile bridges which had been in service about 25 years. These decks were made of a solid course of 12 x 12-in. timbers and were removed because they were getting too light for the power being used. Examination of these stringers after being removed showed that they were in perfect condition as concerns decay, except where they had rotted in from the ends which had been cut after creosoting.

In open-deck timber bridges the stringers and ties are untreated, but for some years past the ties on open-deck steel bridges have been creosoted. The ties are always run through a surfacing machine and brought to exact depth. While Oregon fir loses quite a percentage of its strength as a result of steaming or boiling during treatment, we have had no stringers break under traffic. Fir caps in bridges built under our old standard plans have, however, given some trouble. A good many fir caps are "boxed heart" pieces and our ballast-deck bridges had too many drift bolts through the stringers into the caps. The failures in caps were always in Oregon fir pieces. In almost every case of failed caps I found that the timber was burned or charred in the boiling treatment and the sticks broken up into rings, much like the layers in an onion. Culling "boxed heart" pieces and holding the boiling temperature to a maximum of 220 deg. F. very largely stopped the trouble with the fir caps.

Water Meters and Water Loss in Indiana

At the recent meeting of the Indiana Sanitary and Water Supply Association much attention was given to water meters and their beneficial results. E. J. Jenkins, manager, East Chicago Water Co., said that meters reduced the consumption at East Chicago from more than 200 gal. per capita late in 1920 to 70 gal. in December, 1921, when 12 per cent only was unaccounted for. William Luscombe, vice-president, Gary Heat, Light & Water Co., said 83 per cent of the water pumped to their 50 per cent metered system was accounted for. At North Manchester the loss is 6.77 per cent only. Lexington, Ky., the first all-metered city in the United States, according to W. S. Cramer, chief engineer, has 16½ per cent loss. Whiting has no meters. In 1920 the consumption was 4.2 m.g.d. or 420 gal. per capita. A house-to-house survey disclosed 700 leaky toilet fixtures. The consumption was reduced by 1 m.g.d., after repairs to services were made and a few large leaks in mains were shut off. J. B. Marvin, vice-president, Frankfort Water Co., said that of the $50,000 being spent by his company on new work, $33,000 was devoted to working the plant 100 per cent metered.

Placing 410,000 Cu. Yd. of Concrete on Ontario's Niagara Power Development—II

Source of Aggregate, Storage of Cement and Aggregate and Testing of Cement and Concrete for Power House, Forebay and Lining of Nine-Mile Queenston-Chippawa Canal

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AND

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Part I of this article, which appeared in last week's issue, described the concrete structures on the new hydro-electric development which the Hydro-Electric Power Commission of Ontario is building around Niagara Falls and detailed the many mixing and placing plants which produced 410,000 cu.yd. of concrete in the thirteen months ending last December. This section of the article describes the source of supply of the concrete material and the tests which showed how closely to a prescribed strength the various concretes ran. An earlier article on this method of proportioning and testing appeared in "Engineering News-Record," Mar. 17, 1921, p. 456.—Editor.

A TOTAL of 506,125 bbl. of cement has been used to date, obtained from five different mills. A large part was "bin tested," that is it was sampled, tested and accepted before it left the mill. To make this possible, special bins were reserved at the mills for the exclusive use of the commission. As these were filled, samples of the cement were taken from the conveyor and sent to the commission's laboratories at Toronto for test. Shipments were only made after cement was shown by the tests to be satisfactory, after which it was loaded as required under the supervision of a representative of the commission resident at the mill. As the design of the concrete plants permitted the handling of cement in car lots this arrangement proved a great convenience, since accepted cement could be used directly on receipt at the work, without either delay or rehandling.

Because of the severe cement shortage experienced in the summer of 1920 it was decided to store a large quantity of cement during the winter of 1920-21. Three large sheds, two 35 ft. wide and one 20 ft. wide and totalling 1,760 ft. in length were erected, in these were placed 112,000 bbl. of cement. This cement was stacked as compactly as possible to a height of 11 ft. The doors of the buildings were then sealed and not reopened again until the cement was used. All of this cement was stored over the winter and some of it for eleven months. Practically no cement losses occurred due to the hazards of storage while tests made showed it to have suffered no appreciable deterioration.

Aggregate.—The aggregates used throughout the work were sand and crushed rock. Sand was obtained from several different sources. The first came from a pit which was acquired along with other property as part of the right-of-way. From this pit came most of the sand used in 1917 and 1918. Later, after a careful examination of available sources of supply and after exploring the contiguous district for possible deposits, a pit was purchased which met the needs of the work until the spring of 1921 when it became necessary to obtain large quantities from other sources.

Aproximately 235,000 cu.yd. of sand were purchased. Half of this was obtained from a pit accessible from the tracks of the commission, and the rest from Lake Ontario. Both deposits contained materials of excellent quality.

The pit sand was loaded by steam shovel into side dump cars and delivered by the contractor either directly to the concrete plants or to the storage situated at the forebay. The lake sand was dredged from the bar at the mouth of the Niagara River by a sand sucker of 500 cu.yd. capacity which made four trips per day. This boat delivered the sand into a large storage bin situated alongside the Michigan Central tracks at Niagara-on-the-Lake, from which it was loaded by derricks fitted with clamshell buckets into standard steel dump cars. From here it was hauled 12 miles to the commission's siding at Stamford where it was picked up by the commission's locomotives and either distributed to the work or sent to storage if not immediately required.

Both sands used were of limestone origin, the pit sand having an average surface area of 2,130 sq.ft. and the lake sand of 1,680 sq.ft. per 100 lb. This is equivalent to a fineness modulus of 2.7 and 3.2 respectively. The former contained from 4 to 8 per cent by weight passing the No. 150 sieve while the latter had almost none of this fine material. To attain the same result under identical conditions, the pit sand was found to require approximately one-half bag of cement more for each yard batch of concrete than the lake sand due in part to the difference in graduation and in part to differences in the character of the constituent particles of the two aggregates.

Crushed Rock.—The crushed rock was a dolomitic limestone from the canal excavation. It was delivered as excavated to a 60 x 84 in. jaw crusher, when it was broken up, thence by belt conveyors to a battery of four gyratory crushers which reduced it to approximately 2½ in. stone and under. From these it passed to a screening plant where the dust was removed on a ¾-in. dust jacket and the rock screened on a revolving screen 6½ ft. in diameter and 30 ft. long fitted with plates having 3-in. round openings which gave commercial 2½ in. screened crusher run. This was discharged upon a belt and taken to storage. The oversize from this screen went to a small gyratory crusher which crushed it to 1½ in. The product of this crusher was screened and stored separately and used where the larger sized material would be objectionable. The capacity of the crushing and screening plant was 3,000 cu.yd. per day and this capacity was reached in operation, the output averaging close to this figure for extended periods.

The grading of this crushed rock was practically

uniform between ¼ and 2½ in. It contained on an average 8 per cent of dust and crusher screening. These could not be entirely eliminated because of the nature of the rock and the fact that it was usually wet and somewhat dirty when crushed. It was reasonably free from flat and elongated particles and proved to be a satisfactory aggregate.

The choice of 2½ in. as a maximum size was a compromise between the requirements of the concrete and of the large quantities of crushed rock which were to be used for ballast, highways, foundations and fill. If only the requirements of the concrete could have been considered a smaller maximum size would have been more satisfactory, for its use would have been less severe on the concreting plants and the concrete would have been easier to handle and place. Since of the 1,262,000 cu.yd. of stone crushed to date less than 400,000 cu.yd. were used in concrete (a part of which had already been crushed to 1½ in.) this decision as to size has proved wise.

Aggregate Storage.—The principal storage was at the forebay in conjunction with the crushing plant. Large towers were built at each end and in the center of the storage area. From these towers a platform was suspended carrying a belt conveyor with a traveling trip by which it could be discharged. This permitted distribution of the material to any part of the area desired.

The stone was fed directly to its conveyor from the screening plant. The sand which was received in cars, was run over hoppers and dumped. From these it was elevated by a bucket conveyor up the intermediate tower to the sand conveyor overhead by means of which it was distributed similarly to the stone. It was thus possible to keep the two kinds of sand separate. The stone storage had a capacity of 160,000 cu.yd. of 2½ in. and 70,000 cu.yd. of 1½ in. while the sand storage had a capacity of 50,000 cu.yd. and this was taxed to the utmost during the progress of the work.

When in July it was decided to delay completion of the canal beyond September it was found necessary to find some auxiliary storage for some of the lake sand as it was then being received faster than it could be used. Hence some 40,000 cu.yd. were dumped on a level field convenient to the construction railway from which it was later reclaimed by steam shovel.

The storage piles of both sand and stone were close together and had a common center line along which a covered trench was constructed the full length of both piles. In this tunnel ran a reclaiming belt fed by bin gates from above. After leaving the tunnel the belt rose on an angle of 18 deg. to storage bins from which the aggregate was loaded by gravity into cars for distribution to the concrete plants. A feature of this arrangement was the use of this belt for reclaiming either sand or stone as desired, discharge end being rigged with a gate which diverted the reclaimed material into either the sand or stone bin.

Four classes of concrete, called for convenience Classes *A*, *B*, *C* and *D* were in use on this work. Class *A* was specified as being of such quality as to show a minimum compressive strength of 2,500 lb. per square inch at the age of 28 days when tested in accordance with the standard methods of the Commission. Classes *B*, *C* and *D* were required to have minimum compressive strengths of 2,000, 1,500 and 1,000 lb. per square inch, respectively, under the same conditions. The standard methods of testing referred to are essentially those adopted by the American Society for Testing Materials.

Such a specification made it incumbent upon the field engineers so to regulate the materials, proportions and practices of the construction forces as to result in concrete of the specified quality. To carry out this a very complete system of inspection was maintained and a field laboratory installed.

Inspection commenced with the materials and at their sources of supply. Inspectors were kept at points from which sand was being obtained at the crushing plant and at the cement mills. Those inspecting sand shipments were supplied with sieves for testing and were required to report daily on the quality and grading of the materials shipped under their supervision. Sand not meeting the requirements of the commission was not allowed to be loaded and never got to the work.

One or more inspectors were placed at each of the concrete plants. Their duties were the usual duties of a concrete inspector but they had the power to vary within certain limits the proportions set by the egineers to conform to the inevitable variations in materials and for the changing conditions under which the concrete had to be placed, They were also required to take periodically from the forms samples of the concrete and prepare these for testing.

The field laboratory was equipped with a 100-ton hydraulic compression testing machine of simple and inexpensive design and the usual equipment of sieves, scales and miscellaneous apparatus for testing aggregates. Space was also provided for the storage of concrete test cylinders during the curing period.

Proportions for the different classes were set by the chief field inspector and were determined by a modification of Edwards surface area method of proportioning, as developed in the laboratories of the commission. By this method not only were the proportions of cement and aggregate set but also that for the water. This was accomplished by limiting the quantity of water per bag of cement for each class of concrete. The consistency of the mixtures used was such as to flow readily but without segregation down a chute with a slope of one vertical to two and one-half horizontal. Where the consistency could not be obtained with the proportions set or where circumstances required a wetter mixture additional cement was added until the ratio of water to cement was brought within the limits set. In other cases where a drier consistency could be used, advantage was taken of the circumstance by using less cement, always maintaining the proper ratio of water and cement.

Results of Tests.—That these methods resulted in concrete of uniform quality fully meeting the specifications is evident from its excellent appearance and the results obtained upon test. In Table I are given complete results from the tests of concrete placed in the powerhouse and canal lining during the months of May to July or through the height of the period when work was being rushed to the uttermost. The results speak for themselves. On the entire job from Nov. 1, 1920, to Nov 1, 1921, 74 per cent of the test cylinders either met or exceeded the specification requirements while 87 per cent either met them or did not fall below them more than 200 lb. per sq.in.

TABLE I. COMPRESSION TESTS ON FIELD CYLINDERS
CHIPPAWA POWER DEVELOPMENT
May 1 to July 31, 1921, inclusive

POWER HOUSE

Class B

Date Taken	Nominal Proportions By Volume	Compressive Strength 28 Days Lb. per Sq.In.	Date Taken	Nominal Proportions By Volume	Compressive Strength 28 Days Lb. per Sq.In.
May 9	1:1.83:3.66	2,655	June 16	1:1.83:3.66	2,775
May 16	1:1.83:3.66	2,435	June 21	1:1.83:3.66	3,750
May 19	1:1.83:3.66	2,322	June 23	1:1.83:3.66	2,785
May 26	1:1.83:3.66	2,680	June 29	1:2.44:4.88	1,927
May 30	1:1.83:3.66	2,449	July 1	1:1.83:3.66	2,280
June 2	1:1.4 :4.4	2,180	July 16	1:1.83:3.66	2,324
June 4	1:1.83:3.66	2,443	July 20	1:1.83:3.66	2,398
June 7	1:1.83:3.66	2,140	July 30	1:1.83:3.66	...

Class C

May 2	1:2.5 :5	1,253	June 18	1:2.44:4.88	2,420
May 5	1:2.5 :4.25	1,920	July 5	1:2.44:4.88	1,802
May 11	1:2.44:4.88	1,728	July 8	1:2.44:4.88	1,941
May 14	1:2.44:4.88	1,725	July 12	1:2.44:4.88	1,703
May 28	1:2.44:4.88	1,855	July 14	1:2.44:4.88	1,304
June 9	1:2.44:4.88	1,825	July 26	1:2.44:4.88	2,030
June 11	1:2.44:4.88	2,198	July 28	1:2.44:4.88	1,027
June 14	1:2.44:4.88	2,345			

CANAL LINING PLANTS

Class C

Date Taken	Nominal Proportions By Volume	Compressive Strength 28 Days Lb. per Sq.In.	Date Taken	Nominal Proportions By Volume	Compressive Strength 28 Days Lb. per Sq.In.
May 4	1:2.5 :5	2,935	June 16	1:2.5 :4.8	2,755
May 6	1:2.5 :5	2,687	June 17	1:2.8 :4.4	2,360
May 6	1:2.5 :5	1,555	June 19	1:2.5 :4.8	2,310
May 9	1:2.5 :5	3,066	June 19	1:2.2 :4.8	1,797
May 9	1:2.5 :5	1,673	June 20	1:2.5 :5	1,710
May 11	1:2.5 :5	1,910	June 21	1:2.2 :4.8	1,912
May 13	1:2.8 :4.4	2,050	June 21	1:2.2 :4.8	1,840
May 14	1:2.5 :5	1,877	June 22	1:2.5 :5	1,652
May 16	1:2.8 :4.4	1,633	June 23	1:2.2 :4.4	1,590
May 16	1:2.5 :5	1,077	June 24	1:2.2 :4.8	1,780
May 18	1:2.8 :4.4	1,843	June 25	1:2.2 :4.4	2,935
May 18	1:2.4 :4.4	1,827	June 26	1:2.5 :4.8	1,810
May 19	1:2.5 :5	1,865	June 29	1:2.2 :4.2	1,720
May 20	1:2.8 :4.4	1,820	June 29	1:2.77:5.55	1,450
May 20	1:2.5 :5	1,930	June 30	1:2.5 :5	1,548
May 23	1:2.5 :4.16	1,743	July 1	1:3.11:4.88	1,768
May 23	1:2.5 :5	1,292	July 2	1:2.2 :4.4	2,071
May 25	1:2.5 :5	1,922	July 4	1:3.11:4.88	1,607
May 25	1:2.5 :5	1,868	July 5	1:2.2 :4.2	1,892
May 27	1:2.5 :5	2,445	July 5	1:3.12:6.25	1,390
May 28	1:2.5 :5	2,145	July 6	1:2.77:5.55	1,921
May 30	1:2.8 :4.4	1,845	July 7	1:2.2 :4.4	2,025
June 1	1:2.5 :5	1,865	July 8	1:3.11:4.88	1,472
June 2	1:1.33:4.06	1,845	July 11	1:2.77:5.55	1,412
June 3	1:1.28:4.44	1,886	July 12	1:2.2 :4.2	1,152
June 4	1:2.5 :4.8	1,688	July 13	1:2.77:5.55	1,530
June 4	1:1.45:4.36	1,720	July 14	1:2.5 :5	1,782
June 6	1:3.12:6.25	1,593	July 15	1:3.11:4.88	2,447
June 6	1:2.5 :5	1,428	July 15	1:2.5 :5	2,012
June 6	1:2.5 :5	1,488	July 20	1:2.2 :5	2,605
June 6	1:3.12:6.25	1,247	July 20	1:2.77:5.55	2,178
June 7	1:1.33:4	3,294	July 20	1:2.44:4.88	1,414
June 8	1:3.12:6.25	1,912	July 20	1:2.77:5.55	1,397
June 8	1:1.83:3.83	2,425	July 22	1:2.77:5.55	877
June 8	1:2.5 :5	2,853	July 22	1:3.11:4.88	1,515
June 8	1:2.4	2,396	July 25	1:2.77:5.55	2,549
June 10	1:2.8 :4.4	2,482	July 26	1:2.5 :5	1,613
June 10	1:2.2 :4.6	3,175	July 27	1:2.5 :5	1,515
June 11	1:2.5 :5	1,892	July 27	1:3.11:4.88	1,495
June 12	1:2.2 :4.8	1,594	July 27	1:2.44:4.88	1,435
June 13	1:2.5 :5	1,782	July 29	1:2.77:5.55	1,445
June 14	1:2.5 :4.8	2,403	July 30	1:2.5 :5	1,603
June 14	1:2.4 :8	1,320	July 30	1:2.5 :5	1,557
June 15	1:2.5 :5	1,677	July 30	1:2.77:5.55	1,387
June 16	1:2.5 :5	2,165			

Class D

May 13	1:3.12:6.25	1,663	June 30	1:3.11:4.88	1,632
May 30	1:3.12:6.25	517	June 24	1:3.11:4.88	2,365
June 2	1:2:5	1,138	June 27	1:2.77:5.55	2,165
June 14	1:2.75:5.5	2,018	July 18	1:3.12:6.25	990
June 17	1:2.75:5.5	1,692	July 19	1:3.57:7.14	814
June 20	1:2.77:5.55	1,905			

The average amount of cement used per cubic yard of concrete of all classes on this work has been 1.28 bbl. of 350 lb. net weight, the Canadian standard barrel of cement, equivalent to 1.19 bbl. in American units. The averages for the different classes have been as follows:

Class	Minimum Compressive Strength at 28 Days Lb. Per Sq. In.	Barrels of Cement per Cubic Yard of Concrete
A	2,500	1.67
B	2,000	1.46
C	1,500	1.33
D	1,000	1.20

At times as much as an extra bag of cement above this average would be required to obtain the desired results but more often it was possible to meet the requirements of the specifications with less than the figures shown, for example Class *C* concrete has required as much as 1.45 bbl. (1.35 U. S. bbl.) of cement per cu.yd. while on the other hand the necessary requirements been obtained for extended periods with a 1:2¾:5½ mixture using 1.01 bbl (0.94 U. S. bbl.) per cu.yd.

Calcium Chloride.—During the winter of 1920-21 and again last fall, calcium chloride was used in the concrete place in the canal lining to accelerate hardening and so prevent a slowing down in the production of the lining plants. The quantity used varied from 6 to 15 lb. per yard batch, but averaged 9 lb. or about 2¼ per cent by weight of the cement in the mixture. The chloride was delivered to the plants in drums and was dissolved as required. The method usually followed was to fill a barrel with water to a mark set by the inspector: next was added chloride until the water level rose to a second mark, steam then being admitted into the barrel to dissolve the chloride until the level of the mixture rose to a third mark when a solution of the desired strength would result. No attempt was made to obtain greater accuracy in the measurements as this was not found necessary. Two gallons of this mixture was added to each batch of concrete by discharging it into the barrel used to proportion the water. A very noticeable increase in early strength was obtained and by its use it was possible to strip forms in as short a time as 12 hours even in freezing weather.

TABLE II—CONCRETE PLACED ON QUEENSTON—CHIPPAWA POWER DEVELOPMENT
(Week Commencing June 20, 1921)

Plant	Cubic Yards Placed
Powerhouse	1,162
Screenhouse	1,319
Forebay	151
Forebay (Gunite)	40
Division III	
No. 1 Lining Plant	998
No. 2 Lining Plant	137
No. 3 Lining Plant	1,131
No. 4 Lining Plant	1,306
No. 5 Lining Plant	1,866
No. 6 Lining Plant	2,170
Curve Lining Plant	336
No. 1 Paving Plant	137
No. 2 Paving Plant	219
No. 4 Paving Plant	172
No. 5 Paving Plant	966
Montrose Stationary Plant A	1,381
Whirlpool Stationary Plant	4,787
Total	18,278

From Nov. 1, 1920, to Dec. 17, 1921, 410,000 cu.yd. of concrete were placed, 379,000 cu.yd. of this being placed in 1921 while 332,000 cu.yd. of this latter quantity were placed from May to December inclusive or at an average rate of 41,500 cu.yd. per month. The record day's pour was 3,046 cu.yd. with 17 plants operating, the record week, 18,278 cu.yd. and the record month, 63,362 cu.yd. An idea of the diversity of operations is obtained from Table II which is the record of concrete placed during the record week.

Sir Adam Beck is chairman of the commission, for which Fred. A. Gaby is chief engineer, H. G. Acres, hydraulic engineer, T. H. Hogg, Assistant hydraulic engineer and M. V. Sauer, engineer of design. The work is in charge of H. G. Acres under whom G. H. Angell is general superintendent and A. C. D. Blanchard, chief field engineer.

Design of Sand Box for Kern River Hydro-Electric Plant

Operation of High-Head Reaction Turbines Demands Clear Water—Test Shows 400-Ft. Tank Settles Particles Passing 200-Mesh Sieve

By H. L. Doolittle
Assistant Construction Engineer, Southern California Edison Co.

IN ORDER to preclude the entrance of sand into the vertical reaction turbines installed at the Kern River No. 3 plant of the California Edison Co., every precaution was deemed advisable. The hydro-electric installation consists of two 22,500-hp. vertical turbines in this case operating under an 800-ft. head and utilizing 300 sec.-ft. A turbine of this type with high velocity and small clearances would suffer considerable damage if any appreciable amount of sand were carried in the water. In order to remove the sand from the river water, the sand box or settling basin herein described was constructed. The sand box is located near the diversion dam, about 12 miles upstream from the power house.

To be successful a sand box must accomplish two things: Cause the sand to settle out of the water; and provide for the easy removal of the sand from the settling chamber. In the present case it was necessary to provide for 600 sec.-ft. of water, so it is readily seen that some unusual problems presented themselves.

Centrifugal means of separating the sand from the water were considered entirely impracticable because of the amount of water handled. From a study of available literature it was decided that if the velocity of the water were reduced to 0.5 ft. per second, all sand particles of a size sufficient to cause damage to turbines would be precipitated. This, then, determined the cross-sectional area of the sand box to be 1,200 sq.ft. A size 20 ft. by 60 ft. was adopted.

In the design of the ordinary sand box the reduction of velocity is usually accomplished by means of a gradually-increasing section of the waterway. Too often the increase in area of the section is very abrupt, resulting in a rather swift current flowing through the center of the sand box and thereby defeating the very purpose of the structure. It is generally conceded that, if the angle of flare is about 6 deg., the water will entirely fill the section and will flow with almost a uniformly-decreasing velocity. In the case in point,



FIG. 2—GENERAL VIEW LOOKING DOWNSTREAM

if a constantly-increasing area were relied upon to decrease the water velocity, it would have required a taper section about 600 ft. long to give the waterway a width of 60 ft. While this type of structure would be effective it may be objected to because the cost would be great and in many places the space required would not be available.

Deflecting Walls—It is therefore seen that it is highly desirable to reduce the velocity of the water to a minimum in the shortest possible distance. This was accomplished by means of deflecting walls at the entrance to the sand box. By means of these deflectors the water is forced to distribute itself uniformly over the entire width of the box and is not allowed to flow through the center. As it was thought that there might be some tendency for the water to flow unevenly between the deflecting walls, their upstream edges were made movable. With this arrangement the water is distributed across the entire width of the box in a length of 50 ft., compared to the length of 600 ft. required with the ordinary tapering section.

Sand Removal—The removal of the sand from the bottom of the box is next to be considered. The most common method is to install several valves or sluice gates in the bottom of the box. While such devices are effective in removing the sand directly in their vicinity it has often been observed that only a cone of sand is removed and a considerable quantity is left

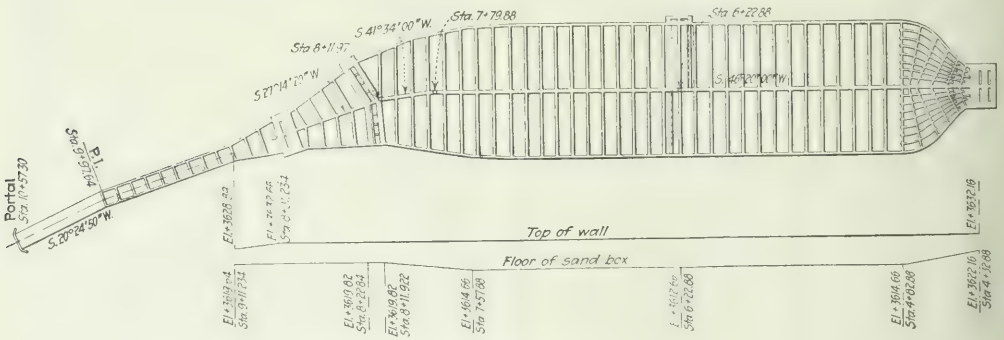


FIG. 1—PLAN AND PROFILE OF SETTLING BASIN

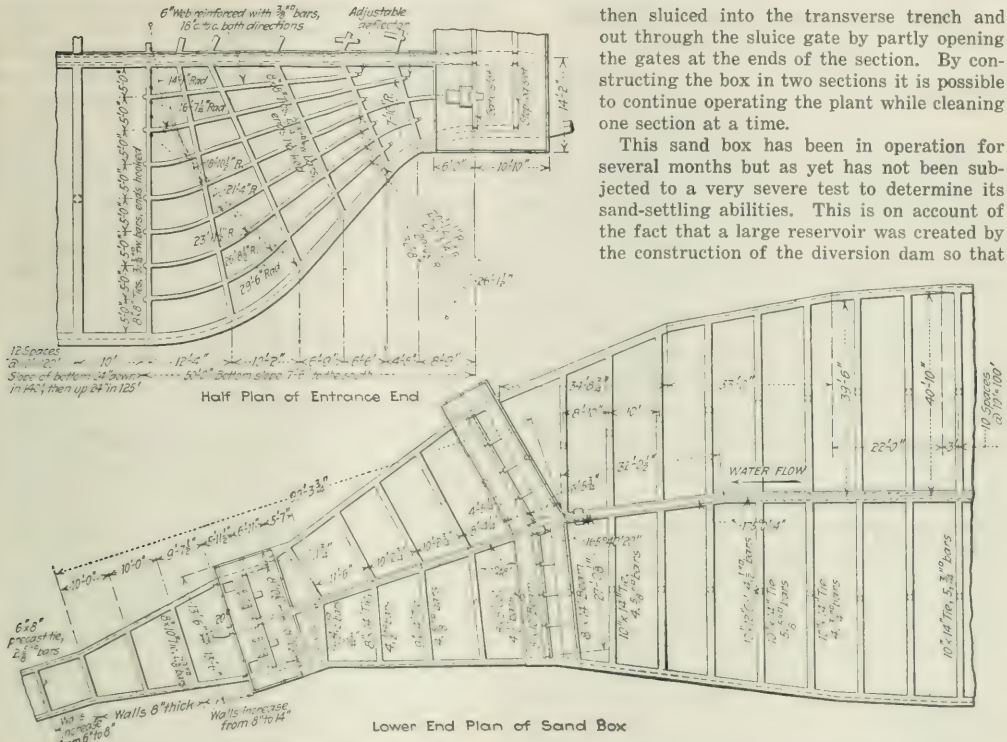


FIG. 3—END DETAILS OF KERN RIVER SAND BOX

between the valves. In addition it is desirable to have as few valves as possible, minimizing upkeep and water leakage.

On the Kern River project sand removal was effected by sloping the bottom toward a trench in the center, this trench connecting to a 4 x 5-ft. sluice gate in the side of the box. The box was made in two compartments with motor-operated gates at both ends. In removing the sand the gates at the ends of one-half of the box are closed and the sluice gate in the side is opened. This unwaters one-half of the box leaving the greater part of the sand on the bottom. The sand is then sluiced into the transverse trench and out through the sluice gate by partly opening the gates at the ends of the section. By constructing the box in two sections it is possible to continue operating the plant while cleaning one section at a time.

This sand box has been in operation for several months but as yet has not been subjected to a very severe test to determine its sand-settling abilities. This is on account of the fact that a large reservoir was created by the construction of the diversion dam so that practically all of the larger particles of sand are settled before the water enters the sand box. This condition is only temporary, as the reservoir will soon be filled.

Tests Show Effectiveness—Coarse sand is quite easy to remove. The finer particles cause the greater concern. However, a recent inspection of the sand box indicates that it is effective in settling very fine particles. When the box was unwatered a layer of fine sand and mica particles about 6 in. deep had been precipitated on the downstream half of the floor. There was no coarse material as this had collected above the dam. An analysis of the precipitated sand showed that 45 per cent passed a 150-mesh sieve and 26 per cent passed a 200 mesh. This would seem to show that the sand box is accomplishing all that could be expected.

The sand box is constructed entirely of reinforced concrete, the walls being tied across the top and bottom. The drawings show the box to be about 400 ft. long. This is more or less an arbitrary figure as there were no data at hand to show how long it requires a particle of a given size to settle out of water flowing at a certain velocity. From observations so far it is thought that the length is sufficient for all practical purposes.



FIG. 4—DEFLECTOR WALLS AT SAND BOX ENTRANCE

Typhoid Fever From Water Held Compensable

Typhoid fever contracted from impure water furnished by an employer is held an "injury" by "accident arising out of and in the course of the employment" under the Workmen's Compensation Act of Indiana, according to a decision of the Appellate Court.

Los Angeles Sewage Problem Again to the Front

Court, State Health Board, Local Section Am. Soc. C. E., County Farm Bureau, All Take a Hand —To Try Another Bond Vote

SINCE Los Angeles began the discharge of raw sewage into Ballona Creek as an emergency measure (*Engineering News-Record*, Feb. 23, p. 366, and March 2, p. 343) a local court has enjoined the discharge of sewage into the creek on the application of Culver City, Venice and private land owners along the creek, but has given the city 60 days from March 28 to provide other emergency means for handling the flow from the overcharged ocean outlet sewer. Recommendations by the State Board of Health for diminishing the sewage flow have been reported against by a committee of the Local Section of the American Society of Civil Engineers, which has also approved the plan of the city's engineering department and consulting engineers to continue ocean disposal after fine screening. This committee advises against any attempt at sewage utilization, by means of activation and irrigation or otherwise unless those who wish to use the sewage for agricultural purposes will stand all the expense necessary to that end. The committee also suggests that to relieve the pressure on the present ocean outlet a series of pumps be installed, as explained below. Besides all this opinion and advice, the Los Angeles County Farm Bureau has renewed its opposition of a year ago to a new outlet sewer and is advocating activated-sludge plants with the utilization of the sludge as a fertilizer and the effluent for irrigation.

After months of apparent inaction, the Los Angeles City Council has ordered a referendum vote on a $12,800,000 sewerage bond issue at the primaries on Aug. 12, with, it is said, no other bond issue on the ballot. Apparently this will be a second vote on the plan voted down 5 to 3 on June 7, 1921. The defeat just mentioned was the third one in five years, settling tanks and sludge beds having been voted down in 1916 and 1917. The election held in June, 1921, was postponed from a date earlier in the year, when the people were to have voted on a plan for a new outfall and drum screens worked out by the W. T. Knowlton, sewer engineer and John T. Griffin, city engineer (see abstract of a paper by Mr. Knowlton, *Engineering News-Record*, Feb. 24, 1921, p. 331; this article also brings out the overcharged condition of the present outfall). Opposition to the proposed election from various quarters and requests for export opinion on the projects led to cancelling the election and the engagement of George W. Fuller, Prof. George C. Whipple and William Mulholland to review the project (see *Engineering News-Record*, March 17 and June 30, 1921, pp. 484, and 1117, the latter being an abstract of the committee's report). The committee approved in substance the plans of the city engineering department for a new outfall and screens but advised more expense for multiple dispersal of the screened sewage and for protection of the interior of the outfall against acids. It also recommended the construction of a 2.5-m.g.d. activated-sludge plant to throw light on the possibilities of sewage utilization. To meet these increased costs a bond issue of $14,000,000 instead of $12,850,000 was recommended by the consulting engineers, but the city authorities submitted the lower figure—which was defeated, as already stated.

Following promptly after the bond defeat, Messrs. Griffin and Knowlton and the three consulting engineers advised that an election be called to vote on a bond issue of $3,500,000 to build temporary relief works, including two fair-sized activated-sludge plants—one on Ballona Creek. This advice was not followed.

Before the decision was rendered in the suit to enjoin the discharge of sewage into Ballona Creek, W. T. Knowlton, sewer engineer, suggested that the Sewer Committee of the Los Angeles Section Am. Soc. C. E. make a report on the situation to the City Council. The following has been abstracted from the report, which was made by Francis L. Sellew, F. G. Dessery and E. L. Adams:

The committee endorses the recommendation of the city engineer that steps should be taken at once toward providing an ocean outlet, with no pre-treatment except fine screening. The committee points out: (a) Ocean disposal is cheaper than any method of treatment. (b) No financially successful treatment has ever been devised for a community even remotely approaching in size that of Los Angeles. (c) There is no immediate demand for sewage effluent for irrigation. There is now wasted for half the year about 200 sec.-ft. of aqueduct water, which is four times the present volume of sewage. (d) Irrigation demands, if they existed, would be so variable that partial discharge into the ocean would be necessary for the greater part of the year and during some seasons the entire flow must go there. (e) When local anticipations are realized and there are two and a half to three million people in Los Angeles County, there will be little agricultural areas available for the reception of sewage.

The general conditions which Los Angeles faces justify the conclusion that the treatment of sewage for irrigation is a function of agricultural development. Provision should be made for the delivery to those who may desire it, and are willing to assume all the further burden of disposal, of all the raw-sewage they may request.

The importance of protecting the popular bathing beaches warrants care in means of disposal beyond the actual sanitary requirements. The method of disposal adopted should be so effective as to make it impossible to detect the presence of sewage in the surf by chemical analysis or otherwise. The point of discharge should be submerged at least 50 ft., with multiple outlets and no sewage visible from shore.

The committee is unable to endorse any of the three following suggestions made to the city by the State Board of Health under date of Feb. 4: "(a) That further petitions for residential connections, tributary to the outfall sewer be denied. (b) Divert into storm drains or natural water courses, all possible industrial waste water which, in the opinion of the City Health Department, will not be a menace to public health. (c) That if practicable the present water pressure in the service connections be reduced, as a considerable portion of the flow in any sewer system results from the excess use of water, and experience has taught us that the flow increases with high pressures and decreases with low pressures."

Since the overloaded sewer is not strong enough to carry additional pressure, the committee suggests that its capacity be increased by the installation of a series of pumps placed so as to increase the hydraulic slope. Under this plan only a short length of the outfall would be under pressure, a suction effect being exerted along most of the line. When the slope above one pump reaches the crown of the sewer, another unit would be installed to increase the slope beyond. Approximately ten pumping units would be required to enable the present outfall to deliver at Hyperion 30 per cent more than its present maximum.

Immediate ocean disposal for the entire city of Los Angeles should have the active indorsement of the Los Angeles Section, Am. Soc. C. E. The design should provide for the most thorough and comprehensive plan possible, with provision for a future metropolitan district.

In the decision already mentioned, which was handed down March 28 by J. Perry Wood, judge of the Los Angeles County Superior Court, the city of Los Angeles is declared to be creating an intolerable nuisance by discharging sewage into Ballona Creek and complainants are granted an injunction against the city (effective after 60 days) to prevent the continuation of the nuisance. An abstract of the decision is given in the following paragraphs:

The expert evidence indicates that chlorination would not sufficiently remove the dangers and objections attending the discharge of sewage into Ballona Creek and that the city has taken an untenable position in claiming that it has nowhere else to put its sewage. The recommendation of the State Board of Health is to the effect that decreasing water pressure decreases sewage flow, that industrial waste water could be diverted into storm drains or natural water courses and that further residential connections could be denied and cesspools permitted as emergency measures.

A storage reservoir which could be built in sixty days and which would have a capacity sufficient to hold the excess sewage which, for a part of each day now flows into Ballona Creek, would remedy the present situation if the quantity of flow did not increase. Such a reservoir could be pumped or drained into the outfall in the night time.

Within sixty days the city could provide other emergency disposal means; an activated-sludge plant to care for the excess flow of sewage for a period of years could be constructed and installed within six months; within the three-year period a new outfall sewer or additional activated-sludge units could be provided.

No announcement regarding a possible appeal from this decision or any other resultant action by the City Council has been received by this journal.

Estimated and Average Daily Water Consumption in St. Louis

COMPARATIVE figures of estimated and actual average total daily water consumption in St. Louis, Mo., by years from 1914 to 1921 agree closely except for variations due to abnormal weather. For the maximum day and for the average for the maximum week and maximum month there is, naturally, more variations. The figures, taken from a paper read recently by Edward E. Wall, water commissioner of St. Louis, before the Associated Engineering Societies of St. Louis, are given in detail in the accompanying table. Mr. Wall points out that war conditions had less to do with the departures from the estimates than did unusually dry or unusually cold weather.

From the figures given in the table Mr. Wall concludes that the annual daily average will be exceeded by 125 per cent for the maximum month in any year, by 135 for the maximum week, and by 150 per cent on the maximum day.

DAILY ESTIMATED AND ACTUAL FIGURES OF WATER CONSUMPTION IN ST. LOUIS, MO.

Year Ending Apr. 1	Population — Estimated	Population — Actual	Maximum Day — Estimated	Maximum Day — Actual	Maximum Week — Estimated	Maximum Week — Actual	Average Water Consumption in Million Gallons — Maximum Month — Estimated	Maximum Month — Actual	For the Year — Estimated	For the Year — Actual	Remarks
1914	729,000	725,500	136.7	120.4	125.0	112.0	114.0	105.0	91.1	91.1	Normal
1915	740,000	734,500	138.0	134.6	129.0	128.4	115.5	116.8	92.5	88.7	Cool summer, low consumption
1916	752,000	743,000	140.4	112.5	126.3	104.3	117.0	95.0	93.6	94.8	Normal
1917	765,000	751,500	114.0	131.4	130.0	124.7	120.5	116.3	96.2	101.2	Hot summer, high consumption
1918	778,000	760,000	148.2	163.0	113.6	146.3	124.0	116.9	99.0	105.1	Hot and dry summer, excessive consumption
1919	791,000	768,500	152.5	145.0	137.3	133.1	127.0	121.7	101.7	102.1	Normal
1920	804,000	777,000	156.5	137.1	141.0	131.0	130.5	122.4	104.5	104.6	Normal
1921	817,000	785,500	160.8	141.0	146.0	148.4	134.0	127.3	107.4	104.5	Cool summer, cold winter, consumption below normal.

Why Reform in Engineering Contracts Is Necessary

(Excerpts from an address by Gen. R. C. Marshall, Jr., of the Associated General Contractors, before the American Railway Engineering Association, March 15, 1922.)

There are hundreds of contract forms used throughout construction, which vary greatly in their obligations. It is difficult for the field force as well as the management to keep in mind the detail requirements of every job. I have in my office some 200 contract forms used all over this country. I think there can be no greater commentary on the lack of business methods of engineers and architects.

One of the great criticism heard concerning the construction industry is that it is not managed along the lines recognized and established in other industries, and that it is far behind in matters of estimating and cost accounting. This condition will not be overcome until the basic agreements under which they work are brought into some semblance of harmony. Under one contract the construction company has certain obligations and under another contract the obligations are entirely different.

Many revelations of conditions existing in the building and general construction industries, during the past two years, show a need of better understanding between that industry and the other industries for which it works. It should be clearly understood that many practices which have arisen in the building industry are traceable to the contracts under which that industry has been conducted.

It is only in recent years that building contracts have been drawn so that they contained any semblance of mutuality. It was within the power of an architect to practically make or break a contractor. Construction costs for the same result ran higher under one architect than another.

In the case of the railroads, some years ago, construction contracts as drawn by the legal department were about in keeping with the general policies of sovereignty pursued by the roads, and had it not been for the fairness with which engineers administered these contracts it is questionable whether railroad development could have taken place. The contractor on railroad work depended more upon the personal equation of the engineer than upon the contract. As a matter of fact, the contract meant little either to the chief engineer or to the contractor. If the chief engineer died all conditions of the contract were immediately changed. No rules of economics are served under such conditions.

In December a committee representing eight great national associations got together to consider this subject. The committee determined that there are a number of subjects that are common to all forms of construction work. But it did not determine definitely that the subject matter of these subjects could be so expressed as to be acceptable in every case.

It has been suggested that a universal construction agreement be adopted which will cover the obligations common to all work, leaving to several acts of general conditions those provisions which are peculiar to each individual type. In such manner it would be possible to establish clearly the obligations of construction and to build up a strong foundation of precedents which would establish an ethical practice throughout.

Successful Spring Meeting Held by Am.Soc.C.E. at Dayton

Flood Protection the Subject of a Dozen Notable Papers—Local Protective Work Inspected—Col. Deeds Delivers Valedictory of Conservancy District Construction—More Than 350 Present

IN MEETING at Dayton last week, April 5 to 7, the American Society of Civil Engineers made trial of a radical departure from time-honored practices. Hitherto the January annual meeting and the summer convention were the only gatherings outside of the monthly New York meetings. Dayton was the scene of the first spring meeting. Appropriately, flood protection was the theme. The occasion attracted an attendance well exceeding 350, and aroused interest, not to say enthusiasm, hardly equalled at prior meetings.

Technical Program.—There was a strong program of technical papers. Reviews of flood conditions in various parts of the United States and a sketch of the Chinese situation were presented, besides more special discussions. The Miami work was briefly summarized, with highly impressive effect because the approaching completion of the great enterprise made the meeting in a sense an inaugural celebration. Col. E. A. Deeds, the inspiring head of the Miami Valley protection movement, in an address of reminiscence described the occasion as the valedictory of the work.

From the interest exhibited by the members, a prime feature of the meeting was a discussion of small-area floods, or cloudburst floods, in two papers. Both authors emphasized the startling lack of data on this type of flood, described as perhaps the most important source of flood loss in the United States. In this connection action by the Board of Direction to form a research committee on Flood Protection Data promises to prove specially significant.

Important steps in the development of society affairs were taken by the Board in its session preceding the meeting of the society. These were reported last week.

Inspection Trips.—Due to the planning of the local committee the members of the society were brought together in a continuous series of social meetings—luncheons and dinner talks—and in inspection trips. The Dayton Engineers Club gave up its clubhouse to the visiting delegation as headquarters and in addition brought the early arrivals together in one of its regular meetings, when Paul M. Lincoln (Cleveland) in a talk on "Some Neglected Factors in the Sale of Electric Service" emphasized the importance of demand charging.

Inspections of the Taylorsville, Englewood and Huffman dams of the Miami Conservancy District and of the National Cash Register plant occupied Thursday. On Friday the Dayton channel improvement work was gone over, research work at McCook aviation field was examined, and an excursion was made to the Middletown plant of the American Rolling Mill Co.

President John R. Freeman opened the meeting with an interesting reference to an early period of flood study in the United States. He recalled James B. Francis' effort to provide, in connection with the Lowell canal, adequate protection of the city from the greatest flood ever to be expected, and his search throughout the valley for records of past floods. Francis found traces of a flood greater than any actually observed in historic times, and then built a flood-gate proportioned therefor. During twenty years this gate remained unused, but when the flood came the gates saved the city from inundation. This with other references to early work, and fine appreciation of the Miami Valley work, introduced the technical program, briefly summarized below.

Cloudburst Floods.—G. H. Matthes (U. S. Engineer's Office, Chattanooga) in one of the stimulating papers of the meetings, dealt with "Floods on Small Streams Caused by Rainfall of the Cloudburst Type." He pointed out the scarcity of data on the subject due to difficulties of observation and analysis in spite of the relative frequency of such floods, and asserted that cloudburst damage is probably the largest item of flood losses. Some specific records of very intense local precipitation included a rainfall of 7 in. in 90 min. at Cambridge, Ohio, and runoffs of 5.7 and 6 in. in 1½ and 2 hr. near York, Pa. That much more intense precipitation, amounting to the falling of water masses, may occur at small spots in cloudburst storms is indicated by scarring of the ground that has been observed repeatedly. The long record of Jones Falls floods at Baltimore was cited in support of the claim of frequency. Some localities seem to be specially subject to cloudbursts, others virtually immune. Plots of a considerable number of cloudbursts, in terms of second-feet runoff per square mile, establish a curve decreasing with increase of area from over 4,000 sec.-ft. for an area of less than 1 sq.mi. to 1,000 sec.-ft. for an area of 60 sq.mi. The author dealt also with control possibilities and the relation of cloud-bursts to the design of structures.

Closely parallel findings were reported independently by H. P. Eddy (Metcalf & Eddy, Boston) in a study of drainage areas. The old rule that a runoff of 6 in. in 24 hr. or 160 sec.-ft. per sq.mi. should be provided for in dam spillways is now known to be inadequate, he said, and in Pennsylvania many spillways are now being enlarged. While data on maximum runoffs in various regions of the country are scanty, so far as they go they seem to indicate that the relation between area and maximum runoff is the same for all parts of the United States. Fuller's method of estimation is found to be unsatisfactory in specific instances. The compilation of records by Mr. Eddy yielded a curve nearly the same as that shown by Mr. Matthes.

Cloudbursts are the chief source of Colorado floods, according to remarks of A. O. Ridgway (Denver & Rio Grande Ry., Denver) in discussion. East of the continental divide the average rainfall is less than on the west slope, but cloudbursts occur, while none occurs west of the divide. There are intense thunderstorms, often several in a group, often recurring, moving apparently without law. For data concerning them, the U. S. Weather Bureau records are entirely inadequate. The annual rainfall averages only 10 to 15 in. on the east slope, yet locally 10 to 14 in. have fallen in a single day, and 5 in. in 30 min.

Besides the irregularity and suddenness of cloudburst storms, factors meriting study are the coincidence of floods in neighboring tributaries, the influence of high flow velocities—often 18 to 20 ft. per min.—resulting

from the steepness of the country and the possibility of saving the flood-waters for irrigation use.

Floods in Canada and China.—Problems of flood control in the Red River and Winnipeg region were described by J. G. Sullivan (Winnipeg) in a paper on "Flood Conditions in Canada." These problems are complicated by their international aspect. Flood control in Minnesota and Dakota is closely related to that in the Canadian down-river region. Ultimately, co-operation between the states and Canada must be invoked, Mr. Sullivan suggested.

China's tremendous flood problems, particularly those of the Huai and the Yellow Rivers, were sketched by President John R. Freeman (Providence) in a richly illustrated address. With the river channels built up well above the delta plains and the soil fine and easily eroded, the task of holding the streams in flood time is great; yet by long experience the Chinese have developed an effective system of groin or spur-dike construction, in which a small amount of stone riprapping at the outer end protects the earth body of the groin from current erosion. A scientific development of the method is proposed by Mr. Freeman as the most available solution of the control problem.

Prof. D. W. Mead (Madison, Wis.) in discussion praised the ingenuity of the Chinese in their river work. They have proved that reeds and clay properly combined can do much. Yet in the long run their attempt to control the great rivers has been a failure, and this fact is attributable to their ignorance of the underlying science. One of the most advanced scientific men in China urged a project for Huai River control which included an outfall channel 200 x 10 ft., whereas flood-discharge calculations showed that a channel 2,000 x 20 ft. would be required.

The essential difference of the Chinese flood situation from any in America, as pointed out by A. P. Davis (U. S. Reclamation Service, Washington) is their much greater severity due to the extreme flatness of the country and the intensity of the rainfalls. One reliable record which he obtained was for 30-in. precipitation in one storm; another storm, in which the rain gage was swept away, is estimated at 36 in. These figures can not be held to be improbable, in view of still heavier rainfalls known to occur in the Philippines.

Great Flood Problems of the West.—In two papers of rather cyclopedic character certain of the great flood problems of the Rocky Mountain and Coast regions were treated. A. P. Davis dealt with "Relation of Flood Problems To Power and Irrigation Development in the Rocky Mountain Region." The Colorado River problem and the Boulder Canyon project were main elements of this paper. C. E. Grunsky (San Francisco) considered "Flood Prevention Methods on the Pacific Slope," a general review of the Sacramento-San Joaquin the White-Stuck-Puyallup, the Los Angeles and the Imperial Valley or Volcano Lake problems. Both authors stressed on the latter problem, and asserted that a final solution must be found soon if disaster to the Imperial Valley is to be forestalled. Mr. Grunsky said that the only agency to carry out the work is the United States, working in co-opeartion with the Mexican government.

Though most of the Reclamation Service dams were built solely for irrigation, Mr. Davis stated that they have proved of great value in flood protection also. Thus, the Pathfinder Dam in 1909 saved a flood loss equal to the cost of the dam, and numerous other dams have done almost as much. In the case of Elephant Butte, one-sixth the capacity of the reservoir or about 400,000 acre-feet is reserved for flood control.

Mississippi River Control.—A valuable survey of the development of Mississippi River levee work was given by Past-President J. A. Ockerson (St. Louis) under the title "Methods of Flood Prevention in the Mississippi Valley." Its beginnings date back to 1717 at New Orleans and to 1818 at Baton Rouge. The great contested question in the early years of the Mississippi River Commission's work and prior levee building was whether levees raise the bed of the river; the contrary has been established that they lower it. The present standard (1919) levee of the commission has an 8-ft. wide crest 3 ft. above high water, and averages 18 ft. in height. Its yardage is about 422,000 per mile. The preceding or 1896 standard had a yardage of 104,000 and the 1882 standard a yardage of 31,500. At present 500 miles are up to standard, but the whole length of levee is up to normal flood height. Mattress protection was described as an important feature, covering willow, articulated concrete and solid concrete sheets.

Miami Conservancy Work Reviewed.—With the approaching completion of the Miami Valley flood-protection work, special interest attached to addresses by Arthur E. Morgan and Charles H. Paul, the former and present chief engineers of the project, describing its planning and construction. Mr. Morgan discussed factors of the work that ordinarily receive only passing consideration but that are as vital as the technical items of design and construction. Thus, concerning proper provision for employees, "If your concrete inspector's wife has indigestion," he suggested, "so that he worries about her and is inattentive to his job, the results may be just as harmful to the work as a fault in design." Accordingly, care for the well-being and satisfaction of the working organization was part of the theme of the address. More important, however, were such matters as the strategy and diplomacy needed to secure the purposeful co-operation of the local people; the volunteer financing of the preliminary investigations; the patience required for deliberate planning of the project and passage of enabling legislation, in the face of a public desire to see dirt fly within three months; development of fundamental data (on rainfall, flow, benefits and the like); and existing prejudices against reservoir control. Mr. Morgan in sketching the early course of the work paid glowing tribute to Col. E. A. Deeds, afterwards a director of the district, for his part in raising the subscription fund that made possible the sound development of the project—the District itself was not formed until 3 years later and obtained no money until 4½ years after the flood—as well as for his fight against the many discouragements and obstacles that threatened the work.

Mr. Paul briefly outlined the project as developed, and the manner of carrying through its construction, as detailed in past issues of Engineering News-Record.

An interesting sequel to these addresses was an intimate talk given by Col. Deeds at a society smoker on April 7, under the title "Human Phases of the Miami Conservancy Project," in which he recounted in graphic style the way in which the almost impossible difficulties that beset the work throughout the 4½-year period up to the start of construction were overcome. Characterizing the occasion of the address as the valedictory of

the Conservancy District, he expressed his deep regret that the finest group of men ever assembled, the engineering and construction staff, will now be scattered again. There will be no tablets of names on the structures of the District; "the work is greater than any one man."

Standing Waves.—Four types of standing wave were described by N. C. Grover (Geological Survey, Washington) under the title of "Standing Waves in Rivers." They are: (1) The hydraulic jump, a wave facing upstream and fixed in position, which is represented in most roughnesses of water surfaces except those due to wind and falls; (2) sand waves, moving surface waves corresponding to moving masses on the bottom; (3) tidal bores; and (4) the standing flood-wave, or the "wall of water" at the front of a flood mass.

Community planning in relation to flood-protective measures was touched on in a brief paper by Morris Knowles (Pittsburgh). He referred to the river-bank development at Harrisburg and the levee drive at Sunbury, Pa., as instances of how several purposes may be joined in one construction, and outlined some possibilities in this direction in the proposed Pittsburgh flood work. Two other short papers, by J. B. Challies (Ottawa) and George M. Lehman (Harrisburg) were passed without reading.

Missouri River "current retards" composed of trees held by cables to deeply submerged anchor piles were described by Roy N. Towl (Omaha). Building up of eroding banks has been accomplished successfully by these retards, which are in effect permeable groins.

J. Albert Holmes (Boston) reported test data on hydraulic-fill core material from the Paddy Creek and Linville dams. Seepage and compression tests were made, whose results, Mr. Holmes said, supply assurance as to the safety of hydraulic-fill dams supplementing that given by C. H. Paul's recent paper on hydraulic-fill cores.

Expansion Coefficients of Some Metals

Recent measurements of the expansion of nickel, monel metal, stellite, stainless steel, and aluminum made at the Bureau of Standards have just been published by the Bureau (Scientific Paper 426). These measurements were carried through the region from 0 to 600 and 900 deg. C. Stainless steel (steel containing about 13 per cent chromium) is the only one of these metals whose expansion curve departed much from a straight line; this material has a sharply defined irregularity of large range between about 800 and 855 deg. C. Nickel was found to have a coefficient of expansion in a range of moderate temperatures (below that of boiling water) of about 13 one millionths per degree, which is 10 to 20 per cent greater than that of steel, and considerably greater than those of most porcelains. In the range from 300 to 600 deg. C., the coefficient rises to about 16½ one-millionths. Monel metal had closely similar values, about 14 for the range from 25 to 100 deg., and 17½ one-millionths for the range from 300 to 600. Various samples of stellite (an alloy of cobalt, chromium and tungsten, sometimes with iron) ranged from 11 to 15½ units for the lower range to 14.7 to 18 units for the higher range. Stainless steels showed a coefficient of about 10 units in the lower range and 13½ in the upper range. Aluminum showed an expansion coefficient of about 23½ below 100 deg., and about 36 one-millionths in the neighborhood of 600 deg. C.

Comparative Merits of Stadia and Plane Table for Mapping

Topographic Work in Rough Alabama Country Necessitates Quick, Accurate, Method—Stadia Believed Best

By Ray Crow
Assistant Chief Engineer, Land Department, Tennessee Coal, Iron and Railroad Company

SOME TWO years ago the Tennessee Coal, Iron and R.R. Co. began the topographical mapping of portions of its coal and iron ore lands in the Birmingham district of Alabama. This information was desired by various departments of the company for use in making studies for and projecting future developments.

The work came under the direction of the land department, George Macatee, chief engineer, and it fell to the writer to develop a system of field work for the purpose. The areas being mapped out are for the most part very rough and broken and practically covered by a thick growth of timber and underbrush. Much of the ground is an eroded plateau cut by numerous geological faults which give many peculiar twists and turns to the drainage. The streams, mostly small, run tortuously in narrow steepsided canyons intercepted with frequent side ravines. The high ground thus is a series of long, irregular, main ridges between the larger streams, with secondary spurs separating the ravines. The timber varies from second growth pine thickets to virgin forest.

The irregularity of the ground, together with the foliage, usually limits the length of vision to from 50 to 200 ft. A transit shot of as much as 400 ft. is exceptional without heavy clearing. It is necessary to use field parties of nine or ten men each as this mapping is a fill-in job and the men are subject to call for other classes of work.

Considering the conditions cited the method to be adopted required thought and experiment. The system tried first embodied the use of the transit and stadia, with the recorder using a drafting board mounted on a tripod on which he platted the shots as the length, azimuth and vertical angle were observed and called to him by the instrumentman. He then sketched in the main drainage features and the contours. However, to use a field party of nine or ten men efficiently it is necessary to keep four or five rodmen busy. With the short distance each had to walk between shots the recorder could not do this and keep up with the sketching. Also, with so many short shots—it is not unusual for the instrument to occupy fifty to seventy stations per day—an occasional error in vertical angle or azimuth was unavoidable and when found by closure or tie to some point on the control, replatting and resketching of possibly an entire day's work was necessary.

For these reasons this method was abandoned and the use of a plane table considered. It was evident, however, that the latter would only partially overcome the dificulties mentioned, and would present additional disadvantages. An alidade sliding on a table would be more unwieldy in searching out a road through natural openings in the foliage than a transit telescope. The table would be cumbersome to carry, set up, and orient. Vertical angles as high as 45 deg. are not uncommon and it would be difficult to read these and keep the straightedge on the platted point. More time would be lost in moving around a plane table when taking

side shots at rough set-ups then around a transit. Moreover, none of the instrumentmen available had even seen a plane table, but then were more or less expert with a transit.

The entire area under consideration had been carefully surveyed by the company as the land was purchased, and permanent monuments had been set at all government section corners and at property subdivision corners. All roads, fences and principal streams had been meandered and the few buildings and other landmarks noted. Each section had been accurately platted to a scale of 500 ft. to the inch, showing this information.

This land survey was taken as the control for the topographic mapping system finally decided upon, and the section was made the unit. Each section plat is carefully copied on a field sheet 16 in. x 20 in. and furnished to the chief of the field party. The stadia party (consisting of the instrumentman, recorder, four rodmen and two or more axemen), start a stadia traverse from a corner or some mapped point in the section and cover the area as closely as necessary, taking notes in the usual way. All instrument stations are marked with hubs and guard stakes. Each rodman carries an axe and when he gives a sideshot he blazes the nearest tree on the side toward the instrument and marks the number of the shot on the blaze with crayon. The traverse lines are usually run approximately parallel to the north and south sides of the section and as often as convenient ties are made to mapped points, or the traverse is closed.

Preceding the stadia work a line of bench marks is established along the alternate east and west section lines with a wye-level. Levels are checked at the end of each two miles of traverse. In the evening the traverse line is platted to the tie or closure of the day, and if the error of closure is small it is corrected then and the adjusted traverse transferred to the field sheet. Any large error is corrected by checking field notes, or if necessary rereading azimuths in the field. The side shots are then platted, elevations are reduced by stadia slide rule and noted on the map in correct location by a dot with number of shot above and elevation below a short line extending from the dot toward the instrument station from which the shot was taken.

When the entire section is completed in this way the topographer pins the field sheet to a light drafting board, goes into the field and follows the traverse from station to station. At each he orients the board and sketches in the contours, drainage features and other information, in so far as the control from that station will permit. Any additional points that may be thought necessary are located by pocket compass, pacing and hand level from the marked points on the ground. The field sheet becomes the original map and all information is retained on it, including location of traverse lines, number and elevation of instrument stations, side shots, etc. However, when tracings are made for reproduction, which are in sheets showing areas two miles wide and six miles long, only the contours and improvements are shown.

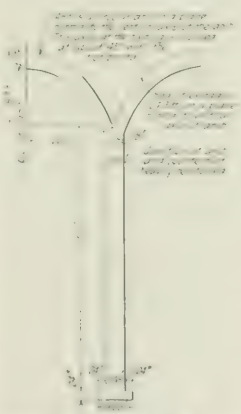
To date about eighty sections have been mapped. The accuracy of the completed work has been tested in many cases and found to be sufficiently close for all required purposes. Quantities estimated from profiles taken off these sheets have checked within 2 per cent of those figured from profiles run on the ground.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

How Should We Figure Foundation Pressures in a Multiple-Arch Dam?

Sir—In a recent engineering argument the foundation pressures in a dam about to be built and the stresses in the structure incident thereto were the subject of violent difference of opinion. In view of the fact that all the principal parties to the argument were rated as engineers well versed in structures, it would appear that certain of us are woefully ignorant of something that we ought to know with the utmost certainty. A difference of opinion concerning matters of judgment is entirely permissible; a difference of design theory of such degree as to represent in the one case safety, and in the other, extreme hazard, if not absolute failure, is absolutely without excuse, and should not be possible within the profession. It is with the hope of obtaining from such of your readers as are qualified to give them, expressions concerning the proper determination of foundation pressures in general, and with regard to a special type of structure in particular, that I am led to open a discussion of the matter.



FOOTING OF 50-FT. MULTIPLE ARCH DAM

Stated broadly, the question involved is simply this: Given a structure of any sort and shape whatever, the various parts of which have footings terminating at the same foundation plane, and in which these parts are so tied together and so rigid that the structure necessarily responds to stress and deformation as a unit. What is the foundation area? Is it the sum of the area of the footings of all of its parts, or is it the sum of only one or more of these areas? If one of the structural members is of much greater bulk than the others, with a correspondingly larger footing area, and carrying the greater part of the vertical load on the structure, is that any reason for assuming that all of the foundation pressure or reaction is carried by the footing of this member, leaving the other footings to sustain no pressure whatever? If the other footings do sustain pressure, then in what amount and how distributed? Are we to use our "judgment" and our idea as to what "looks reasonable" in solving this question, or shall we consider the structure as a unit, the foundation area as a whole, and then solve the problem by the application of the established principles of mechanics applicable thereto?

The above questions are purposely put in the general form. Applied to the particular case which was the subject of the argument previously mentioned, let us consider a multiple-arch dam. For the purpose of this discussion the structure may be said to be of the usual type, the arches being securely and rigidly attached to the face of the abutment, and carried down to the same foundation plane and material as the abutment. The arches are of such mass and are so secured that there is presumably no possibility of any vertical movement of the arch with respect to the abutment. There is no perceptible line of

demarkation between the arch footing and the abutment footing, the one simply merging into the other. For the purpose of determining foundation pressure, what is the foundation area of the structure? That of the abutment alone, or that of the abutment plus that of the half arches attached to it?

The designer of this dam, who is an engineer of considerable prominence and repute, claimed that the foundation area was that of the abutment alone, and on this basis, together with the magnitude and position of the resultant force, which *included the entire weight of the arches*, he showed a maximum pressure at the toe of about 8 tons per square foot and a minumum pressure at the heel of about 6 tons. This accounted for the whole vertical load, so that under the arch footing immediately adjacent to the heel of the abutment footing, continuous and integral therewith and divided only by an imaginary line, there was shown to be no pressure whatever. It appears to me that under a rigid and continuous footing, such an abrupt change in the distribution of foundation pressures is absolutely inconceivable and that any theory or method which gives such results is necessarily an absurdity.

In my analysis to determine the foundation pressures which the proposed structure would develop, I considered the abutment and the two half arches attached thereto, as a unit, together with all the forces acting thereon. The position and magnitude of my resultant was in virtual agreement with that of the designer. The foundation area I took to be the sum of the footing areas of the half arches and the abutment. I found the center of gravity of this area and its moment of inertia, also the moment of the resultant about the center of gravity of the area. I then applied the well known formula, $f = P/A \pm Mc/I$, which gave a maximum pressure at the toe of abutment of about 19 tons per square foot, and tension at the crown of arch footing of about one ton per square foot, assuming that the structure would take tension in the footing. The great difference between my results and those of the designer is of course accounted for by the fact that the inclusion of the arch footing as part of the foundation area, moves the center of gravity of the whole area a considerable distance toward the upstream end of the footing, as compared with the center of the abutment footing proper, and results in a large eccentricity of the resultant, as compared with what this would be if taken about the center of gravity of the abutment footing only. The resultant remaining fixed in direction and magnitude, this eccentricity is, of course, one of the most important factors in determining the foundation pressure.

The particular foundation pressure analysis above referred to, in which the different methods employed gave maximum compressions differing by about 11 tons per square foot, applies to a section of the maximum height of 80 ft. The situation becomes increasingly critical as the height diminishes, since, while the area of the abutment footing decreases rapidly, the area of the arch footing decreases very slowly, resulting in the continual movement of the center of gravity of the whole area toward the heel of the abutment, and the consequent increase of eccentricity of load unless the resultant also moves forward correspondingly, which in the case of this particular dam it did not. It would appear then that, considering both safety and economy of design, it is scarcely permissible that such divergent theories should be held and applied by different, but presumable responsible, members of the profession of engineering.

In conclusion, the writer wishes to state that he has had available a fair assortment of text-books which purport to treat more or less fully on the subject of foundation pressures in general and particular. He has investigated these works most carefully in an effort to find a direct and authoritative discussion of the point at issue, and has found almost nothing. The nearest approach to the thing sought was found on p. 532 of the American Civil Engineers Pocket Book, which, by analogy, the writer believes substantiates his position. With this one exception, the authors all discussed foundation pressures as applied to a rectangular footing area pertaining to a mass structure of simple and regular foundation plan. It is not remarkable if some engineers have formed the habit of thinking that a foundation area must necessarily be rectangular in order that the pressures thereon be capable of determination; that the only formula for this purpose is the usual one in the form of $f = P/L(1 \pm 6e/L)$; and that the only criterion of safety is the "rule of the middle third." If our text-book writers would occasionally bring out the fact that the preceding formula is only a special and simplified form of the general equation, $f = P/A \pm Mc/I$, as applied to a rectangular area of pressure, I believe that the general understanding of the principles of foundation design would be greatly improved.

It would afford me pleasure to sign my name at the bottom of this, but the injection of personality is not called for by the purpose of this discussion, and for various reasons it is desirable that just at this time there be given no publicity concerning the relation between this discussion and a certain proposed structure. Consequently, I sign myself. ENQUIRER.

Anywhere, March 14.

Economics of Narrow-Gage Railways

Sir—So much has been said of the burden imposed on transport by the transfer of freight between railways of different gages that the main reason for narrow-gage lines has been obscured. That main reason is the economy in construction and operation. Freight transfer is only one of several factors which must be weighted in arriving at a decision. Where a considerable part of the movement will probably originate or terminate on a connecting line, the gage of the latter would determine that of the new line. The question of gage has been considered too much from the viewpoint of a national or continental transportation unit, which may not be justified where the transportation needs of a region must be considered mainly on the basis of the topography and probable economic development of that particular region.

Such cases are encountered occasionally in this country, but in the southern hemispheres they are numerous. For example, Argentina offers many points which indicate faulty decision. About 1909 the province of Buenos Aires adopted a policy of fostering the construction of light meter-gage railways between the lines of the larger broad-gage systems. But in this prairie district the difference in first cost was negligible, curvature was not a factor and any intermediate lines would speedily develop a greater traffic than could be handled economically on a narrow-gage line.

In the narrow-gage railways, both state and private, in the northern part of Argentina, all factors at the time of development indicated the superiority of narrow-gage construction. Although an unlooked-for turn in the development of the country has brought forward the consideration of dense, long haul traffic and freight transfer, these questions are not paramount. These narrow-gage lines, grouped about the Central Cordoba Ry., should have brought their export-import haul to navigable water near Parana instead of carrying it over the Central Cordoba trunk line to Buenos Aires. But the necessary coordination, including river and harbor work, is difficult to accomplish. In spite of this wrongly imposed burden of long dense-traffic haul, for which narrow-gage lines are uneconomical, it is doubtful if its cost approaches the saving effected by narrow-gage operation throughout the rest of the system where light tonnage prevails.

In the west coast countries conditions warrant narrow gage roads, if we accept low cost per ton mile as the criterion. It is true, however, that there are standard-gage lines of considerable tonnage in successful operation. In most cases the problem has been to supply transportation from an interior valley to the nearest navigable water and this has resulted in a succession of small units each serving a territory which can never develop a great volume of traffic, and quite or nearly independent of intercommunication with contiguous units. Here it is obvious that the

lighter the tonnage, the greater becomes the proportion of fixed charge to total cost of transportation, so that a saving of 10 per cent in construction cost may effect a 20 per cent saving in total transportation cost.

The saving in construction cost due to reduction of cross-sectional area is small, but in mountainous country the difference between curves of 21 and 14 deg., comparable on meter-gage and standard-gage, respectively, may mean the difference between a comparatively light cut and a tunnel, or a choice between a feasible line and one that is financially impossible. Another reason for the narrow gage is that many such small lines hold no hope of being commercially profitable. The government, believing their construction necessary to the development of the country, may grant financial assistance, but would not feel justified in incurring the extra cost for a line which could never be used to full capacity. This attitude, based on economic conditions, has become in some cases a clearly defined policy, as in the Chilean government's adoption of the meter gage on all new development since 1908. C. C. MUHS.

Chicago, March 20, 1922.

Possible Full-Size Dam Tests at Boulder Canyon

Sir—The writer was impressed by the ingenious method discussed in *Engineering News-Record*, Feb. 2, p. 184 by Arthur P. Davis for constructing a rock-fill dam at the Boulder Canyon site, by blasting huge masses of rock from the high cliffs on both sides of the canyon.

However, such an undertaking would be so far beyond any precedent both with regard to size of structure as well as to method of construction that undoubtedly it would be viewed with great concern by many engineers. The writer is informed that the rock of those canyon walls, when blasted, is liable to break rather into small pieces than into large blocks. This process might be intensified to a rather undesirable degree by the material dropping for a height of several hundred feet from the cliffs above the crest of the dam onto the first layers at the water level or slightly above it. Thus, local accumulations of comparatively fine material might lead to rather annoying consequences, as it is the intention to build the diversion tunnels only large enough to carry the low flow and moderate floods of the river, and to take the excess waters of big floods over the dam. Assuming such excess waters at about one-tenth of the annual run-off, a quantity of nearly two million acre feet of water would then pass the first year over and through the unfinished dam. The danger from blow-outs in the rock-fill placed during the year preceding the flood would therefore appear to be so imminent that unquestionably a very liberal allowance would have to be made in the cost estimates for such contingencies. The critical time, of course, would be when the dam had reached a height of from 50 to 150 ft. above river bed, and before the reservoir capacity thus created were large enough to store the flood peaks.

The construction of a masonry dam would seem to involve far less risks than the building of a dam of the rock-fill type as discussed above. If it is possible to build a thin arch diversion dam upon the foundation rock, as Mr. Davis suggests, and it may be found necessary to build farther downstream a similar structure, but arched in opposite direction to keep off the back-water, the excavation for the main dam and the construction of the dam itself would appear to be a comparatively simple matter. Also the diversion tunnels, which for the rock-fill dam would have to be at least three-quarters of a mile long, could then be perhaps less than one-third as long. Consequently, at the same cost they could be excavated for a masonry dam about three times as large in cross section than for a dam of the rock-fill type, and this would bring them probably close within the size necessary to divert also floods of considerable magnitude. By building further the arch diversion dam for 20 or 30 ft. higher than the structure discussed by Mr. Davis, sufficient head could be created upon the enlarged tunnels to divert also the maximum flood flow of 200,000 sec.ft.

If such a masonry dam were selected for the Boulder Canyon site, and constructed by the aid of an arch diversion dam, as suggested by Mr. Davis, the writer believes that this would be an excellent opportunity for making numerous tests and experiments on this arch dam and stressing it ultimately to virtual destruction after it had done its useful work for diversion purposes.

In order to enable such tests to be made, the main dam would have to be built a short distance below the arch diversion dam in such a manner that a free space of a few feet were left between the up-stream side of the main dam and the downstream side of the arch. As soon as the main structure had been built to a safe height above the arch dam, systematic experiments could be started on the arch by regulating the flow through the diversion tunnels in such a manner as to obtain any desired head of water in front of the arch dam.

By equipping both the big dam and the small arch dam with valves which would permit to fill or to empty at will the narrow space between the two structures, a large range of varying loads, acting upon the arch dam, could be obtained. For instance, by putting the arch dam under full pressure, measuring its deflection, stresses, etc., then filling the space between the two dams with water, which, of course, would have the effect of releasing the arch entirely from pressure, and then taking new measurements, most valuable results could be obtained. Such experiments might be repeated several times a day and thus furnish excellent checks.

By using high unit stresses from the beginning and raising the arch subsequently in a very slender cross section, it might be possible to increase the water pressure such as to make actual failure imminent. It would not be necessary to let the arches really break through, because the very instant that stress and deflection measurements would show that the elastic limit of the arch material had been reached, water could be let to flow into the narrow space between the two dams, thus relieving the arches almost immediately from dangerous pressure. Thus, it would be possible to conduct over a period of a year or more, and without interfering with the construction of the main dam, such "full-size" tests on the arch diversion dam, by relying for safety on the "big brother" back of it.

It is the understanding of the writer that the alternately proposed masonry dam at the Boulder Canyon site is of the gravity type. It is entirely possible that such tests as suggested above might furnish sufficient data to warrant after their completion, that the upper part of the main dam be continued in the shape of an arch. The cost of the experiments might thus pay for themselves manyfold by the large saving which undoubtedly would result by changing the upper few hundred feet from a gravity to an arch section. Furthermore, the space between the main structure and the arched diversion dam could be filled out with concrete after the tests had been completed, and the two structures securely tied together to act as an enlarged gravity base and as a perfect support for the upper arching part of the main dam.

The enormous benefits which would be gained by such "full-size" test (the arched diversion dam would be from 175 to 200 ft. high) for future dam constructions, are evident. They would most probably lead both to greater economy and increased safety of future similar structures, and they might possibly prevent that the engineering profession has to learn the real statical conditions and the ultimate strength of arch dams by an actual failure with all the distressing consequences incidental to the destruction of a large storage dam.

The writer hopes that the Boulder Canyon dam is going to be built in the near future, and that the dam selected will be a masonry structure. It would appear that the construction program outlined by Mr. Davis for a masonry dam, perhaps with some slight modifications as further investigations may develop, will lead to a safe and economical solution of the problem of the Colorado River.

San Francisco, Calif., FRED A. NOETZLI,
March 10, 1922. Chief Engineer,
Beckman and Linden Engineering Corp.

NEWS OF THE WEEK

New York, April 13, 1922

Review Construction Status at Federation Meeting

Hoover Speaks on Trade Associations —Program Fails to Attract Representative Attendance

Despite the hard work of its president, E. T. Trigg, and its general secretary, W. S. Hays, the fifth annual meeting of the National Federation of Construction Industries, held in Chicago last week, proved to be a disappointing affair. It had been announced as a National Construction Conference, and though the subjects outlined and the papers introducing them were worthy of an imposing meeting there were lacking the attendance and enthusiasm necessary if the conference was to have any influence on the construction situation. It is true that the presidents or other prominent officials of various organizations within the construction industry were present, but they alone made only a small conference group and could not carry a meeting which had been given the high-sounding title of "National Construction Conference." The total registration remained below 200, and at none of the meetings did the attendance exceed that figure.

The whole purpose of the program was to inquire as to what could be done to revive construction through a cheapening of construction costs. The various methods for cheapening costs, such as simplification and standardization of building materials, the training of apprentices in order to secure an adequate supply of competent construction labor, the work of the Architects Small-House Service Bureau, the various activities of the Department of Labor, the effects of transportation, building codes, financing methods, etc., were all covered in excellent papers.

Hoover's Address

Chief among the addresses was that by the Secretary of Commerce, Herbert Hoover, in which he laid emphasis upon the service to industry and to the country which could be performed by trade associations through the elimination of waste. He pointed out that it was far better to work out these problems by private initiative through trade associations than through the "patent medicines of government interference." Speaking of the influence of labor on construction costs, he remarked:

"There can be no answer to the fundamental fact that the standard of living of all the people is the simple quotient of the commodities and services we produce. The more we cheapen the production of a commodity, the larger the number of people who can obtain it. Restriction upon effort in the building trades simply reserves the better class of buildings and of homes to the better-to-do fraction of our people. At present costs it is scarcely possible for a worker from his own income to build a new and ample home. We want a nation of home owners. There are more buildings needed and in position to fin-

(continued on p. 629)

Kansas City Votes $11,000,000 Water Bonds

A water bond issue of $11,000,000 was carried by a 4 to 1 popular vote at an election in Kansas City, Mo., on April 4. These bonds had an actual, but not necessary, two-thirds majority at an election held Nov. 22, 1921. On the latter date a bi-partisan water commission of four men was chosen with power to build new works. This commission will supplant the existing Fire and Water Board as regards the Water Department only. The commission has as members one engineer, Alexander Maitland, Jr., president of the Kansas City Bridge Company; a wholesale jeweler and former mayor of Kansas City, George H. Edwards; a clothing merchant and a real estate man.

Detailed plans for the proposed new works have not yet been made, but it is expected that they will follow in general outline the recommendations of a report made in 1920 by Fuller & McClintock, New York City, and reviewed with recommendations for certain modifications by a board of local engineers of which W. Kiersted was chairman (see *Engineering News-Record*, Oct. 28, 1920, p. 865).

According to the report mentioned the choice of the new works was between building an entirely new intake, pumping and filtration plant in Clay County, Mo., and a new and somewhat similar plant at the present Quindaro station on the Kansas side of the Missouri River.

Trial of Cement Makers on Criminal Charge Begins

Attempt to Prove Trade Restraint and Price Control Begun in Federal Court of New York

The trial of forty-four individuals and nineteen corporations engaged, at the time of indictment a year ago, in the manufacture of cement in the Lehigh district, began last week in the federal court for the southern district of New York, before Judge Knox. The charge against the cement makers is a violation of the Sherman anti-trust law—the charge imputing the existence of a conspiracy to control prices through the general interchange of price and trade information.

The government will base its case largely on proceedings recorded in minutes books of the defendant corporations and the association of firms now known as the Cement Manufacturers' Protective Association. The government charges that there was a conspiracy inferred in minutes of meetings, correspondence, etc., in and between companies and that in the Eastern district there was no competition in the manufacture and sale of portland cement. The government will also aim to prove price control through curbing of production below actual demand.

(continued on p. 630)

Submit New Plan for Use of Narrows Tunnel

Propose Combined Rapid Transit and Freight Service between Staten Island and Brooklyn

Following the rejection by the executives of the trunk-line railroads entering New York of the city plan for a terminal railroad system keyed to the proposed Narrows tunnel, the special committee of the Board of Estimate and Apportionment having the matter in hand has submitted to that body new plans and recommendations concerning the project.

It is now proposed to build a combined freight and rapid-transit passenger railroad connecting Brooklyn and Staten Island by means of a two-tube tunnel designed to accommodate the largest freight and passenger cars that enter the metropolitan district. In Brooklyn a rapid-transit terminal is to be provided in the vicinity of Fourth Ave. and Bay Ridge Parkway, convenient to the existing Fourth Ave. subway, and a freight terminal is to be located between Sixth and Seventh Aves. adjacent to the Long Island R. R. On Staten Island both freight and passenger terminals are to be located at Arlington, and a freight connection is to be made to the new city piers at Stapleton. Intermediate passenger stations are to be provided at St. George and at other points.

Features of Project

The entire project consists of a tunnel about 5.5 miles long from portal to portal and an extension of about 3.6 miles on Staten Island, which for the most part will be on embankment, thereby avoiding grade crossings. These figures do not include the several spurs and connections. The tunnel will have a maximum grade of 2 per cent and within the harbor line will not project above a plane 50 ft. below mean low water.

It is estimated that the project, exclusive of rolling stock, will cost not to exceed $60,000,000 and will require until the summer of 1929 to complete. It is recommended that the subaqueous section of the tunnel, about 2 miles in length, with its two shafts, be put in hand at once and that for this purpose and for the acquisition of the lands necessary for the remainder of the line $27,000,000 be made available. From time to time further appropriations will be required which will amount to the total of $60,000,000 by 1927. Estimates have been based on the shield method of construction, although the trench method will be considered as an alternative provided the consent of the War Department can be obtained.

The committee reports an opinion of the corporation counsel that, although the city has the right to construct this line, it lacks the power to operate it, and intimates that such power should be obtained by the city before the completion of the railroad.

A.A.E. Nominates Three Candidates for President

Three fields of engineering are covered by the experience of the three candidates for president of the American Association of Engineers; the election results will be announced at the annual convention to be held in Salt Lake City, Utah, June 5-7. A. M. Van Auken, consulting engineer of Chicago, has been identified with railroad engineering during the most of his professional career. A. N. Johnson, at present dean, Engineering College, University of Maryland, is closely associated with highway engineering, and Clarence W. Hubbell, consulting engineer of Detroit, has specialized in municipal engineering problems.

Something new in the announcement of candidates for technical society offices are the platforms which each of these three men have enunciated. Excerpts from these platforms are given below.

Mr. Van Auken began his engineering experience with the Union Pacific R.R. in 1883 and he followed that class of work almost continuously until his association with Harold Almert as consulting engineer, Chicago. He has served on various engineering committees. He was the first vice-president of the Chicago chapter, A.A.E., and secretary of the Nashville, Tenn., chapter in 1920. He is the chairman of the educational committee of the Chicago chapter.

Mr. Johnson, after his graduation from Harvard University in 1894, became an instructor at that institution. Positions which he has held include the office of state highway engineer of Maryland, chief engineer of the U. S. Bureau of Public Roads, state highway engineer of Illinois, consulting engineer for the Bureau of Municipal Research, New York City, and consulting engineer for the Portland Cement Association. He was the first vice-president of the A.A.E. and has been most active in its committee work.

Previous to his graduation from the University of Michigan in 1893 Mr. Hubbell had been on railroad location and construction work. Five years after his graduation he served as civil engineer to the board of water commissioners of the City of Detroit, a position which he held for nine years. In 1909 he was made city engineer of Manila, P. I., and in the next year became chief engineer of the Bureau of Public Works of the Philippine Islands. In 1917 he was appointed city engineer of Detroit, a position he held until his recent entrance into the consulting field.



A. M. Van Auken — "Thirty-nine years of engineering experience, working in thirty-five states, in railroad, irrigation, mining, river and harbor, municipal and building engineering, has given me an insight into the aspirations, resentment and yearning of the junior engineer. Long a student of economics, it has been my privilege to advise in law making. Long associated with reform bodies has given the privilege of aiding and remedying abuses. I feel that my training fits me to serve you. Should you select me as your president, I will serve you with loyalty."



A. N. Johnson— "My ideal of A.A.E. is: To advance the engineering profession that it may render ever greater service for the public good; to promote the welfare of the engineer that he may be of greater worth to himself and his profession; to secure the active aid of all organizations of engineers and to render them generous help in every worthy endeavor; to imbue each member of the American Association of Engineers with a spirit of service to his fellows and to his community; and always to make him sensible of his respons bility to live and impart the ideals of the American citizen."



Clarence W. Hubbell — "Ethics! Of course, we must have them and live them. They keep us from being savages.

"Education! Yes. He who does not master some branch of his chosen profession is not worthy to be a member of that profession. But always it is not to be found in universities and learning is a poor substitute for common sense.

"Get your job. Deliver the goods. Collect your money. Live your life. These four things every man must do. To help each member of the engineering profession to do them well is the true aim of the Association."

Engineer Carries Suit for Pay to U. S. Supreme Court

Engineering work performed by E. Kirby-Smith for the International Lumber and Development Co. is involved in a case before the U. S. Supreme Court. The case is an appeal from the Circuit Court of Appeals, which reversed the first decision of the District Court.

Mr. Kirby-Smith is a Tennessee engineer, who developed the lumber company's plantations in Mexico for six years beginning in 1905. He worked under contract of Markley & Miller, employing 500 to 2,500 men, clearing the tropical forest and planting 20,000 acres in hevegeer, rubber and bananas. When he left on account of ill health Markley & Miller owed Mr. Kirby-Smith $105,000 for which they gave him notes and drafts on the Mexican company. Only one draft, for $1,000, was paid by the company, payments on the others being refused, whereupon Mr. Kirby-Smith sued.

The District Court awarded him judgment in a first trial but refused to enforce his claim on a second which was affirmed by the Circuit Court. From this decree Mr. Kirby-Smith has appealed to the Supreme Court.

Department of Justice Asks Increased Appropriation

In asking for an increase from $100,000 to $300,000 in its funds for investigating violations of the anti-trust laws, officials of the Department of Justice told the House appropriations committee that the department was much behind in this work, there being 157 pending cases. The Department has 27 attorneys engaged in anti-trust prosecutions, six of whom are in New York in connection with the building investigation. Pending anti-trust cases are against tile, ceramic and cement combinations, including a combination of cement manufacturers operating from Denver.

Am. Soc. C. E. Has 10,275 Members

According to its latest *Year Book*, the American Society of Civil Engineers on [illegible] had 10,275 members distributed among the following grades: Honorary members, 6; members, 4,479; [illegible]; associates, [illegible]; juniors, [illegible]; affiliates, [illegible]; juniors, [illegible]; [illegible]. The [illegible] total membership was 2,[illegible] members on Feb. 10, 1921.

California Supreme Court Reaffirms Antioch Decision

The Supreme Court of the State of California on March 22 reaffirmed its decision of last year dissolving the temporary injunction of a lower court that was issued to prevent irrigators along the Sacramento River from diverting water from that stream.

This suit, which is known as the "Antioch case" and which was reported in *Engineering News-Record*, Oct. 27, 1921, p. 697, has attracted widespread interest because of the precedent which it would establish. The San Francisco city attorney attended the hearing as amicus curiae and filed a brief on behalf of the city because of the possible effect on the Hetch Hetchy project of the outcome of the case.

Reaffirmation by the Supreme Court means that irrigationists along the river will [illegible] the water they receive, pending the trial of the suit itself. Thus far the hearings have had to do only with question of granting the temporary injunction forbidding water diversions.

No date can be set for trial of the suit on the merits of the [illegible] themselves.

House Bill Provides Two-Year Road Program

Appropriations of $65,000,000 and $75,000,000 Planned—Federal Participation $12,500 per Mile

(*Washington Correspondence*)

After nearly a month of intensive consideration of the highway situation the Committee on Roads of the House of Representatives came to the conclusion that it would be better to provide at this time for two-year program only. As a consequence, the committee has placed upon the calendar of the House the Dunn bill appropriating $65,000,000 for federal aid during the next fiscal year and $75,000,000 for the fiscal year to end June 30, 1924. The main reason influencing most members of the committee to provide a two-year program only was the hope that financial conditions would be better later and that it would be possible to appropriate $100,000,000 for the third year. The bill also carries $6,500,000 for forest roads and trails during the fiscal year to end June 30, 1924.

The new bill is so worded as to leave no doubt as to the intention of the federal government to participate in underpass as well as overhead construction in the elimination of railroad crossings at grade.

LIMIT OF $12,500 PER MILE

State highway officials generally are pleased with the provision in the new bill which limits federal participation to $12,500 per mile during the next fiscal year and $10,000 per mile thereafter. The position of the committee is that road construction exceeding $20,000 or $25,000 per mile is almost entirely in sections of congested traffic where the localities are amply able to contribute more than one-half of the cost of construction.

Heretofore when federal money would be allocated to a definite project it would remain idefinitely to the credit to that particular piece of construction. In case the project were abandoned, the money was lost to the state. The new bill allows this money to be allocated to another project.

A clause covering fraud, with penalty of 5 years imprisonment or $10,000 fine, or both is included in the bill.

The bill makes it mandatory for a state to put a project under contract within one year. Provision also is made for the extension, for five years, of the time in which Texas, Arkansas and other states may change their constitution to comply with the Federal-Aid Act.

More War Material for Roads

Large quantities of surplus war material which was so helpful to many of the states in road construction last season are still being distributed to state highway departments by the U. S. Bureau of Public Roads. Recently there has become available for distribution 5,000,000 board feet of lumber and material valued at $220,000 consisting of steam and gas engines and machine shop equipment, none of which has been used. Most of the lumber was intended by the army for the construction of a pier at Charleston, S. C. and will be suitable for highway bridges. The machinery and equipment are stored at the Picatinny Arsenal, Dover, Del.

Buffalo Section Endorses Loweth, Not Coleman

In *Engineering News-Record*, March 30, p. 544, it was stated that the Buffalo Section of the American Society of Civil Engineers had endorsed the name of John F. Coleman for the presidency. This was an error. Up until the time that note was written no action by the section had been taken, but on April 5 a resolution was passed endorsing the candidacy of C. F. Loweth.

Canadian Road Builders Select Victoria For Convention

Announcement is made by the executive committee of the Canadian Good Roads Association that the ninth annual convention will be held June 13-16, 1922, at the Empress Hotel, Victoria, B. C. In the program particular attention will be given to the experience gained during two years of federal aid.

Statistics collected by the Dominion authorities show that up to Sept. 30, 1921, approximately 50 per cent of the federal appropriation of $20,000,000 had been absorbed. Eight provinces had participated (Alberta being the exception), and in all 126 projects had been undertaken, representing a total of about 3,800 miles and an estimated total expenditure of $24,000,000, with 40 per cent of this sum being drawn from the Dominion grant.

Other subjects to be discussed at the convention include cost data, highway financing, economical methods of improving earth roads, and greater attention to maintenance.

International Engineering Congress in Rio Planned

It is probable that an international engineering congress will be held at Rio de Janeiro in connection with the centennial exposition which is to start there next September to celebrate the 100th anniversary of the independence of Brazil. Under the direction of the Club de Engenharia de Rio de Janeiro preparations are now being made for the congress, and it is understood that representative engineers from all American countries will attend the congress.

The principal subjects of discussion as now outlined are: The utilization of fuel resources, the best utilization of water power, recent advances in irrigation methods, the elimination of waste through the standardization of supplies for agricultural and industrial purposes, coal as a factor in industrial development, essentials of a national railroad policy, intercontinental engineering cooperation, port developments, terminal facilities, and steel industry.

As the first step of American participation in this congress, it is announced from Washington that the Bureau of Public Roads is to have an exhibit at the exposition which it is expected will stimulate trade in American-made road machinery and motor vehicles. Models showing various steps in the construction of roads, colored transparencies and motion pictures will be used to illustrate American methods of road building. Manufacturers of road machinery and equipment are invited to supply small-scale models, literature, and motion pictures if desired.

Further action on the international engineering congress is expected from the national engineering societies.

Live Water-Works Program for Philadelphia Convention

The tentative program for the American Water-Works Association convention at Philadelphia, May 14 to 19 has many features that promise to give life to the convention. Besides the general sessions at which a variety of papers and committee reports will be presented, the Manufacturers Water Works Association will have the floor one evening, the superintendents will have a whole day, and the chemical bacteriological section will have two afternoons and also a joint forenoon session with the other members of the association.

On May 14 provision has been made for "group meetings" in the forenoon and afternoon. In the evening the president's address will be followed by a reception and dance. Among the papers on Tuesday will be one by George W. Fuller on the "Philadelphia Water Supply, Present and Proposed" and another by F. C. Jordan, on "Fire Prevention and Fire Protection in Relation to Public Water Supply." In the afternoon of the same day the development of the Schoharie watershed, Catskill water supply, New York City, will be taken up by J. Waldo Smith, the Hetch Hetchy water supply for San Francisco by M. M. O'Shaughnessy, the construction of the Loch Raven dam, Baltimore, by William A. Megraw, and twenty years of filtration practice at Albany, N. Y., by G. E. Willcomb. Prof. John H. Gregory will speak on a subject not yet announced.

Later on during the convention there will be moving pictures showing steam control by the Dean system, and lantern slides illustrating the casting of iron pipes centrifugally. Wood pipe will be discussed by J. W. Ledoux, causes of failure of cast-iron pipe by F. A. McInnes, control of tastes and odors in water by W. W. Brush, water softening by Prof. Edward Bartow and G. C. Baker, and chlorination by Dr. Frank E. Hale and others.

The convention will be held at the Bellevue-Stratford, Philadelphia. The secretary of the association is J. M. Diven, 153 West 71st St., New York City.

F. K. Zook Resigns After 47 Years With One Railroad

After completing 51 years of railroad service, 47 of which were spent on the California system now known as the Northwestern Pacific, F. K. Zook has resigned.

Mr. Zook was graduated from the Polytechnic College of Pennsylvania in 1871 and immediately joined the engineering staff of the Painesville & Youngstown R.R. In March, 1875, he became assistant engineer of the Sonoma-Marin R.R., one of the several lines which were consolidated and extended to form the present Northwestern Pacific system. He was soon made chief engineer of that line and throughout the succeeding years continued to direct the engineering work of the system as it grew to larger proportions. From time to time he also filled executive positions, some of which were assistant superintendent, superintendent and general superintendent.

From 1919 to the date of his retirement he was valuation engineer for the company.

Review Construction Status

(*continued from p. 626*)

ance themselves than there are skilled workers to build them if we could reduce the costs of building. Any justification of those employers opposed to organized labor would disappear at once if labor used its organization to promote the best effort of its members."

In conclusion he again addressed himself to the subject of trade associations in the following words:

"This brings me again to trade associations themselves, whether of manufacturers, distributors or workers. I believe in them. They are a complete necessity in our growing economic life. They can and have been mis-used. They can make for stability and economy in industry and for public welfare. Their two greatest fields of usefulness lie in the lifting of moral standards in these trades and in the increased efficiency of our production and distribution."

MISCELLANEOUS

Many of the matters covered by the convention would not be new to readers of *Engineering News-Record*, such as the various activities of the Department of Commerce in simplification, building codes, and zoning ordinances. Much emphasis was given to the need for building up a satisfactory system of apprenticeship in the building trades, an excellent paper on the subject having been sent by Hugh Frayne, general organizer of the American Federation of Labor. The subject recurred several times during the conference, showing that contractors would probably be willing to do their part in the working out of a satisfactory apprenticeship system.

Adding to the interest of the meeting were a number of exhibits showing the work that had been done in standardization of different building materials, such as floor and wall tile, common and paving brick, slate, lighting fixtures, elevators, and wall paper.

The following new directors were elected: D. Knickerbacker Boyd, architect, Philadelphia; E. J. Russell, architect, St. Louis; F. W. Walker, of the Tile Manufacturers' Association, Beaver Falls, Pa.

The following officers were re-elected: Vice-presidents, Gen. R. C. Marshall, Jr., general manager, Associated General Contractors, Washington; B. F. Affleck, president, Universal Portland Cement Co., Chicago; treasurer, A. M. Maddock, president, Thomas Maddock's Sons Co., Trenton; directors, Rudolph P. Miller, former superintendent of buildings, Borough of Manhattan, New York; Charles W. Brown, president, Pittsburg Plate Glass Co., Pittsburg; Charles S. Keith, president, Central Coal and Coke Co., Kansas City, Mo.

New York To Develop Barge Canal Water Power

Governor Miller has signed the Robinson bill which appropriates $1,000,000 to be expended in building water power plants at the Crescent and Vischers Ferry dams on the New York State Barge Canal, where approximately 10,000 hp. may be developed. The bill provides for the ownership of the plants by the state and the sale of surplus power over the small amounts required to operate the canal to the highest bidder.

Consolidate British Railways as Step in New Grouping

(*London Correspondence*)

The first big consolidation under the British railways-grouping scheme has taken place in the amalgamation of the Midland and the London & North Western companies which are being absorbed as from Jan. 1, 1923, into a new company. For the remainder of this year the two roads will work in close co-operation in order to facilitate the actual consolidation. The London & North Western serves London and the northwestern counties, including the cities of Rugby, Birmingham, Derby, Sheffield, Crewe, Manchester, Liverpool, Leeds and Carlisle. The Midland Ry. serves most of these cities together with the city of Lincoln. The capital of the L. & N. W. amounts to £188,292,156 and that of the Midland to £203,894,659.

Plan to Extend Tumalo Project

Bonds to the extent of $550,000 have been voted and validated by the courts for the extension of the facilities for irrigating land in the Tumalo Irrigation District in Oregon. The plan includes the extension of the present feed canal with a capacity of 250 sec.-ft. from Tumalo Creek about 5 miles to the Deschutes River near Bend, and to store 30,000 acre-ft. water at some point on the upper Deschutes River.

The Tumalo Irrigation District comprises 26,500 acres, of which 15,000 acres are irrigable, exclusive of about 1,000 acres in the old Tumalo reservoir which was constructed by the state but never used because of leaks which developed soon after construction. If these leaks cannot be stopped by sluicing, land within the reservoir will also be irrigated. About 7,800 acres of the irrigable land in the district now have party water-connecting rights.

Reconstructed Waterloo Station Opened to Traffic

Reconstruction of the Waterloo station, London terminus of the London & Southwestern Ry., commenced in 1900, has recently been completed and the new station formally opened to traffic by Queen Mary.

The first section of the new station was completed in 1912. Since then the project has been carried on continuously although much hampered by the war. All the work has been conducted without interruption to traffic, which, it is estimated, consists of about 1,200 trains entering and leaving the station daily. One of the entrances from York Road has been designed to form a memorial to the employees of the company who fell in the war. The completed station, regarded as the most extensive and best arranged railway terminus in the country, occupies a total area of 24 acres, of which 10 acres are roofed in. Subway passages provide for direct access to the Underground railways and for the handling of parcels traffic.

The remaining work was designed and carried out under the direction of the chief engineer of the company, a position which is now occupied until the early part of 1923 by the late Mr. J. G. Jacomb Hood, a post now filled by Mr. W. A. Szlumper. Mr. R. D. Hawes has been resident engineer throughout.

Live Topics Before Illinois Section, Am. W. W. A.

Fire Engines Favored—Tastes and Odors, Iron Removal—Meter Reading and Billing

Like the Indiana Sanitary and Water Supply Association and the Iowa Section of the American Water Works Association, the Illinois Section of the last named society at its annual meeting March 29 and 30 went on record as opposed to raising the water pressure for every fire turned in. Calling for a gradual increase in the use of pumpers the resolution followed a discussion of a paper on "Co-ordination of Water and Fire Departments" by Clarence Goldsmith, assistant chief engineer, National Board of Fire Underwriters, who stated that he was in hearty sympathy with the idea if a sufficient pressure, night and day, were maintained normally. Since the high cost of operation has existed it appears that many plants have materially dropped night pressures to save fuel. Mr. Goldsmith felt that sprinkler systems should always be under a head.

Particular interest centered in round-table discussions on tastes and odors, iron removal, records and accounting.

TASTES AND ODORS

Howard M. Ely, superintendent, Danville Water Co., outlined his experience with a novel aerator wherein the water falls onto a perforated cone-shaped distributor on which are angle baffles. He has not yet had sufficient experience to judge of the efficacy of the aerators to remove tastes and odors due to microorganisms. H. F. Ferguson, chief engineer, Illinois State Board of Health, instanced a case of a dangerous, polluted well supply being substituted for a public supply because of objectionable though innocuous algae growth in the latter. R. E. Greenfield, chemist of the Illinois Water Survey, asked that the superintendents send to the Water Survey or State Board of Health data on the use of copper sulphate to destroy growth and chlorine gas, odors.

Office Records—W. E. Lautz, superintendent, Pekin water-works, led the discussion on office records and accounting which followed a paper on "Collections" by E. McDonald, superintendent, Lincoln Water & Light Co. Strong tendencies were noted toward systems which keep a few meter readers and bill clerks busy continuously rather than a large number rushed at the end-of-the-month periods. Mr. McDonald has put water, gas and electricity bills of each customer on one sheet of paper.

Iron Removal—A hundred supplies have trouble from iron, said Dr. A. M. Buswell, chief of the State Water Survey. W. A. Hutchins, Freeport, stated that a treatment with 2 gr. per gallon of lime followed by filtration had been used successfully for 20 years but the sand cemented together and had to be removed at intervals. Recently the lime dose has been omitted and the quality of adsorption of the precipitated iron in the surface of the filters left after incomplete washing was made use of to take out the colloidal iron. The use of extremely small quantities of clay to adsorb the iron and to prevent the precipitated iron sticking to the sand is to be tried at Freeport.

Henry Ringness was elected chairman and G. C. Habermeyer secretary

Colorado Wants Interstate Stream Priorities Protected

Amendment of the Reclamation Act and the Water Power Act to recognize the principle of equitable division of interstate waters, particularly those of the Colorado River, among the states involved is called for in a recent report to the Denver Civic and Commercial Association by a committee on interstate streams. L. G. Carpenter, consulting hydraulic engineer was a member of the committee. The recommendations in the report have been adopted by the association and support of Colorado's congressmen is to be enlisted.

The report recites various difficulties which have been encountered in Colorado in the past when the federal government has refused to grant rights of way over federal lands which would permit diversions for use of new projects within the state, from the headquarters of the North Platte feeding the Pathfinder Reservoir and the Rio Grande feeding the Elephant Butte Reservoir. Colorado wants to divert without subsequent interference some of the Colorado River water through the range for use of Denver and the vicinity. The amendment to the Reclamation and Power Acts recommended would provide specificially that no water project constructed by the government and taking its supply from an interstate stream should constitute a priority of right in respect to later diversions and applications of water from the same source in other states.

Trial of Cement Makers Begins

(*continued from p. 626*)

Roger Shale, Special Assistant U. S. Attorney General, opened the case for the government, sketching the history of cement manufacturing in this country and the importance of the product as a construction material. He asserted the government would endeavor to prove there had been no competition among manufacturers for years.

Col. Henry L. Stimson, of counsel for the defendants, asserted that competition and not co-operation among cement makers had been responsible for the apparent similarity of prices within certain producing districts. Four points on which the defense will make its case are: (1) that government investigators have found competition most keen among cement manufacturers; (2) that profits, according to federal statistics, have been extremely low—a return on invested capital of 7 per cent in 1919 and 5 per cent in 1920; (3) that during post-war price inflation cement prices rose much less than the average of other commodities; and (4) that the Portland Cement Association and the Cement Manufacturers' Protective Association existed not as agencies to stifle but to make more intelligent the competition among manufacturers through a widespread dissemination of statistics on production, stocks and shipments.

The defense will endeavor to show there is ample cause for the existence of identical prices for a product which must conform to certain standards as to constituent materials, strength, quality, etc., and that cement requires such large facilities for storage and handling that the best merchandising is found through dealers, which fact further tends toward uniformity in price.

New Committee for Bridge Over The Hooghly at Calcutta

Numerous plans for a long bridge with drawspan over the Hooghly River at Howrah, just above Calcultta, India, were submitted to a committee some months ago, but the committee arrived at the conclusion that a drawspan of sufficient width for ocean steamers was unnecessary. A new committee has been appointed by the government to investigate the situation and to recommend the type of bridge best suited to the conditions. This committee includes J. Coates, city engineer of Calcutta, and J. McGlashan, chief engineer of the Calcutta Port Commission.

Civil Service Examinations

UNITED STATES

For the United States civil service examinations listed below apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the Civil Service Commission.

Vacancies in the General Land Office Service.

Transitman, $120 to $150 a month and subsistence while in the field. Examinations will be held May 10.

Vacancies in the Patent Office.

Assistant Examiner, $1,500 a year plus bonus of $20 a month, granted by Congress. Examinations will be held May 10, 11 and 12 and June 21, 22 and 23.

Engineering Societies

Calendar

Annual Meetings

NATIONAL FIRE PROTECTION ASSOCIATION, Boston, Mass.; Annual Meeting, Atlantic City, May 9-11.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, Philadelphia, May 15-19.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Annual Convention, Salt Lake City, Utah, June 5-7.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Annual Convention, Portsmouth, N. H., June 21-22.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, University of Pittsburgh; Annual Convention, University of Illinois, June 20-23.

The North Carolina Chapter, A. A. E. elected the following officers at its annual meeting: President, W. S. Fallis; vice-president, Harry Tucker; secretary-treasurer, H. K. Witherspoon.

The Buffalo Section, Am. Soc. C. E. has elected the following officers for the year: President, Walter McCulloh; vice-president, Alfred Spire; secretary-treasurer, John H. Feigel.

The Engineering Council of Utah held its annual banquet at the Hotel Utah, March 27 having Herbert C. Hoover and other members of the Colorado River Commission as guests.

The Arkansas Chapter, A. A. E., held its March meeting at Bauxite, lunching at the club house of the American Bauxite Co. and making a tour of the mines and plant during the afternoon.

The Wisconsin County Highway Commissioners' Association elected the following officers at its recent meeting: President, Andred Eklund; vice-president, William Hoenig; secretary-treasurer, E. Gleason.

The St. Joseph Chapter, A. A. E., elected the following officers at its recent annual meeting: President, Clayton O. Judson; 1st vice-president, A. C. Lingley; second vice-president, J. R. Leslie; secretary-treasurer, H. J. Gish.

The Utah Agricultural College Chapter, A. A. E., was recently established at Logan, Utah. Officers elected were: W. H. Willesen, president; W. T. Cannon, vice-president; and H. E. Dalton, secretary-treasurer.

The Washington Post of the Society of American Military Engineers had as its principal speakers at its recent meeting held at the engineer reproduction plant in Washington, Col. John Stewart, president of the post, Major-General Lansing H. Beach, Chief of Engineers, and Major W. W. Kirby, Director of the reproduction plant. Major Kirby gave a talk on the importance of maps in war. Throughout the evening the plant was in full operation and upon completion of the lecture the audience divided into groups and inspected each department whose chiefs explained in detail the various operations and processes. More than 250 members of the post and their guests attended the meeting.

The San Francisco Section, Am. Soc. C. E. on March 24 conducted an excursion to the new pumping and filtration plant now under construction for the city of Sacramento, Cal. The party of about thirty members visited the plant under the leadership of Charles Gilman Hyde, consulting engineer on the work. A series of pipe tests conducted by the California Concrete Pipe Manufacturers' Association was also witnessed.

Personal Notes

F. Lavis has recently returned to New York from Bolivia where he has been engaged as consulting engineer to the Bolivian Government and the Ulen Contracting Corp. in connection with railway projects including the line from Atoche to La Quiaca.

Harvey Fuller, city engineer of Chatham, Ont., has been appointed city manager. He will continue to act as city engineer.

George H. Rowe, assistant engineer of the board of public utilities of Los Angeles, Cal., has been appointed assistant engineer with the California State Road Commission. He was formerly instructor in engineering at Leland Stanford Jr. University and at the Colorado School of Mines.

Guy C. McGee and Chas. B. Smith have opened offices in Boise, Idaho, for the practice of engineering, specializing in irrigation, drainage and municipal projects. Both have been identified with this class of engineering work in the West for many years.

L. O. MARDEN, formerly bridge engineer for the state highway commission, Bismarck, N. D., has been appointed engineer for the Worcester Consolidated St. Ry. Co., Milford, Attleboro & Woonsocket St. Ry. Co., Interstate Consolidated St. Ry. Co. and the Attleboro Branch Ry. Co., with headquarters at Worcester, Mass.

ROBERT WINKLER, for 21 years director of the technical service of the Swiss Federal Railways, has retired because of ill health. He was vice-president of the Swiss section of the permanent commission which organized the Berne International Railway Congress in 1910.

FRANK D. DANIELSON, formerly assistant manager of Glencoe, Ill., has been appointed village manager of Hinsdale, Ill.

HORACE BOYOTT, for three years engineer of Brazos County, Tex., has resigned to become assistant engineer of Jefferson County with headquarters at Beaumont, Tex.

DAVID B. MILLER has been appointed city engineer of Michigan City, Ind., succeeding D. C. FORD, who retired to enter private practice.

JAMES C. ADAMS, deputy city engineer of Binghamton, N. Y., has resigned to become consulting engineer for Stento & Serifina, contractors, Binghamton, N. Y.

M. C. ERWIN, sanitary engineer of the state bureau of sanitary engineering, Tex., has resigned to become city engineer and sanitarian of Port Arthur, Tex.

THOMAS COLIN, superintendent of the water department at Caledonia, N. Y., has resigned to engage in business for himself.

H. L. ALBERT, civil engineer, Green Bay, Wis., has been appointed city engineer of Seymour, Wis.

H. R. F. HELLAND, who entered an engineering partnership with his father in San Antonio early this year, has been made assistant sanitary engineer for the State Board of Health, Tex.

W. W. HARMON has been appointed city engineer and ex-officio superintendent of streets of Oakland, Cal., succeeding George Mattis.

BUSINESS NOTES

THE CHAIN BELT CO., Milwaukee, Wis., has announced the appointment of G. F. Sherratt as manager of the Pittsburgh office.

A. W. BOWIE and J. J. LYDON, connected for the last twenty-five years with Westinghouse, Church, Kerr & Co. and Dwight P. Robinson & Co., their successors, have resigned and organized the construction firm of Bowie, Lydon & Co., with offices in Chicago. Mr. Bowie has been in charge of the design and construction of shops, office buildings and power plants for the Missouri Pacific Ry. Co., Crane Co., The Armour Leather Co. and others. Mr. Lydon superintended the construction of the Government nitrate plant at Muscle Shoals, embarkation camps Stuart and Hill, and various facilities at Newport News. W. G. BIERD, president of the Chicago & Alton R.R. Co., has accepted the presidency of the new organization.

HENRY S. DAY, engineer of equipment, Kansas City Ry. Co., has been made vice-president in charge of production of Smith & Sons Manufacturing Co., builders of road machinery. Previous to the war he was with Sanderson & Porter.

E. D. BARSTOW, sanitary engineer, and G. E. MCCURDY, former manager of the Akron branch of the Morris Knowles Engineering Co., Inc., have formed an engineering partnership with offices in Akron.

THE DRESSER-MINTON CO., construction engineers, has been organized in Cleveland, Ohio, by F. J. C. Dresser and J. H. Minton. Mr. Dresser had been with the Chicago & Northwestern for a number of years, and also with the Pennsylvania and New York Central Railroads in charge of construction. Mr. Winton was formerly senior assistant engineer in the office of the chief engineer of construction, Pennsylvania Lines West.

ALFRED C. ANDERSON and GEORGE A. SPOONER have formed a partnership for the practice of engineering and architecture under the firm name of Anderson and Spooner, with offices at Council Bluffs, Iowa.

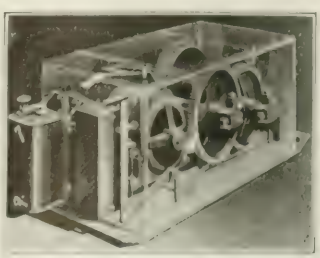
PERRY K. MILLER and CROSBY J. MCMIFFERT have opened an office in Montclair, N. J., for the practice of civil engineering. Both Mr. Miller and Mr. McGiffert had been connected with the engineering department of the town of Montclair for several years.

THE KOEHRING CO. OF CANADA, LTD., has been organized in Toronto to handle Koehring mixers, pavers, cranes, and other construction and industrial-plant equipment.

EQUIPMENT AND MATERIALS

A Self-Contained Small Hoist

A self-contained, portable hoist different from small hoists heretofore available has been developed by the Treadwell Engineering Co. of Easton, Pa. This hoist is wholly enclosed in a steel casing, mounted on a ⅜-in. steel

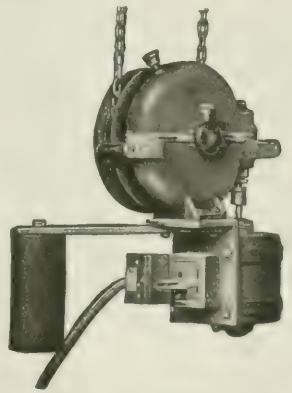


side plate. The cast casting forms the support for the drums and gear shaft bearing which are steel castings fitted with renewable bronze bushings and lubricated from a waste packed oil reservoir.

The controller box and resistance panel are mounted on the exterior of the casing. All other mechanism and the motor are entirely enclosed. The hoist has a clutch manipulated by a lever at the operator's end of the hoist. Control of the load is effected by a powerful band brake whose controlling hand-lever is normally latched in an "off" position, allowing the hoist drum to run free. A removable door or cover is provided on the top of the casing to give easy access to the mechanism within. The 8 x 12-in. drum has a capacity of 1,500 ft. of ⅝-in. wire rope and the rated hoisting capacity of 1,500 lb. at a speed of 100 ft. per minute. The motor is 5 hp., operating at 1,200 r.p.m. The hoist measures 2 x 2 x 4 ft. 5 in. over all.

Motor for Operating Hand Hoists

A motor which can be hung in the bight of the operating chain of a hand hoist and which will overhaul 138 ft. of chain per minute and furnish a chain pull of 130 lb. has been put on the market by the New Jersey Foundry & Machine Co., New York City. The ap-



pliance gives a load-lifting speed approximately four times that obtainable by handpower and requires but one man for operation. Current may be supplied by a flexible conductor connected to convenient sockets or suspended from the hoist if it is more desirable to bring the feeders to that point. The machine balance itself, weighs about 160 lb. and is easily handled.

Out-of-the-Ordinary Trade Publications

A 500-page book of views and brief descriptions of reinforced concrete structures has been published under the title of "Hennebique Ferro-Concrete" by L. G. MOUCHEL & PARTNERS, 38 Victoria St. London, England. The volume is a valuable one for students and others interested in knowing the variety of uses made in Europe of reinforced concrete.

Calcium chloride as a material for laying dust on gravel roads and for delaying frost action, and is a curing agent on concrete road construction is discussed in "How to Maintain Roads" published by the DOW CHEMICAL CO., Midland, Mich.

Cast-iron pipe and fittings are catalogued in a 125-page leather bound book published by the LYNCHBURG FOUNDRY CO., Lynchburg, Va.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Rapid-Fire Survey of Business Conditions

Common labor on road work averaged 28c. per hour for the entire country in February, according to the Bureau of Public Roads of the Department of Agriculture. The range was 13@20c. in the South, 25@30c. in the Middle West, and 45c. in the Pacific States. Teams withcut drivers ranged from 24@42c. per hour.

Common labor on all construction averaged 43c. per hour for the United States in both February and March, according to *News-Record* reports. The range was 15@30c. in the South, 47½@62½c. on the Coast, 40@72½c. in the Middle West, 35@75c. in the East. Highest rates are in New York and Chicago.

Retail cost of food, Feb. 15 to Mar. 15, declined as follows: Manchester, 4 per cent; Baltimore, Bridgeport, Newark, New Haven, New York, Richmond and Washington, 3; Milwaukee, 2; Denver, 1. The decline over the last twelve months ranges from 26 per cent in Denver to 51 per cent in Richmond.

Cost to build a residence is over 70 per cent higher than in 1914, according to Charles Cason, director of public relations of the Chemical Bank of New York. A 7-room, 30 x 34 ft., 2-story frame house, contents 29,100 cu.ft., floor area 2,640 sq.ft., costing $5,529 in 1914, rose to $12,815 in 1920, and now costs $9,502. A 2-story colonial house, 8 rooms (2 attic rooms), 23 x 41 ft., 25,315 cu.ft., 2,530 sq.ft., costing $4,176 in 1914, rose to $9,767 in 1920, and now costs $7,374.

Building permits in March, 1921 and 1922, issued in three cities were:

	March Number 1922	1921	March Value 1922	1921
Columbus....	622	520	$1,294,500	$971,910
Los Angeles..	4,241	2,911	10,864,829	6,915,216
Tacoma....	401	444	301,431	361,935

27,839 apartments are under construction in New York, according to the Tenement House Commission. The number of rooms is 107,054; the cost, $120,462,500.

Immigration aggregated 226,841 from July 1, 1921, to Feb. 28, 1922; emigration, 152,649. Following are some of the figures:

Race or People	Immigrant	Emigrant
English	19,301	6,349
French	8,536	2,046
German	21,109	3,798
Hebrew	41,689	516
Irish	10,363	1,561
Italian (north)	5,747	5,365
Italian (south)	33,776	37,301
Scandanavian	9,789	2,888

Bank Business totaled $9,166,000,000 in the week ending April 5, which was 16 per cent greater than the preceding week, or the same week of 1921. This can be accounted for partly by end-of-month and end-of-quarter settlements effected March 31.

Steel production for March totaled 2,370,751 tons of ingots, which is at the rate of 33,787,400 tons per year, or 64.3 per cent capacity. February production was at 47.2 per cent.

Foreign exchange active, with sterling at $4.41 and the Canadian dollar nearly 98 cents.

Bond issues offered to investors in the New York market this week aggregated $111,912,500, the largest week's total since the first part of March, according to the *Times*. The continued ease of the money markets and the strength of old bonds in the open market turned the attention of investors to the new securities, and, practically without exception, they were fully subscribed, investment brokers reported. The bonds were divided into the following groups:

State and municipal	$10,757,000
Foreign	23,700,000
Public utility	14,955,000
Railroad	60,000,000
Land Bank	2,500,000
Total	$111,912,500

The largest single issue was of $60,000,000 refunding and improvement mortgage 5s. of the New York Central Railroad Company, offered by a banking syndicate at 94½, to yield approximately 5.30 per cent. The bonds mature in 91 years and are redeemable as a whole, but not in part, after Oct. 1, 1951, at 105. Bankers reported, when the books closed, that there had been about three applicants for every bond. Allotments were made on a 30 per cent basis, and trading in the bonds, on a when-issued basis, has been at a slight advance over their offering price.

Largest tax-paying States of the country were Illinois, Massachusetts, New York, Ohio and Pennsylvania paying 60 per cent of the total corporation tax of the United States in 1916; 63.3 per cent in 1917; 63.7 per cent in 1918. The same five States paid in 1916 personal taxes amounting to 72.2 per cent of the total personal tax of the country; 66.6 per cent in 1917 and 63.2 per cent in 1918 (Nat. Lumber Mfrs.' Assn.).

PERCENTAGE OF TOTAL UNITED STATES TAX RETURNS

	Corporation Tax			Personal Income Tax		
	1916	1917	1918	1916	1917	1918
Ill....	8.74	10.23	8.82	6.31	7.02	7.50
Mass.	5.21	6.40	8.68	6.28	6.47	7.20
N. Y..	25.88	18.42	25.56	44.96	36.96	31.40
Ohio..	7.20	10.18	8.46	4.45	4.59	4.89
Penn..	12.97	18.10	12.19	10.16	11.53	12.22
Total	60.00	63.33	63.71	72.16	66.57	63.21

Federal taxation is a problem of utmost importance to the lumber industry said Wilson Compton, Secretary and Manager of the National Lumber Manufacturers Association, in his annual report, Apr. 5. Its general importance was also indicated: "That this problem is not yet solved is apparent when the citizens of five states, having less than one-third of the representation in Congress and one-tenth of the total vote in the Senate, pay two-thirds of the Government's revenue from taxation. It can be expected that the incentive to economy in Federal expenditures will be inadequate, and will so continue until the sources of Federal revenue by taxation are more widely diffused. As long as the representatives in Congress of forty-three states, whose citizens pay but little of the taxes, can commit the Government to expensive enterprise, and send the bill to the five states which pay the bulk of the taxes, it can scarcely be expected that men, willing to experiment with other people's money but not with their own, can be pushed away from the Government bargain counter."

Bituminous prices averaged $2.06 per ton at the mines for the week of Apr. 3, which is 71 per cent higher than before the war, according to 'Coal Age."

Painting Trade in Chicago on Non-Union Basis

Refusal of the painter's union in Chicago to accept the required wage cut and eliminate certain unfair and arbitrary restrictions indicated by Judge Landis has resulted in that trade being declared open shop by the Citizens Committee to Enforce the Landis Award. The painters had a contract to March 31 which the committee did not disturb until expiration. About 600 men struck and are being replaced by painters furnished by the committee.

Eleven trades comprising 6,600 craftsmen are now operated under non-union conditions. Nearly one-half are carpenters, with the number of laborers, sheet metal workers, plumbers and painters following in the order named.

Nearly 650 jobs valued at $30,500,000 are going ahead under the Landis award and building is progressing as expeditiously as at any time in the last five years. Some remarkable results have been accomplished according to T. E. Donnelley, president of the citizens committee. There has been no graft. Any man can undertake to get a building done on time and be assured that there will be no stoppage.

Opportunities for Steel Sales in Canada

A considerable amount of new construction which would involve the use of steel is being contemplated by the Canadian government according to a recent report to the Department of Commerce by the vice-consul at Quebec. The chief engineer and director of railways of the Province of Quebec has stated that for 1922 a substantial number of new bridge projects are being planned. Cost of the 55 bridges now under construction totals in excess of $1,000,000. Seven bridges are to be built this season. The steel necessary to build them aggregates 3,500 tons.

Only two railway projects are planned for this year. The first, which is under construction, is a 70-mile colonization road of the Interprovincial and James Bay Ry. The second is the Quebec-Chibougamou Ry. through Lake St. John. This will be a first class road using a 100-lb. rail.

Production and Materials Stocks in Ten Cities

Increased Steel and Lumber Output—Quick Mill Shipments of Steel—Lumber Demand 5 Per Cent Above Normal

Steel—The present annual rate of steel ingot production is estimated at 33,000,000 tons as compared with a rate of 29,000,000 tons, one month ago. Production now stands around 70 per cent of capacity and represents a rate somewhat higher than the average tonnage rate for either 1912 or 1913, the two best pre-war years for steel tonnage. Production is particularly heavy in steel pipe, tin plates, sheets and wire nails and has practically tripled in the last nine months. The coal strike and replenishment of stocks probably serve as the two principal factors in determining the present increase in steel output. Pig iron production is estimated at a rate of 25,000,000 tons per year, at the present time, or over 50 per cent greater than production in 1921.

Cement—Production of portland cement for the month of February, 1922, according to the United States Geological Survey, amounted to 4,278,000 bbl. as against 4,379,000 bbl. in February, 1921. Cement shipments, however, reached a total of 3,285,000 bbl. for February, 1922, as compared with 3,331,000 bbl. for the same month in 1921. Stocks on hand for the entire country, at the end of the month totaled 14,310,000 bbl. for February, 1922, while 11,400,000 bbl. represented the total reserve for the same period in 1921.

Brick—Information as of Mar. 1 received from the Common Brick Manufacturers Association shows only 83,900,000 burned brick on hand as against 237,980 000 on Feb. 1, 1922, and only fifty plants closed down as compared with fifty-eight inactive during the month preceding. The quantity of unburned brick on hand indicates that the plants being operated are piling up stock preparatory to an active season; the labor situation throughout the country being favorable. In the Chicago district which is the largest brick producing center in the world, the deliveries of brick throughout the months of February and March were at a rate that promises a season's output closer to normal than has been expected.

REPORT ON COMMON BRICK FROM 108 YARDS AS OF MARCH 1, 1922.

Dist. No.	Including States of	No. of firms reporting	Plants Closed down	Burned Brick on Hand	Orders on Books	Price Per Thousand at Brickyard	Price Per Thousand at Brickyard Feb. 1, 1922
1.	N. Y., New England	11	10	4,160,000	3,983,000	$11 00 to $20.00	$11 00 to $20 00
2.	Pa., N. J., Md., D. C., Del.	12	3	3,950,000	32,438,000	12 00 to 17 00	12 50 to 17 00
3.	Va., N.C., S.C., Ga., Fla	6	2	1,314,000	1,334,000	10 00 to 16 00	10 00 to 16 00
4.	Mich., Ohio, W. Va.	11	6	4,957,000	7,915,000	10.00 to 16 00	10 00 to 16 00
5.	Ill., Ind., Wis.	29	9	59,474,000	109,230,000	11 00 to 17 00	11.00 to 17 00
6.	Ky., Tenn., Miss., Ala., Ark., La.	11	4	4,577,000	3,699,000	8 00 to 14 00	8.00 to 14 00
7.	N. and S. Dak., Minn., Neb., Ia., Kan., Mo.	8	7	220,000	428,000	10 50 to 17 00	12 00 to 17.00
8.	Okla., Tex., N. M.	3	6	579,000	2,136,000	8 00 to 14 00	7 50 to 14.00
9.	Wash., Ore., Mont., Wyo., Ida., Utah, Col.	3	3	783,000	76,000	10 00 to 17.50	12 00 to 18.00
10.	Calif., Ariz., Nev.	3	0	3,886,000	5,755,000	14.00 to 15.00	14.00 to 15.00
	Total	108	50	83.900,000	166,994,000		

Lumber—An average of 382 mills reporting weekly to the National Lumber Manufacturers Association for the month ending Mar. 25, shows 720 744,343 ft. cut; 743,469,637 ft. shipped and orders for 780,201,616 ft. have as compared with 683 385,486 ft. cut; 660,939,476 ft. shipped and orders for 671,747,145 ft. during February, 1922. Production for the week ending Apr. 1 stands at 20 per cent and shipments at 10 per cent below normal. Lumber demand throughout the country has reached 5 per cent above normal—as compared with 43 per cent below normal for the week ending Dec. 31, 1921.

New York—Demand for basic building materials unusually heavy in March. Steel, brick, lumber, sand, gravel, crushed stone and hollow tile all shipped into New York by water. Slowness of deliveries from manufacturers to dealers, in some of the important materials, threatens to prevent warehouses from keeping sufficiently stocked, in excess of demand, to meet the increasing seasonal building activities. Brick demand exceptionally heavy. A total of over 16,000,000 Hudson River common brick shipped into the New York market during the week ending Mar. 31, were all sold out by the following day.

Minneapolis — Lumber stocks are fairly well assorted but small; about 75 per cent of normal in this trade territory (Minnesota, the Dakotas and eastern Montana) and 90 per cent of normal in the Twin City District. Brick stocks are normal but lower than a year ago.

Los Angeles—Plenty of sand, gravel, cement, brick and sewer pipe; not on the market for yellow pine, spruce, paving block and paving stone.

Cincinnati—Hard lumber on hand for 100 carloads of woodblock and can furnish granite block in any quantity within one week. Any amount of sand and crushed boulders on hand; no paving brick in stock.

New Orleans—About 4,000 bbl. portland cement consumed weekly as compared with 3,000 bbl. one month ago. Stocks sufficient to meet all demands. Tile plants operating within 20 per cent of normal; demand heavy.

Philadelphia—Building stocks of sewer pipe low. Demand at this time better than expected. Paving stone and wood blocks used in large quantities, exceptional season anticipated. Cement

CONDITIONS OF MATERIALS STOCKS IN IMPORTANT CENTERS

Stocks on hand in approximate figures, example: (cement, Denver, 10,000 bbl.—time required for delivery of carload lots to city, job, example: sewer pipe, Atlanta, 4 to 5 days), and stocks on hand in general terms, example, (common brick, New Orleans, plenty).

	Cincinnati	Los Angeles	Atlanta	New Orleans	Denver	Philadelphia	New York	Detroit	Minneapolis
Sewer pipe	8,000 ft.	Plenty	Del. in 4 to 5 days	Ample	24 hr. del. local plant	Stocks low	Enough; del. 24 hr.	Moderate	Del. in 24 hr. local mills
Cement	15,000 bbl. (Portland) 1,000 bbl. (Utica) (natural)	Sufficient	20 to 25 cars	Demand about 4,000 bbl. weekly. Stocks normal	10,000 bbl.	Will not stand heavy demand	70,000 bbl.	Local mills stocks lighter.	Del. in 24 hr. local mills
Lime (common)	200 tons		10 to 12 cars	Enough			Moderate stocks in city.	10 to 15 cars. Mostly Ohio and Michigan mills	Del. 24 hr. to 5 days.
Lime (hydrated)				No demand					
Common brick	12,000,000 No. paving brick	Yards well stocked	25 to 30 cars	Plenty	Depleted	Enough with working full time	16,000,000 Hopelessly depleted	Ample	Normal
Hollow tile			Ample; del. in 3 to 4 days	About 25 per cent normal		10 carloads	Large plants near city; shipments by water	Small supply; del. 5 to 6 days	
Lumber	120,000,000 ft.	Yel. pine and spruce not on market	Plenty	Normal	Ample; 24 hr. del. yards.	Normal; excellent supply	Prompt del. 24 hr.	Sufficient in local yards.	About 75 per cent normal.
Asphalt	300 tons Mex. asphalt				10 carloads	Plentiful	Refineries [illegible]	Small	

stock sufficient to meet present demands only. Brick yards operating on full time but barely keeping up to orders. Ten carloads of hollow tile on hand all taken up by unfilled orders. Lumber stocks moving out faster than they can be replenished; demand increasing.

Detroit—Ample supply of cement available; stocks on hand show decrease from February. Local and nearby mills can supply demand immediately. Small stocks of asphalt and hollow tile; several days required on large deliveries. Moderate supply of lime and sewer pipe.

Denver—Little change in building materials stocks since last month, with the exception of common brick. Stocks of this important material will be depleted to a considerable extent during April.

Birmingham—Stocks in general at manufacturing plants have been somewhat depleted but in nearly all cases production has been increased sufficiently to make up for the deficit. Most plants are now in shape to take care of the increases in orders.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted. Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section. The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of April 6; the next, on May 4.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minne-apolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$2.48	$3.35	$4.00	−$2.38	$2.66	−$3.30	$3.10	$3.25	$3.75
Structural rivets, 100 lb	3.35	3.90	5.50	−3.00	3.90	−4.45	4.50	3.75	6.50
Reinforcing bars, ¾ in. and larger, 100 lb	2.38	3.25	3.50	−2.28	2.56	−3.32½	2.75	3.25	2.75
Steel pipe, black, 2½ to 6 in. lap, discount	61%	68%	45%	59½%	61.9-5%	44%	58 8%†	53%	−30.00
Cast-iron pipe, 6in. and over, ton	47.30	+42.50	48.30	43.10	−46.50	52.00	48.00	−51.00	55.00
Concreting Material:									
Cement without bags, bbl	2.40	2.39	2.25	+1.97	2.24	2.90	2.73	2.94	2.48
Gravel, ¾ in., cu.yd	1.75	1.85	2.25	2.00	1.50	2.50	2.25	1.50	1.50
Sand, cu.yd	1.00	1.15	2.25	2.00	1.00	1.10	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd	1.75	1.90	2.73	1.60	2.25	3.50	2.25	3.00	2.00
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	−48.00	+38.00	33 50	−41.00	38.00	34.75	28 00	20.00	47.00
Lime, finishing, hydrated, ton	15.80@16.80	18.00	25.00	18.00	29.00	24.00	22.00	27.00	21.00
Lime common, lump, per bbl	2.75@3.18	1.25	2.50	1.40	1.40	2.70	1.75	2.75	11.00
Common brick, delivered, 1,000	19.40@19.90	+9.00	11.15	11.00	15.00	12.00	−15.00	14.00	16.00
Hollow building tile, 4x12x12, block	Not used	.07975	.115	.0821	.0752	.08	....	+ 12	+.095
Hollow partition tile 4x12x12, block	.11120	.06525	.115	.0657	....	.10	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal	−.82@.83	+.90	.109	.90	+.95	−1.05	−.96	.86	1.05
Common Labor:									
Common labor, union, hour	.75	.35	.....	.80	.....	.50@.55	.56¼	.50@.60	.....
Common labor, non-union, hour	.....	.20	.25	.72½	.40@.50	.35@.40	.47½@.50	.50	.20@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or − signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over

New York quotations are delivered except tiles, which are "on trucks." Common lump lime per 280-lb. net; both lump and hydrated quoted f.o.b. cars New York. Sand gravel and crushed stone are quoted alongside dock. Cement and steel pipe delivered to contractors on job. Gravel ready mixed $2 per cu.yd.

Chicago quotes hydrated lime in 50-lb. bags; common lump line per 180-lb. net.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net Lumber prices are to contractors in yards at San Francisco. Lumber price is for No. 1 fir, common.

Seattle quotes on Douglas fir instead of pine. Common lump lime per 180-lb. net. Hollow building tile delivered.

Montreal quotes on fir instead of pine. Sand, stone, gravel and lump lime per ton. Lime and tile are delivered; cement, sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 97.56 cents). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net.

Changes Since Last Week

Structural shapes are quoted in Denver at $3.30 as against $3.50; rivets at $4.45 reduced from $4.55 and reinforcing bars at $3.32½ as compared with $3.42½ per 100 lb., last week. Mill shipments of steel shapes quoted at $2.80; rivets $2.10 and bars $2.57½ per 100 lb.

Pittsburgh mill price of $1.50 for structural shapes and reinforcing bars continues to gain in firmness; plates, however, are quoted at $1.40@$1.50 per 100 lb.

Downward tendency in cast-iron pipe prices in New York and Chicago; Minneapolis quotes $46.50 as against $47 and Seattle $51 as compared with $52 per ton for 6-in. pipe. Atlanta quotes a rise of $2.55 per ton.

Long leaf yellow pine quoted in New York at $48 as against $49 and in Atlanta at $38 as compared with $36 per M. ft., one week ago.

Common brick down 50c. in San Francisco and up 25c. per 1,000 in Atlanta. Slight advance in hollow tile in Seattle and Montreal.

Lumber, brick and steel pipe prices showing upward trend in Seattle market.

Linseed oil advanced 1c. in Atlanta, 2c. in Minneapolis and declined 3c. in Denver and 8c. per gal. (5-bbl. lots) in San Francisco. Oil is quoted in Denver at $1.03 per gal. in iron barrels; in wooden containers 2c. per gal. extra.

Bricklayers have gone on strike in San Francisco, refusing to work with non-union men on the American or open-shop plan.

General building trades strike called in Niagara Falls, involving 1,200 men. A 10-per cent wage reduction, from the scale specified in an agreement expiring Mar. 31, 1922, was refused by all trades excepting bricklayers. The latter will return to work at a rate of $1.05 per hour.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, President

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. Mehren
Editor

Volume 88 — NEW YORK, APRIL 20, 1922 — Number 16

Enforcing Ethical Codes

FOR years there has been felt in engineering circles the need for enforcement of codes of professional ethics. In this respect engineers have lagged behind the lawyers, the medical men, and the architect. The A. A. E. has had an ethics committee and has set a commendable example. Now the American Society of Civil Engineers is to take up enforcement in a more vigorous way; at least, we so interpret the action of the Dayton meeting of the Board of Direction in authorizing a Standing Committee on Professional Conduct. The profession can make itself in the eyes of the public whatever it chooses. If it be jealous of its standing, if it be strict with its discipline, the public will be sure to feel the reflex and appraise the engineer accordingly.

Strengthening Its Technical Life

LAST WEEK we commended highly the spirit of the Dayton meeting of the American Society of Civil Engineers. But the Dayton event signifies even more to the society, for it marked in the Board of Direction meeting another step in strengthening the society's technical life. Two new technical committees were organized, five special research committees authorized and a by-law introduced looking to the organization of technical divisions of the society. All of this is most hopeful. It gives promise of directing the great energies of the society toward the development of the science and art of engineering and the technical advancement of its members.

A Forward Step

A LONG forward step has been taken in New York State by the enactment of a law providing that health officers shall be appointed for four-year terms and shall not be removed except on charges. The same rule might well be made country-wide in application and extended to other municipal, to county and state officials where adequate civil service regulations do not already govern appointments and removals.

Ten-Year Municipal Programs

REPEATEDLY we have urged that every city adopt a municipal program of public works improvement extending over a series of years. The period would vary with the size of the city. A 10-year period would be none too long for a city of large size and many improvements in hand and to come. Such a program and period were advocated by Robert Hoffman, city engineer of Cleveland, Ohio, before a recent meeting of the Cleveland Engineering Society. Presumably Mr. Hoffman and some of his associates have long worked to a program, but to ensure a reasonable degree of adherence to a municipal program formal official sanction and the support of public opinion are essential.

The Navy Bill

TO JUDGE by the noise from the House of Representatives one would think that a "big-navy" lobby were at work in Washington. As a matter of fact those who want Congress to appropriate enough money for an enlisted personnel (including apprentices) of 96,000 merely want the United States to maintain its quota in the 5: 5:3 naval ratio agreed upon at the Washington Limitation of Arms Conference. Sentiment in this country doubtless favors small armaments, but sentiment also favors the United States playing its rôle so that it will be respected and that it will be a factor in the next naval-limitation conference, even as it was in the last. We took the lead in the last conference because we had a hand full of trumps and could play as long as anyone else. Our strength was well up to that of the greatest. But if we now cut our navy down to 3 in the ratio, instead of the 5 we are entitled to, we shall have a weak hand and cannot force the play. In order to bring about further reduction later it is necessary to keep our navy right up to where it was placed by the Washington conference.

British and American Vehicle Taxes

IN HIS recent presidential address before the Institute of Transport, Sir Henry Maybury, director of roads, Ministry of Transport, cited figures on the number of motor vehicles and the revenue derived from them which are decidedly timely when compared with similar statistics for the United States. On Aug. 31, 1921, the number of motor vehicles for which licenses were in force in Great Britain was approximately 870,782. The gross receipts from motor licenses in Great Britain totaled £9,276,628. Figuring the British pound at its normal rate of exchange ($4.86) we find that British motor vehicles last year paid an average fee of $52. Statistics collected by the U. S. Bureau of Public Roads, as already reported in this journal, showed that on Dec. 31, 1921, there were 10,448,632 motor vehicles in the United States, from which the revenue, in 1921, amounted to $122,478,654, an average contribution per vehicle of slightly less than $12. In other words, the individual British motor-vehicle owner, due to the higher scale of fees in force, contributes annually toward road work more than four times as much as the American owner. The mere fact that Great Britain has such high taxes does not indicate that they would be proper under our conditions. However, the British view is at least suggestive of that which this journal has before urged, namely, that all states which are below the level suggested in the proposed uniform motor vehicle law ought, as soon as possible, raise their fees to these figures. Taxes as high as those in Britain, however, would undoubtedly act as a very considerable check to the increase of automobile sales in the United States.

Sensationalism vs. Judicial Inquiry

REMARKABLE is the contrast in the amount of publicity given hearings conducted by the Lockwood Committee into housing evils in New York City and the actual criminal trial there of a group of Eastern cement manufacturers. Unquestioned sensationalism characterized the former and dignified examination of fact, the latter. The legislative committee accomplished much in the exposé of certain evils and in securing the indictment, trial and conviction of guilty individuals, agencies and corporations responsible for increasing in one manner and another building-construction costs in and near New York City. It is all too obvious, however, that the methods pursued by the committee's counsel were hyper-sensational. The accounts bore strong evidence of that. The press table was always crowded and the news of the investigations was difficult to keep off the front page.

Now the trial of forty-four individuals and nineteen corporations on a charge of conspiracy and restraint of trade has been in progress for about ten days. Yet there are always seats in the court room and the press table is practically deserted. This is all the more notable because the public interest is actually more affected by a criminal trial than by an investigation before a body that is not, in itself, vested with either legislative or judicial power. Comparing these two situations it is safe to say that the public that became so familiar with such opprobrious terms as "Hettrickism" and "Brindellism," and read every day the most minute details of the activities of the meanest union business agent, will know few details of the criminal trial that affects a group selling a building material with a yearly market value in excess of $250,000,000, except that the trial has begun and that a verdict has been reached.

As *Engineering News-Record* said a year ago it is well that the facts concerning the operations of the cement companies be laid bare. The stigma should be removed from their operations if the facts warrant it: they should pay the penalty if found guilty of the indictment they are under. In the meantime the public that is interested may get the facts; facts clarified by cross-examination and evidence for the defense, which were not permitted in the recent inquisition. After the fetid atmosphere of a Lockwood Committee investigation the cool breeze of a federal courtroom is refreshing.

Publicity for Statistics

TO ONE impatient for results there was an unsatisfactory conclusion to Secretary Hoover's conference with trade associations. The accomplishments did not go beyond an airing of their views on statistical activities by trade-association executives and an offer by the Department of Commerce to help if the trade associations desired its assistance. However, one can readily understand why there was not more conclusive action. The Department of Commerce has no power under the law to force its will regarding statistical activities upon trade associations, nor does it desire to exert any pressure. It would have helped, though, had there been means of determining how many of the associations represented were favorable to clearing statistics through the government.

Without a doubt the expressions favorable to publicity carried conviction to some who were "on the fence." Nor could there be doubt of the anxiety of the association executives who spoke at the meeting nor of their belief that in publicity lies the means of security. Mr. Hoover's remark, "Why skate on thin ice or stay in the twilight zone," drove home to the mark in an impressive way.

The actual results from the meeting remain for the future to unfold, but we strongly hope that, for the benefit of American business and of the American public, there will be generous response to the department's offer to serve as a clearing house for trade figures. Widespread acceptance of the offer would help to regain whatever of public confidence the trade associations have lost.

Charting the Business Course

THE widespread feeling of business men that the government should define for them in a positive way what business procedures are legal, received strong endorsement at Secretary Hoover's conference last week with trade association executives. Chairman Gaskill of the Federal Trade Commission and Senator Edge both declared for a positive expression by the government regarding those things that business should be allowed to do.

The carrying out of a plan of this sort is neither revolutionary nor difficult, nor does it commit the government to unchangeable precedents which might, due to change in the public temper or the methods of conducting business, put actual practice out of harmony with the times. It would be well to set up a commission to which individual businesses and, particularly, associations of business men could submit plans of procedure. If the commission should determine that, in its judgment, these practices were not in contravention of the law, it would issue a certificate permitting their use. Such certificates should be revocable at any time, such revocation being the only penalty, if it could be construed a penalty, attaching to the use of the practices covered. In other words, a business man, corporation or association could not be prosecuted for having followed plans that had been approved by certificate of the commission.

By some such mechanism business could proceed with confidence. This is little, indeed, to demand from Congress, particularly in view of the fact that labor and the farmer have had themselves exempted in large measure from the applications of the Sherman Act. Business does not ask for itself any modification of the anti-trust law. It merely asks that the government shall assume a positive attitude and assist business men in charting a legal course.

Parks Functionally Designed

THAT public parks are designed to serve specific public needs and should be held inviolate from all encroachments is a principle well known to park designers and some portion of the public to whose use parks are dedicated. But sooner or later every part requires defense from invasion. The defense is usually all the harder because the would-be invaders have some most worthy object which would be saved expense or be helped otherwise by the provision of a free site for a public or semi-public building or for some temporary exhibition.

Central Park in New York City has to be constantly defended against such invasions. The latest proposal to use Central Park comes from an organization devoted to members of a profession so closely allied to landscape art as to cause wonder. The National Sculpture Society seeks the use of space north of the Metropolitan Art Museum for an exhibit of outdoor sculpture next autumn. Such an exhibit would be less of an invasion than many—perhaps less foreign to the objects of the park than is the Art Museum—but the proposed exhibit of sculpture should be considered as at the very least a menace through establishing a precedent that would lead to further and increasingly worse encroachments.

In every case of possible encroachment on a park, judgment should be passed by some competent jury as to whether the object sought violates the function of that particular park, bearing in mind that when park lands are acquired and properly laid out the object is to supply certain needs of a city or district. Time and circumstance may change the needs. If so, that should first be determined and then the park redesigned accordingly—which would lead to far different results than altering the plan of a park now here and then there in accordance with the request of some person or organization which has, first of all, its own ends to serve rather than the park needs of the public.

Engineers have seldom if ever proposed park invasions. They, better than almost any other class of professional men, are by education and training fitted to realize that every public improvement should be ably designed to serve a specific purpose and should not be devoted to another object without due regard to possible violation of the function to which the improvement was dedicated. They should stand ready to defend parks against invasion. This service may be more necessary in smaller than in larger cities since in smaller places engineers may be the only class of men present whose training has fitted them to recognize and protect the principle of functional design.

Floods and River Control

A REMARKABLE range of thought is represented in the extracts from the papers on flood control read at the Dayton meeting of the American Society of Civil Engineers and printed in this issue. They demonstrate very effectively how important and how manysided is the flood subject. The problems involved have received much less than their due attention during the past decade, as has been emphasized repeatedly in these columns (see *Engineering News-Record*, Sept. 22, 1921, page 471, and Jan. 5, 1922, page 7), but henceforth the entire civil engineering profession is sure to make them its own and to take up their detailed study.

President Freeman in telling of millions of deaths from flood and famine in China, repeated time and again, characterized the seriousness of river-control problems. Foreign as it may seem, the Chinese situation contains useful facts and warnings for America. Indeed, river control is, because of its very complexity, a subject of world-wide scope in spite of the overshadowing influence of local conditions on methods of control.

Before the Dayton meeting no occasion ever brought together so comprehensive a picture of American problems in this field. Much more remains to be added to the picture, no doubt, but for the present ample food for thought is offered. Ranging from the clear outline of how the Mississippi flood-control system was worked out, as given by Mr. Ockerson, to the anxious emphasis laid on the Imperial Valley problem by Mr. Davis and Mr. Grunsky, all the subjects dealt with are absorbingly important. Farm lands and city property are both involved, in different instances.

Two matters, however, invite rather special attention because of their broad meaning. The first is the danger of phenomenally intense small-area rainfall, the danger of *cloudburst floods*, as Mr. Matthes called them. We appear to face here a phenomena of extremely rare occurrence in any locality but one which—so far as can yet be predicted—may visit any stream basin in the country. Before its economic importance can be estimated properly, a great deal of further research will have to be carried on. For the present the maximum curves deduced by Mr. Matthes and Mr. Eddy supply certain datum points of great value, at least for application to structures which should be able to weather even the emergency flood. Bridges may be overtopped, but they should not be washed out.

The other matter is the interdependence of flood-control with other elements of river utilization. Mr. Davis referred to this in his citation of unexpected flood-control action developed by the great Western irrigation reservoirs. Mr. Knowles in discussing the application of broad community-planning ideas to such problems as that at Pittsburgh and Mr. Grunsky in his reference to the necessity for joint work in the Sacramento valley also expressed the truth that flood control is not always, or perhaps only rarely, a separate problem. From this truth it follows that a proposed solution of a flood problem requires examination not only as to its effectiveness *per se*, but also as to its adequacy from the viewpoint of full utilization of a stream. The latter will not always govern, of course; in the Miami Valley it does not.

So far as the Dayton discussion dealt with flood protection it concerned itself solely with structures and their construction. However, in the development of flood control that, it may be hoped, lies just ahead, the point needs to be kept in mind at all times that more than the mere construction of works is required for ultimate success. Works once built must be maintained and administered, with heed to their proper functioning. Otherwise they may not only fail to yield useful service, but even do mischief far beyond that which they were built to prevent. Along the Mississippi experience has taught this to the riparian dwellers, so far as watchful care of the levees is concerned. Elsewhere, with different conditions and less obvious dangers, a long process of educating the people may be required.

Chiseled in stone on the outlet works of the Miami dams is an inscription which reads about like this: "The dams of the Miami Conservancy District are built for flood protection. Their use for power development or storage would be a menace to the cities below." This impressively simple and direct bit of maintenance teaching is the outcome of the thought given to this point in one notable instance. In other stream-control or flood-protection enterprises the salient facts to be taught the people are likely to be less simple, and more elaborate means of conveying the lesson may need to be resorted to. In every case, however, the burden of providing for the process of teaching will rest on the engineer as an integral part of his work of construction.

Thrust of Skew Barrel Arch Measured on Laboratory Model

Results Showing Concentration of Thrust at One Corner of Abutment Indicate That Common Method of Stress Calculation Is In Error—Field Tests To Be Made on Scioto River Bridges

By Clyde T. Morris
Engineer, Stadium Building Committee, Ohio State University, Columbus

FLOOD-PROTECTION channel-improvement work in the Scioto River through the city of Columbus required the construction of three reinforced-concrete arch bridges, all of which are skewed. In the preparation of the designs for these in the winter of 1917-18, question arose as to the distribution of stresses along the spring line of a skew barrel arch and this was suggested as a thesis subject to two senior civil engineering students at the Ohio State University, P. H. Elleman and W. Hartline. Under the direction of John R. Chamberlin, at that time Deputy Highway Commissioner of Ohio,

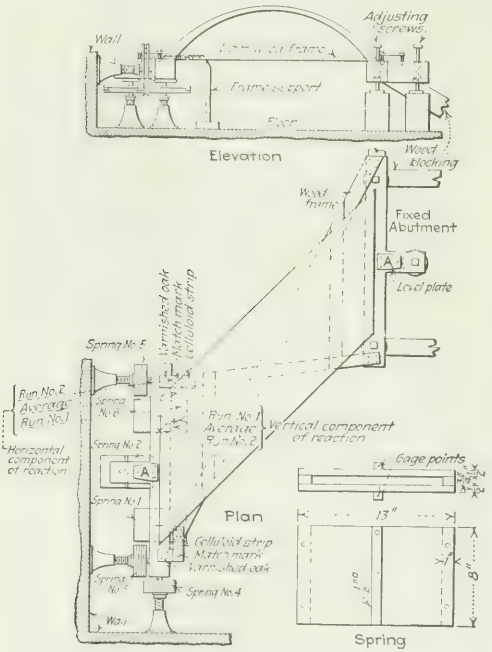


FIG. 1. FOUR-FOOT MODEL ARCH AND GAGE ARRANGEMENT FOR MEASURING THRUSTS

and the writer, they built and tested a small concrete skew arch at the University. The results of the work are given in the present article.

The object of the test was to determine the magnitude, location and direction of the resultant reaction at one abutment. No deformation measurements to determine unit stresses were taken on any part of the arch. The span of the arch normal to the abutments was 4 ft., the width parallel to the abutments 3 ft., and the skew 45 deg.; this gives an arch which is comparatively narrow and which has no part of the abutment within which lines normal to the abutments will strike both spring lines. The general arrangement is shown in Fig. 1. The rise of the arch was 12 in., the crown thickness 1¾ in., and the reinforcement about 0.31 per cent near each face at the crown. The concrete was mixed of 1 part cement, 2 parts well graded Canadian sand, and 2 parts crushed limestone under ¾ in. with the dust screened out. The concrete was kept damp for ten days after placing; the tests were not made until the arch was more than a month old. The abutments, which were T-shaped, 5 x 5 in. in cross-section and reinforced with ⅜-in. rods, were cast integrally with the arch.

Adjustments and Gages—One abutment (fixed abutment) was securely blocked against horizontal movement in either direction and supported vertically at three points by screws so that adjustments for level could be made. The movable abutment was supported vertically on three springs resting on screw jacks, and laterally in both directions by screw jacks with springs interposed between the abutment and the jacks. These six springs were calibrated and used to measure the components of the reaction.

Three adjustments were necessary after each change in load, before readings could be taken: (1) The movable abutment must be raised to the same elevation as before loading; (2) each abutment must be made level; (3) the movable abutment must be shifted horizontally until in the same position relative to the other abutment as before loading.

Differences in elevation of the abutments were observed by means of a transit with level bubble on the telescope tube, set up about 10 ft. distant. Celluloid scales fastened to the abutments were used for targets. On a horizontal plate at the middle of each abutment (A, Fig. 1) a striding level could be set in either direction. With the aid of this level, each abutment could be leveled in both directions by the adjusting screws at the fixed abutment, and by the vertical jacks at the movable abutment.

Below the arch a light wooden frame was rigidly bolted to the fixed abutment and supported in a horizontal position from the floor. Two blocks of polished, varnished oak were bolted similarly to the movable abutment. Pieces of thin, transparent celluloid were tacked to the wood frame in such a position that they would overlap the polished blocks on the movable abutment. Points were set on the celluloid and the oak blocks, which were brought into coincidence each time before readings were taken.

As shown by a detail in Fig. 1, the springs used to measure the reaction were made of two 8 x ½-in. steel plates separated by fillers at the ends and having bars riveted across the middle for bearings. In the ends of these bearing bars gage-holes were drilled to receive the points of a 2-in. Berry strain gage reading to 0.0002 in. Each spring was calibrated in a Riehlé testing machine. In each case the average of the readings on the two sides of the spring was used.

Loading — A bottomless box was made to fit on top of the barrel of the arch to retain the

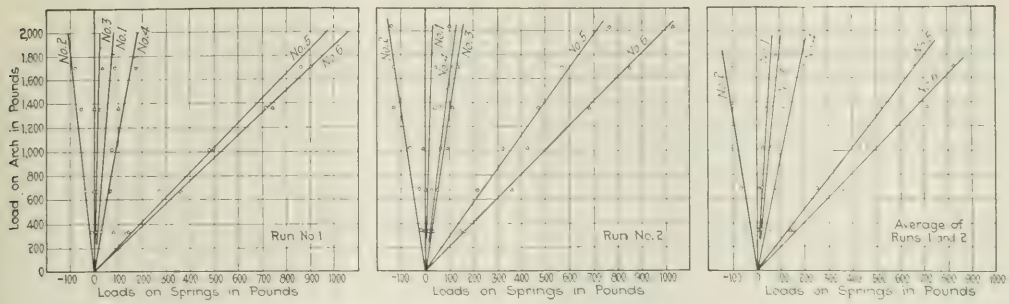


FIG. 3. GAGE READINGS VARIED DIRECTLY WITH LOAD; TWO TEST RUNS AND AVERAGES

spandrel fill. This box was anchored to the arch at the ends and sawed in two at the middle so that it would not interfere with the arch action of the concrete. The spandrel fill of dry sand was then placed and leveled off to a depth of 3 in. over the crown, after which the abutments were leveled and brought into proper position. This was called the zero-load condition. Load was applied by piling 85-lb. bags of sand on the arch. They were piled in tiers so that there would be as little arch action in the load as possible.

Several runs were made to get the apparatus into satisfactory working condition, and then two complete runs were made. Readings were taken after the addition of each four bags of sand (load increments of 340 lb.) until a load of 2,040 lbs. had been applied. Then the process was reversed and readings were taken as the load was removed.

The readings of each spring for each run were found to be roughly proportional to the loads. In other words, a straight line could very well represent any one set of readings. These readings are shown plotted in Fig. 3. From the loads on the horizontal springs the location and magnitudes of the vertical components of the reaction were determined. The locations and directions of these components are shown by arrows in Fig. 1.

It will be seen that the resultant pressure falls very near to the obtuse angle of the arch, and from the curves in Fig. 3 it is seen that there is very little load on the springs near the acute angle. In fact, in some cases a negative reading is recorded on Spring 1, and it was found necessary to put a strut on top of the fixed abutment at A' to hold it down.

In Hool's "Reinforced Concrete Construction," Vol. III, page 43, the statement is made that "skew arches may be treated exactly as right arches, the span being taken parallel to the center line of roadway and not at right angles to the springing lines of the arch." Rankine in "Applied Mechanics," Art. 228, makes a similar statement. The method has been generally followed in the design of skew arches in this country.

Fig. 4 shows an arch in which S is the clear span normal to the abutments and S' is the skew span. For the distance A within which lines normal to the abutments will strike both spring lines, there is no doubt that the stresses are transmitted by the shortest route to the abutments. It is evident that the loads on the triangular portions of the arch, ABC and $A'B'C'$, will cause an additional thrust near the obtuse angle of the arch, B and B', and cause a greater pressure at B than at A. The location of the resultant thrust shown in Fig. 1 bears out this statement.

C. R. Young, of Toronto, in a paper read before the Canadian Cement and Concrete Association in 1910, entitled "Analysis of Concrete Bridge Failures," described the failure of a skew arch at Bendigo, Australia, with loss of life, some seven years previously. In this arch, the concrete near the obtuse angle B was "literally pulverized by the intensification of stress." The causes of

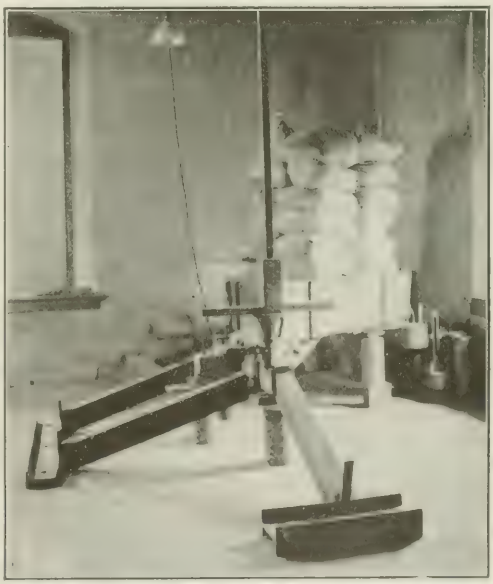


FIG. [illegible] ACUTE ANGLE OF ARCH HELD DOWN BY STRUT TO PREVENT LIFTING

this failure were investigated by the late Prof. W. C. Kernot, of the University of Melbourne. By means of experiments on rubber models and mathematical calculation he was able to show the fallacy of the old theory of skew-arch calculation, and prove that the stresses along the short diagonal of the arch in question were nearly double the stresses calculated by taking an element parallel to the center line of roadway.

Dr. E. Fischer, in "Beton und Eisen," 1911, p. 391, gave a theoretical analysis of the stresses in skew arches. His method of analysis is similar to the analysis of the stresses in an eccentrically-loaded pier. The following is based on Dr. Fischer's article.

Outline of Theory—In Fig. 4, if the right arch be completed by drawing the lines AD and $A'D'$, and the triangles ADB and $A'D'B'$ be considered to be without weight, the *total* horizontal thrust H and vertical reaction V at each abutment can be determined as in a right arch. In fact identical results for these total reactions will be obtained if the calculations are based on the right arch of equal areas, $AB'C'D$. From the laws of equilibrium, the resultant must pass through the center of gravity of the load at E (for the arch fully loaded.)

Taking a section along the crown of the arch and considering the left half, the distribution of pressure along the abutment AB' may be determined as in an eccentrically located pier. The distance of the resultant H from the center of the abutment F is

$$e = \frac{s}{2} \cot \phi$$

The unit pressures at the extremities of the abutment, A and B', are given by the equation

$$p = \frac{H}{b} \pm \frac{6He}{b^2} = \frac{H}{b}\left[1 \pm \frac{6e}{b}\right]$$

in which p is the pressure per unit of length along the abutment. The plus sign gives the pressure at B' and the minus sign that at A. The distribution along any other section parallel to the abutment, as $X\ X'$ may be obtained by a similar equation in which e is replaced by $e' = x \cot \phi$. When the arch is partially loaded a similar method of analysis will apply. Consider the hatched area $AXX'B'$ loaded. The *total* horizontal thrust H' and vertical reaction V' at each abutment can be obtained by considering the right arch of equal area as before, and the resultants of these must pass through the center of gravity of the load at E'. The rest of the analysis is exactly similar to that already given for full load.

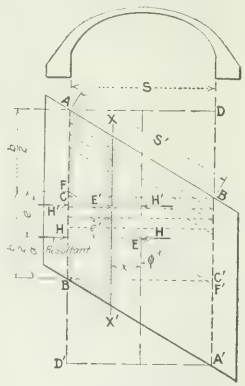


FIG. 4. THEORETICAL CALCULATION OF THRUSTS

When the resultant falls outside the middle third of the abutment length $A\ B'$, there will be tension at A. This fact is proven by the negative readings recorded on Springs 1 and 3 in the tests, and by the fact that the fixed abutment had to be held down at the acute angle of the arch.

These tests also showed a small reaction component parallel to the abutment. Dr. Fischer's theory does not take this into account and further tests are necessary to determine the amount of this component and a method of taking it into account in the calculations.

Shear and Torsion—The fact that the pressure on the abutment is greater at B' than at A proves that there is a longitudinal shear on vertical planes normal to the abutment. Knowing the variation in pressure, this shear is easily calculated. In most cases if the arch ring is properly designed for thrust and moment, the shear will be well within safe limits.

In a series of skew arch spans, the fact that the thrusts on the piers do not coincide with the axis of the bridge causes a torsion on the piers which they should be designed to resist. If the angle of skew is great and the spans are long compared to the width, this torsion moment assumes large proportions.

At the time of making the designs for the bridges in Columbus, above referred to, the existence of Prof. Kernot's and Dr. Fischer's work was unknown to the designers, but after careful consideration extra reinforcing was placed in the piers and arch rings at the obtuse angles, and conservative unit stresses were used.

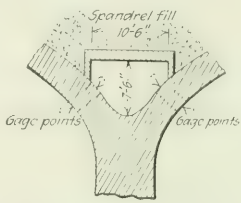


FIG. 5. OBSERVATION GALLERIES FOR STRESS MEASUREMENTS BUILT IN SCIOTO RIVER BRIDGES

Tests of Columbus Bridges—In November, 1919, while these bridges were in process of construction, the writer requested the commissioners of Franklin County and the officials of the city of Columbus to authorize the necessary expenditure for building observation galleries over the piers of two of the bridges, as shown in Fig. 5, for stress measurements along the springing lines. These are now in place and the bridges are completed.

Strain-gage points were set along both the intrados and extrados at the spring lines as soon as the arch rings were poured, and stress measurements have been taken at intervals since that time. Holes for taking temperature readings at varying distances from the surface of the concrete were also placed in these observation galleries. The readings have not yet progressed far enough to draw conclusions, but we expect to have results by summer. The work of setting the strain-gage points and taking the initial readings was done in 1919-20 by Messrs. H. L. Goodnight, B. F. Hatch, W. E. Owens, E. L. Sheley, L. E. Vandegrift, and H. L. Waugh. The work was carried on in 1920-21 by Messrs. A. J. Hill, G. W. Holman, H. W. Taylor, and R. H. Tittle.

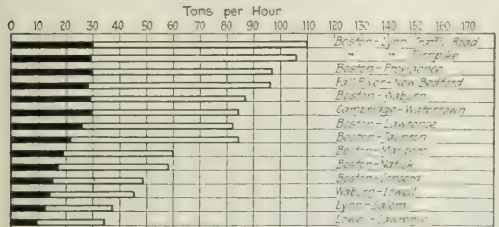
Importance of Railway Water Supply

Centrifugal pumps for water stations were dealt with in the report of the committee on Water Service presented at the Chicago convention of the American Railway Engineering Association. Mr. Campbell (El Paso & Southwestern R.R.) stated that he has found this type of pump economical for lifts up to 200 ft. One pump is lifting water 400 ft. but as it is not economical it is to be replaced by another type of pump. Specifications for chemicals used in water treatment were adopted. In presenting this report Mr. Knowles (Illinois Central R.R.) referred to the enormous consumption of water by railways, which aggregates 900 billion gallons at 14,000 water stations, involving an annual expenditure of $100,000,000 for operation and maintenance. But this expense is small in relation to that involved in locomotive operation and repair and train delays due to the use of unsatisfactory, or inadequate water supplies. High economies have been effected where special attention has been given to the water department, but in general there has been little progress in the development of water service organization on railways.

Heavy Truck Weights Observed on Massachusetts Roads

BOTH loadometers and platform scales have been used by the division of highways, Massachusetts Department of Public Works, to check the weights of motor trucks. The following comment on the results is from a discussion by A. P. Porter, inspector, before the Boston Society of Civil Engineers:

During 1920, 90 trucks were weighed by the loadometers, and in 1921 100 trucks by the loadometer and 400 by platform scales. The first two jacks used were calibrated to 20,000 lb. each, but the second pair, supposed to be an improved model, have a capacity of only 15,000 lb. each. The first truck I met after I began using these improved jacks was



INTENSITY OF TRUCK TRAFFIC, TONS PER HOUR

too heavy to be weighed with them and I had to resort to a neighboring 20-ton platform scale. The rear axle of this truck weighed 33,200 lb., the heaviest I ever weighed.

The largest gross weight of a four-wheeled truck and load which we actually weighed was 38,300 lb., and the largest load on six wheels was 40,000 lb. The accompanying table shows the maximum loads encountered. Undoubtedly there were some larger than these which did not happen to come our way.

The proportion of the weight which comes on the rear axle of a truck varies from 70 to 87 per cent. It is not constant for a certain truck. As more load is added, the percentage on the rear increases. It varies also with different makes of truck, different classes of commodities, length of wheel base, length of body, overhang, and how the load is placed. Loads of wool or cotton are sometimes piled forward over the cab. The average per cent on the rear, for all makes, is about 78.

The legal limit in Massachusetts for the weight of truck and load is 14 tons, and outside the metropolitan parks and sewerage districts there is also a limit of 800 lb. per inch width of tire. Since the largest tire practicable is 14 in. wide or its equivalent, two 7-in. tires, this practically limits the legal axle load to 22,400 lb. even with the largest tires. When the weight of the truck and load was over the legal limit several hundred pounds or more, we summoned the driver to court. In 1921 we had 116 cases in court and secured a verdict of guilty in 109 cases.

Sometimes we made the truckman remove part of his load. On one occasion in Reading, I stopped a truck going from Boston to Lowell which weighed 38,300 lb., and another owned by the same company going to Lawrence which weighed 34,100 lb. When told they could not proceed, they telephoned to Boston for another truck, which came out and took 25 barrels of sugar off one truck and 17 off of the other.

When we started the investigation there were three facts we wanted to determine:

1. *The Maximum Load*—Actual weight of heaviest truck load and how its weight is distributed on the wheels. This is to be used as a basis for computing the greatest stresses in the pavement and in bridges.

2. *Overloaded Trucks*—The ratio of the actual load to the manufacturers' rated carrying capacity is called the "load factor." While we found some trucks carrying as much as two or three times the rated capacity, the average load factor for all the trucks carrying any load is about 1, and taking into account the trucks returning empty the average load factor is about 0.5.

3. *Intensity of Traffic*—A highway engineer is often called upon to compare the traffic over one road with that over another. For this purpose it is necessary to stop every heavy truck passing a certain point, ask the driver a number of questions regarding the weight of his truck and load, and find the total weight of all the trucks in a given period of time. I adopted "tons-per-hour" as being probably the most convenient unit to express the volume of traffic. For instance, if one road carries ten times as many tons per hour as another, it is reasonable to suppose that the former road will wear out about ten times as fast as the latter and cost ten times as much to keep up, other things being equal.

MAXIMUM TRUCK WEIGHTS IN MASSACHUSETTS, 1920, 1921

Rated capacity, Tons	Character of Load	Type of Body	Actual Gross Wt., Tons	Wt. of load, Tons	Overall Length, Ft.	Length Wheel Base, Ft.	Wt. on Front Axle, Tons	Wt. on Rear Axle, Tons
7½	Leather	Platform	22	16	24	14	5	17
7½	Cr. stone	Dump	18	11	23	14	3	15
7½	Beef	Platform	17	10.5	25	15	3 4	13 7
* 5½	Wool	Platform	22[1]	11.5[1]	45[1]	14	5[2] 4 2[3]	10 5[2] 4 3[3]
* 5	Boiler	Platform	23	14	37½[1]	15 5	3	10[2] 10[3]
	Road oil	Tank	16½	6½	23	14	3 3	13 2
†...	60 ft. I-beams	Special	29	16½	99	11	2[4] 2[4]	4[4] 6[4] 15[3]
5½	Sugar		18½	12½	..	13	2 1	16 6
6	Sugar	Stake	19 1	13	..	..	4	15 1
7½	Gravel	Dump	18½	12	..	13.2	3	15½
6½	Grapes		18½	12½	..	..	3½	15
‡10	Jars in ice	Enclosed	20	12	..	12.2	3	8[2] 9[3]
‡ 5	Boiler	Platform	20	10	..	15½	3	8[2] 9[3]
5	Veph shingles	Platform	18½	12½	..	15.6	4½	14
5½	Groceries	Platform	18½	12[4]	..	15 7	4½	14
5½	Sugar	Platform	18½	13	..	12 2	3½	14½
Special			20		30	12	6	14

* For truck only; in truck trailer combination, 1 ton on truck and 5 on trailer
† tractor and semi-trailer ‡ tractor and full trailer [1] 3 on [2] tractor [3] trailer [4] tractor
The "Special" truck is the Massachusetts standard 15-ton truck for bridges

The diagram herewith showing intensity of truck traffic gives first the average weight in tons per hour of the commodities carried, i.e., the pay load; and secondly, the average gross weight of the trucks and loads passing that point, including the weight of the trucks returning empty. The former is an index of the relative economic value of the road to the community. The latter is a measure of the relative wear due to trucks. Pleasure vehicles and light trucks are not included in this diagram.

We divided the commodities carried into five groups: (1) Crushed stone, gravel, etc; (2) oil, gasoline, and tarvia in tank trucks; (3) groceries, meat and produce; (4) wool; and (5) machinery, lumber and furniture.

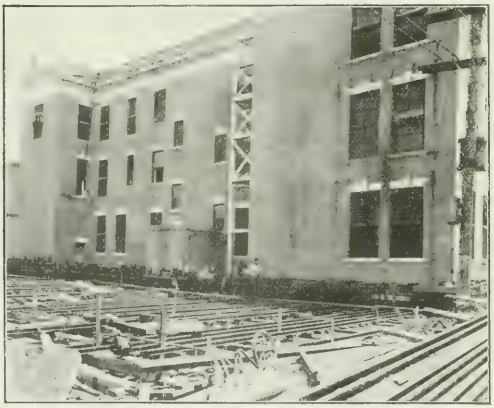
Our analysis of these figures shows some interesting conclusions—among others, that the loads going out from the city are very much greater than the loads going in toward the center. About 75 per cent of the net load on any one of the through routes is going out from Boston, and only 25 per cent coming in. If these could be more nearly balanced, the efficiency of this kind of transportation would be very much increased.

Service to Tenants Unbroken During Moving of Three-Story Building

By W. C. Bushfield
Assistant Engineer, Galveston County, Galveston, Tex.

In order to make room for a modern twelve-story office building which the San Jacinto Life Insurance Co., Galveston, Tex., was about to construct, the three-story brick office building the company occupied was moved 60 ft. to a new foundation without any damage through cracking or settlement in walls or floors, and without inconvenience to employees occupying the building. Elevator, telephone, telegraph, electric light, as well as water and sewage service were uninterrupted during the four days necessary for actual moving operations.

Holes were first cut through the walls and steel beams and needles inserted therein. The building was then lifted 1 ft. from its old foundation by jack screws and a solid bed of heavy planking and timbers, supporting



BUILDING EN ROUTE TO NEW LOCATION

twenty steel tracks was put in place. The building was then lowered onto steel rollers running upon the steel rails and the lifting jacks were removed. The actual moving was accomplished by a set of twelve pushing jacks which were placed against the building. The feet of these jacks were set against heavy timbers fastened to the tracks. One-quarter turn of the jacks pushed the building a distance of $\frac{1}{4}$ in., the quarter turns being made at a given signal. When the jacks had reached the limit of their travel they were reset, the chains were shortened, and the operation continued until the building had been moved into its new position. Once upon its new site the lifting jacks were again placed and the building lowered to its final position. The brick walls were extended down to the new foundation and the jacks, needles and beams were removed and the openings bricked up.

The working force consisted of an average of twenty-eight men and the following materials were used: 750 ordinary house jacks, two carloads of 12-in. 45-lb. steel beams, 700 steel rollers 3 x 2 in. in dimension, and five carloads of timbers, planking and blocking.

The work was done by John Egert of Galveston under the personal supervision of his son. Sanguinet & Staats, Fort Worth, Tex., were the supervising architects.

Combined System of Collections for Water, Gas and Light

After a combination of the water, gas and light companies in Lincoln, Ill., into a single company, the collection system was combined into a single system. E. McDonald, superintendent, in a paper read recently before the Illinois section, American Water Works Association, stated that the combined addressograph list was reduced from 5,000 to 2,200. The addressograph plates were then assorted in order according to the location on east and west streets beginning at the western end of the most southerly street. Each north and south intersecting street was included in its order for one block only to the north. In the first layout only odd numbers were used leaving even numbers for new customers. If more than one new customer is obtained the subsequent numbers are 2 A, 2 B, etc.

One man reads all meters in a house following the numbers closely. The loose-leaf meter reading sheets for all three utilities are identical except for colors.

The customers' ledger sheets are arranged in numerical order, ruled and printed alike. The sheets are white but are stamped with a large letter "W" for water service, "G" for gas, etc. A combined bill form was devised on which the meter readings, dates, and charges are placed. On the back are the block rates for all classes of service to conform to the State Public Utility regulations.

The city is divided into three equal districts which are billed in turn, the first, tenth and twentieth of each month. Each district has a ten days' 10 per cent discount thus evenly balancing the work of billing and collecting.

Bills are distributed by hand following the same route as the meter reader. Approximately 3,000 bills are sent out monthly, covering 2,017 water customers, 1,363 gas customers, 2,095 electric light customers and 200 merchandising accounts. Except in the case of governing bodies, such as churches and schools and out-of-town parties all bills are delivered on the premises where service is rendered. Originally numerous objections of customers to deliveries on the premises were made, but were overcome by explaining the steps in the system. Only 50 bills are delivered elsewhere than on the premises.

The only time the customers' accounts are handled separately is when adding up the day's receipts from the stubs. Each month the books are proved by adding the total revenue as posted and checking it with three adding machines, one clerk calling off the various amounts and another manipulating the water, gas or light adding machines.

China to Have Modern Telephone System

According to recent reports construction is about to begin on a modern long distance telephone system connecting all the principal cities of China. The line is planned to run from Shanghai to Soochow, thence to Wusih, Changchow and Nanking where it will connect with the existing government line. Future extensions will include a through line from Peking to Tientsin and Harbin. Some of the lines to be included in the system are privately owned. All the construction work except for the installation of the central stations will be supervised by the electrical engineers of the Chinese Government.

Following the Great Wall of China

American Engineer's Observations on an Inspection Trip Over the Peking-Suiyuan Railroad, a 400-Mile Line Engineered, Financed and Constructed Solely by Chinese—Recommendations for Improvement

By J. A. L. Waddell
Consulting Engineer, New York City

HEREWITH are some notes of an exceedingly interesting trip that I made lately over the entire length of a railroad engineered, financed, and constructed solely by Chinese; and, as the principal engineers of the line were educated in the United States, this road more nearly represents American practice than does any other in China. For that reason I have deemed that a description of the line and an account of the trip should interest many readers of *Engineering News-Record*.

The builders of the Kin-Sui line had desired me to inspect their work, report upon it in a general way, and offer suggestions concerning possible improvements for the extension of the line, grading upon which has just been started. It was intended that the trip should be made about the end of August, when the weather was propitious, but circumstances over which I had no control prevented. I had first to make another trip through the heart of China, involving travel over more than 3,000 miles, mainly by rail. Other means of transport included jinrikisha, automobile, sedan-chair, basket-chair, Peking cart, horse, mule, donkey, and foot. The trip occupied twenty-five days, and was most interesting and enjoyable. During that time I located, made layouts for, and estimated the costs of two bridges over the Yangtsze and one over the Han, as well as a plate-girder bridge-shop for Hankow, besides delivering lectures at four technical schools and an address at an engineering reunion.

The result of this delay prevented our making the trip to Mongolia until the last day of October, thus running us into cold weather, which was unfortunate, as difficulty was experienced in keeping cars comfortably warm after we reached the higher altitude.

Members of party—The guests in our party were my wife, our friend Mrs. Baldwin, Capt. Thos. K. Meloy (my assistant engineer), Murray Sullivan, Mr. Kau, and myself. The railroad officials were K. Y. Kwang, the chief engineer of the line, Thomas Sze, the assistant chief engineer, and H. H. Ling, one of the two engineers detailed by the Ministry of Communications to aid me on my work during my entire stay in China.







FIG. 1 (LEFT). THE GREAT WALL OF CHINA
"The wall is in a fair state of preservation, but there is an occasional spot where a breach has occurred."
FIG. 2 (RIGHT ABOVE). SMALL STATION ON THE KIN-SUI LINE
"The [illegible] are usually built [illegible] and [illegible] have been used there for [illegible] years."
FIG. 3 (RIGHT BELOW). TUNNEL CARRYING ROAD OVER [illegible]
"As can be seen, a very good job was done at the masonry."

Mr. Sullivan and Mr. Sze were with us only two days, and Mr. Kwang left us at Suiyuan, the end of the completed line. It certainly was a jolly party, and the whole trip was most enjoyable in spite of the cold. By wearing extra clothing we managed to keep from becoming chilled; and when at night it became too cold for comfort, we turned in with plenty of blankets and other wraps for covering.

Our cars were well supplied with food; and, as the Chinese are expert cooks, we lived well, picking up on the station platforms such luxuries as persimmons, grapes, pears, and peanuts, the latter being an important article of diet in China. Our hosts were most kind and attentive; and they did everything in their power to make the trip pleasant. They succeeded so well that the week we spent on the journey will long be remembered as one of the most agreeable in our various experiences.

The name "Kin-Sui" is a contraction of "Peking-Suiyuan," the road being generally known by the former appellation. Similarly, the Peking-Hankow line is called the Kin-Han line.

Route followed—The Kin-Sui line starts from Peking, and runs in a northwesterly direction to and beneath the Great Wall as far as Kalgan, where it turns to the southwest and west to Tatungfu, and thence north and west to Suiyuan, some 400 miles from Peking. Soon after leaving the city we began to climb, gradually at first and then by steeper and steeper grades until the maximum of 3.33 per cent, uncompensated, was attained. There are many consecutive miles of this heavy ruling grade, necessitating powerful locomotive and comparatively short trains.

The scenery along the route is bold and striking rather than beautiful. Perhaps the lack of beauty was due to the season of the year, because all crops were harvested and the country was dry and bare. There are very few trees, either on the hills or in the valleys. This lack of forests is undoubtedly due to the large population of China having stripped the country of all timber. Today almost every twig or leaf that falls from the few existing trees is carefully gathered for fuel, with the result that the soil has no humus and the rainwater flows away almost as fast as it falls. The hills and the foothills are badly gullied, as on our own western plains, and, wherever practicable, they are terraced off for cultivation, all available land being utilized down to areas of only a few square yards.

A small amount of afforestation is being attempted, but the ground beneath the trees is kept as bare as a billiard table. Under such conditions the development of a forest is a slow business. There are many similar matters of political economy in China that need careful study and correction, if the country is to thrive to the greatest practicable extent.

Visit to the Great Wall—Our first stop-over was at the Great Wall, where we remained several hours between trains, examining this wonderful construction and climbing over a part of it. We did not attempt to reach the summit, as the ascent would have been too arduous, and as there was a cold wind blowing. After attaining an altitude of several hundred feet above the railway station, we stopped for luncheon in an embrasure of the wall, then returned to our cars.

The Wall is in a fair state of preservation; but there is an occasional spot where a break has occurred, as shown in Fig. 1.

Our second stop-over was at Kalgan, from which city there is a road (?) to Urga across the Great Gobi Desert. It had been arranged that our party travel to the latter by automobile, and an attempt was made thus to reach it; but, after a struggle of three hours through slippery mud in a driving snowstorm with a bleak, cutting wind, we turned back at the foot of the Pass not very far from the Plains. We traveled in two open cars, one only of which had canvas curtains that kept out most of the snow and some of the cold. Our Chinese friends very courteously had given the better car to the ladies, Mr. Sullivan, and myself; and we managed to be not too uncomfortable in it; but those in the leading car nearly perished with the cold, necessitating a premature return to the town, in which our car led the way. The occupants of the other stated that on one occasion, when our car slued in the mud, we had one wheel over the cliff; consequently it was just as



FIG. 4. CHINESE ENGINEERS WITH MR. WADDELL
Part of the large Suiyuan (end of completed line) Station in the background.

well, perhaps, that we did not attempt to surmount the steep grades of the Pass.

The roads were exceedingly rough, due to the great number of Peking carts by which it is constantly traversed. They are without springs, and the tires are slightly cogged, nominally to furnish an additional grip on the ground but actually to accentuate the bumping. A trip in one of these vehicles is an event long to be remembered.

Condition of roadbed and structures—As one travels along the Kin-Sui line he cannot but notice how well it is maintained. The roadbed is always in perfect condition, excellently ballasted, and free from weeds and grass.

All the constructions along the line are truly first-class and generally economic. For instance, the stations are small but substantially built, and, while very little ornamentation has been used on them, their general effect is pleasing, as can be seen from Fig. 2. This picture, too, shows a bit of the Great Wall against the skyline. A portion of the rear of the larger station at Suiyuan is illustrated in Fig. 3, and in the foreground there is a group of Chinese engineers with the writer.

"Ships of the desert"—Suiyuan is a great harbor for the "ships of the desert," a fine specimen of which is shown in Fig. 5. Some of them are immense animals,

and a string of a hundred or more makes an imposing sight. They were coming in from the Plains loaded mainly with hides; and I spent some time watching them being unloaded. It was an interesting sight which I was reluctant to leave. The *modus operandi* was as follows:

The driver led the camel by a rope attached to the nosepiece of a halter to the proper place for discharging and ordered it to kneel, often enforcing the command by a twitch of the rope. Slowly and with apparent reluctance the great beast sank to its knees, then with the utmost deliberation lowered its hind legs, and drew all four limbs beneath its body, every portion of the animal fitting together as closely as if packed for boxing. Then two men unfastened the lashings of the burden and rolled it off into the place of temporary storage. Finally, at the word of command the camel slowly reversed the folding process in regular order, rose to its feet, and majestically stalked off.



FIG. 5. ONE OF THE "SHIPS OF THE DESERT"
"Some are immense animals and a string of a hundred or more of them makes an imposing sight."

Construction methods—At this place, the temporary end of the line, there are locomotive sheds, repair shops, etc., all built neatly but economically; and they were then putting in a turn-table and finishing some of the buildings. At one place they were mixing concrete for a shop floor—not by machinery, but in the old-fashioned way I did myself some forty years ago—by hand. Although the method of transporting both the materials and the mixed concrete in baskets is rather crude, the work proceeded expeditiously, the workmen handling their shovels vigorously. At my request, Captain Meloy took several snap-shots of a mixing and transporting gang, the best of which is shown in Fig. 6. There was one feature of the placing of the concrete that struck me forcibly as both effective and economic. The tramplers, instead of wearing rubber boots, which would be exceedingly expensive in this country, tied to their Chinese shoes by small rope pieces of wood about the size of paving blocks, being some four or five inches high, the same in width, and as long as the wearer's foot. In operation they appeared to be quite effective.

Our party made an excursion into the walled city by means of Peking carts drawn by mules. We saw not only the usual busy street life, but also a large market and a most interesting temple, said to be 1,350 years old. It is filled with both large and small images of men and gods all highly gilded and colored, but somewhat faded through age and dirt. The architecture of the building is most impressive.

Mr. Kwang, unfortunately for the rest of the party, here received a call for his presence at the front from some of his subordinates on the construction of the extension; hence we had to return without him. We were lucky enough to catch a special, which took us without stop-over to Kalgan; and early next morning we were hauled out by the regular train for Peking, arriving about 3 p.m.

Observations and recommendations—As an old locating engineer, I was forcibly struck by the scientific and economic manner in which the line had been run. Along the rocky side-hills contour lines had been closely followed, but without employing too sharp curves; and the climbing of grades was generally continuous.

There was one place, though, where, as an American engineer, for the sake of economy, I should have broken the grade; but, had I been a Chinese engineer, I might not. There was a long stretch of grade of 1:140 over quite a high embankment. I should have come down from the summit by a grade of 1:100 until within two or three feet of the surface and then followed the latter with a low bank. Labor, however, is so cheap in most parts of China that a few feet of extra height in an embankment is not much of an extravagance; and I concede that the uniform grade not only looks better but also permits of a more steady speed of ascent.

As a part of my duty in connection with this trip was to prepare a report upon what I saw, immediately after my return I did so; and from it the following excerpts are taken:

"Permit me to compliment you on your scientific alignment through very difficult country, the sound judgment displayed in the general style of construction, the economics that governed your entire work, the magnificent condition of your track, and the general excellence of your entire line. Such work would be creditable in any country of the world; and as the line was surveyed, financed, and constructed entirely by Chinese, it shows how thoroughly you all must have studied both the theory and the practice of economic railroading.



FIG. 6. MIXING AND CARRYING CONCRETE
"Although the method of transporting both materials and mixed concrete in baskets was rather crude, the work proceeded expeditiously."

"As for suggestions for improvements on your work to utilize on the extension of the line, everything that you have done is so good that I have but little advice to offer. However, the following suggestions may be worth while.

"A. In deck bridges, no matter how cheap the substructure may be or how expensive the metal, you will find it economic to make the bottom chords parallel to the top chords from end to end of span, thus reducing the height of pier shafts to a minimum. The reasons for this are that the extra weight of metal required

is a bagatelle and that the saving in volume of pier shafts *is at the bottom where it is large, and not at the top where it is small.*

"B. I favor compensating for curvature, *especially on all ruling grades,* because if your apparent maximum allowable grade is 3.33 per cent, and you put a 6-deg. curve on it, the actual ruling grade is 3.57 per cent.

"C. I favor also the use of easement curves where the curvature exceeds 2½ deg. Your corresponding limit, I understand, is 4½ deg. You would find that the employment of the limit I suggest would provide a more smoothly-riding track. I know the trouble you have in getting the trackmen to maintain spiral curves; but they should be taught how to do it and then forced under penalty to obey instructions."

Chlorine Gas for Killing Garbage and Other Offensive Odors

By W. J. Springborn
Consulting Sanitary Expert, New York City

NEED for a cheap, easily regulated and dependable method of controlling offensive odors from processes dealing with organic matters, particularly garbage and sewage, has long been recognized. Such a method, utilizing chlorine gas, will be described in this article.

First, personal experience of the writer with an earlier and unsuccessful method of odor control will be summarized. This, which was one of the earlier large-scale attempts to control garbage-reduction odors, was made under the author's direction at the municipally-owned garbage reduction works of Cleveland, Ohio, about a dozen years ago.

The Cleveland Scrubber—This installation consisted of a double deck scrubbing chamber built of brick, approximately 43 ft. long, 13 ft. high and 8 ft. wide. Throughout the length of the two compartments there were 17 baffle walls so arranged that the hot gases, carrying the obnoxious odors, alternately passed over and under these baffles through a constant spray of water. The gases were admitted to the lower compartment, passing through its entire length, then back through the upper, thence through a specially constructed furnace in which natural gas was burned to consume any odors which had not been condensed by the water spray; finally, the products of combustion were discharged through a stack 60 ft. in height. The water spray alone was found to be entirely ineffective.

Similar efforts were later made in other cities but have never completely destroyed the odors. Attempts to consume the odors in a furnace have not only failed but have also resulted in greatly raising the temperature of the odors, thus increasing their volatility so that an even larger area was affected by the spread of the odors.

Henderson-Haggard Chlorine Process—About a year ago a process using chlorine gas for the destruction of odors was developed. It is known as the Henderson-Haggard process, after its inventors, Prof. Yandell Henderson and his associate, Dr. Howard W. Haggard, both of Yale University. During the past year the writer undertook the commercial application of the process and made a number of installations under widely varying conditions. Careful and exhaustive tests have demonstrated the chlorine process to be highly effective in destroying odors, arising from the rendering of animal, vegetable and fish materials, and also odors from septic sewage, with a remarkable ease of control and low expense.

Briefly stated, the process consists of injecting volatilized gas from liquid chlorine into a mixing chamber where it combines with the collected odorous gases, immediate oxidation taking place with the destruction of all odors. Having once obtained the proper proportion of chlorine gas the operation becomes practically automatic. It is then only necessary to set the valve on the control apparatus, regulating the supply of chlorine. The control apparatus is a simple and foolproof device, made and developed by the Wallace & Tiernan Co.

Process Tested at Cleveland and Elsewhere—The first test on a large scale was conducted a year ago at two private rendering plants in Cleveland, Ohio, where both garbage and animal materials were being rendered. Some months later a test was made on sewer gas which was being discharged at the west side outfall at Cleveland. Chlorine gas was injected at a low rate into the sewer above the flow line, at a point about 200 ft. above the outfall, with thorough destruction of odors. An installation was made at the municipal garbage-reduction plant at Cleveland late last summer. In this case, however, the machines have not been in constant use because not all odors could be collected. Arrangements are now being made to collect these for complete chlorination before their discharge into the atmosphere.

In July, 1921, a machine was installed at a plant in a large eastern city where dead horses and bodies of dogs, cats, and other small animals, together with condemned food and market refuse, are being rendered. This installation has been in daily operation since and is giving the best of satisfaction, no complaints having been registered against it. Another machine is in daily use for eliminating odors from the curing or drying of manure, in a plant located in a densely-populated district.

Used at New Bedford Garbage Reduction Works—In November, 1921, the process was put into service at the municipal garbage-reduction works of New Bedford, Mass., where a direct-heat rotary type of dryer is now being used for drying raw garbage. Here the vapors carrying the odors are withdrawn from the dryer by means of a fan and discharged into a duct about 3 ft. square and 70 ft. long. The chlorine gas is injected into a mixing chamber ahead of this duct and is allowed to mingle with the odors through its entire length. The velocity of about 10 ft. per second allows a contact of but seven seconds. Even in this brief period complete oxidation takes place.

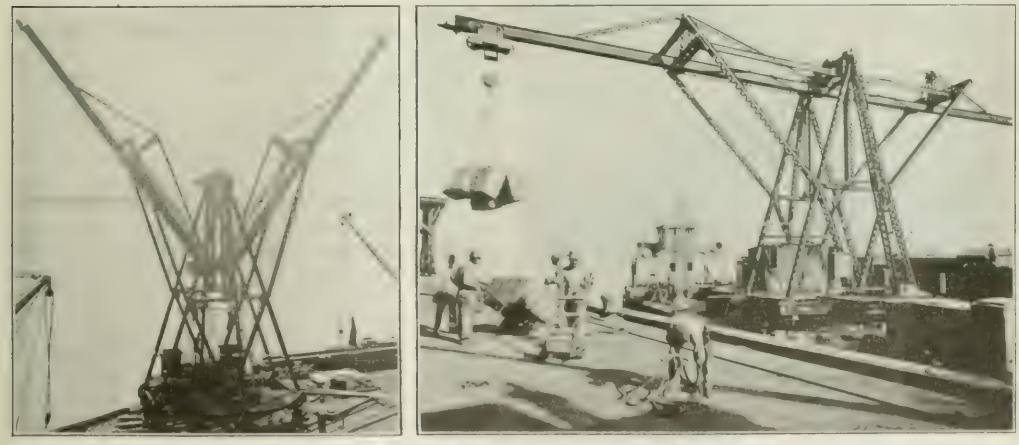
A demonstration was given recently at a rendering and drying plant where a mixture of leather scrap, wool waste, hair, feathers, etc., was being cooked and dried. The odor from these materials is intense and very obnoxious, and here again it was proved that complete destruction of odors took place within five or six seconds after the chlorine gas came into contact with the odor-bearing gases.

Jack-Knife Crane Solves Problem of Restricted Operating Space

By A. B. Proal
Consulting Engineer, Robins Conveying Belt Co., New York City

Confronted with the necessity of handling a general cargo from the smallest packages up to those weighing 10 tons to and from 1,000-ton river barges, the Commission supervising the Mississippi-Warrior River service, formerly under the control of the U. S. Railroad Administration and now the War Department, had designed and recently installed an interesting type of cargo-handling crane. The crane also handles coal or cargo directly from barge or dock to steamship.

As many of the dock sheds along the river are built close to the edge of the dock, it was found necessary to provide equipment which could be slipped in between a vessel and a freight shed. In order to operate successfully the equipment could not interfere with the vessel's rigging, the boat stanchions, or other apparatus attached to either vessel or dock. With the above requirements in mind, the jack-knife crane shown in the accompanying illustration was built.



FOLDING CRANE ECONOMIZES OPERATING SPACE

The crane itself is erected on a floating power-driven barge, one of the old barges propelled by producer-gas being used for the purpose. The crane is located in the middle of the barge and is mounted on a turntable with two overhanging booms. These booms are capable of folding so that the machine can slip between vessels or between vessels and dock with ease. After the crane barge is located in the proper position the derrick is swung so that the booms overhang the vessel and pier. In this position cargo can be handled easily from one side of the derrick barge to the other. Several holds of a barge can be served with one setting of the crane. It is not necessary to have the crane set opposite the hatch to be served or the point from which the cargo is taken.

The crane has a maximum reach of 67 ft. at each boom, at which distance it is capable of handling a 2-ton load, making two round trips per minute. It is operated by one man and is electrically driven. The operator controls all movements by means of a portable remote control, enabling him to be located at any convenient place where he can see the cargo hook or grab bucket in use. The operator not only handles the cargo winch with this remote control but also the slewing mechanism. The mechanism used for raising and lowering the booms is operated by a separate drum control.

One of the advantages of this type of equipment is that the wind loads are equalized so that the vessel can be handled in stiff winds. Head-wind resistance can be materially reduced as the machine can be pointed in the direction of the wind as the barge is being propelled from place to place.

Located on either end of the barge are two 10-ton bullwheel derricks which are used for handling occasional loads found too heavy for the jack-knife crane. These derricks are also used for handling a series of portable conveyors which are part of the barge's equipment. The conveyors are self-contained units mounted on steel frames and are long enough to bridge the space between the river barges and the docks. Several auxiliary portable conveyors are also carried so that cargo can be conveyed from different parts of a barge to the main conveyors.

The electric motors for operation of the crane receive power from a generator driven by one of the two gas engines which drive the barge propellers. The propellers are disconnected by a friction clutch when the generators are operating.

The entire machine, including the conveyors, was designed and built by the Robins Conveying Belt Co., New York City.

Scope of the Lumber Industry

The lumber and wood-working industries in the United States represent an investment of $12,000,000,000, and employ approximately 1,000,000 men; their annual railroad freight bill is approximately $170,000,000 paid for transporting 200,000,000 tons, which is more than 10 per cent of the total tonnage of the American railroads, according to Charles Hill, general manager, Southern Pine Sales Corp. of New York, in an address delivered at the annual meeting of the Southern Pine Association held recently in New Orleans. Lumber ranks first among the nation's industries in the number of employees, and second in invested capital.

Water Seepage Along Fault Planes Causes Serious Clay Slide

Extensive Slip in Brick-Clay Pit in Hudson Valley Traced to Softening of Strata by Surface Water

By Robert W. Jones
West New Brighton, N. Y.

On Dec. 16, 1921, a clay slide at Glasco, N. Y., repeated a course of events that has happened time after time at various localities in the Hudson Valley, many times with loss of life, serious injury to workmen or destruction of property. The slides have always been described as "acts of God" while in reality they were simply the result of the refusal by operators and engineers to recognize certain geological conditions as to deposition of the clays, sands and gravels and later secondary changes in their physical conditions.

On the above mentioned date a very serious clay slide occurred on the property of Washburn Brothers Co.



FIG. 1. CONTACT BETWEEN CLAY AND ROCK

The crude clay was used in the manufacture of the ordinary Hudson Valley soft-mud building brick. Operating conditions at this plant were recognized throughout the valley as being of very high grade; every attempt had been made to fully protect the workmen from injury. The slide occurred under what was recognized by all clay workers as a perfectly safe method of excavating clay, and yet certain minor geological conditions that by certain engineers are looked upon as of no significance were present, and it was these that made it possible for the slide to occur. The various Hudson Valley slides have occurred not through disregard for safety conditions but through lack of knowledge.

The original deposits of the glaciated valley were of a morainal origin, pushed forward by the advancing ice-sheet or deposited during its retreat. As the glacial waters became more quiet and reached a greater depth, due to blocking of channels, a fine-grained siliceous and highly carbonaceous product of local rock erosion began to be deposited. In the area where the fall of clay occurred the water level of the glacial lake reached a height that is approximately the present 200-ft. contour. At this height adjacent lakes to the east and west began to deliver their burdens of siliceous and calcareous sediments in the form of delta deposits. The immediate neighborhood of Glasco received the deposits from a stream that at one time flowed south along the present

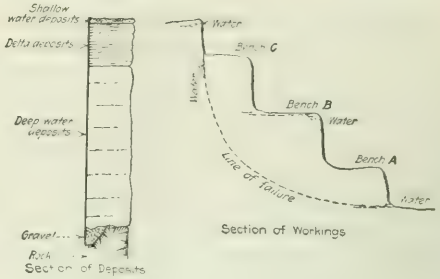


FIG. 2. BENCHES OF WASHBURN CLAY PIT

valley of the Kaaterskill creek. As the sediments became deeper and the land surface began to rise, shallow deposition began in certain localities.

So we have in the Hudson valley, in an ideal section, the following comparatively recent sedimentary deposits, listed in descending order: (a) Shallow-water deposits; sand, gravel and clay deposits of meandering streams; (b) delta deposits; bedded clays and sands deposited in comparatively quiet and deep waters; (c) deep-water deposits; clay in thin layers with very thin partings of sand; (d) morainal sand and gravel.

This statement of the deposition sequence is given to explain why the contact between the various materials or beds is sharply defined. Such a contact is apt to be water-bearing.

After the water had receded and the sediments had been eroded to the approximate present cross-section of the valley, movement of the underlying rock structures took place, and fault lines of sometimes considerable displacement developed through the sands, gravels and clays. These formed natural watercourses to the lower layers. Other natural watercourses developed along the contact between the deposits and older rock formations (see view Fig. 1) and also between the contact of the clays and gravels where they outcropped at the surface.

The fault lines have had a great influence on the methods of excavation. There are localities where, to the operator, the clay appears to stand up better and easily retains an almost vertical face. This may perhaps be a joint plane developed through drying of the deposits but in most cases these joint planes have been also planes of local vertical movements, developing into fault lines, whose range of displacement may be from less than an inch to 30 or 40 ft. These local fault lines, in most cases roughly parallel, often determine the limits of the upper workings or benches and furnish a channel for descending waters. This was the condition on the upper bench at the Glasco locality.

Excavation at Glasco was carried to a depth of about 65 ft. from the surface, the work being carried on by means of benches with an easy grade towards the river. West of the upper bench on the unexcavated surface attempts had been made to drain the surface waters by means of shallow ditches approximately parallel with the excavated face but finally delivering the water over the face of the pit. The surface material was naturally wet, being underlaid by an impervious layer at a depth of about 4 ft., where the delta deposits made contact with the later shallow-water deposits. The drainage water had developed the vertical watercourse along the face of the upper bench. The section Fig. 2 shows the lo-

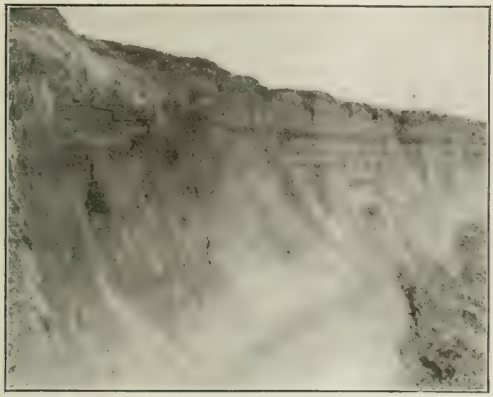


FIG. 3. FACE OF SLIDE IN CLAY PIT AT GLASCO
Top of bench B was a dark layer near bottom of view.

cation of this watercourse and of various impervious beds.

All of the surface water was descending this course, coming to the surface along the impervious bed on bench B, Fig. 2. This impervious bed shows plainly in Fig. 3 as a dark band passing through the point of material that has failed to slide. A portion of the water passed on to the impervious bed at the foot of bench A, practically the bottom of the pit. This bench becoming saturated suddenly flowed out from under the upper beds. It flowed with sufficient speed to overtake a running man and did not stop until it had crossed the pit, a distance of approximately 500 ft. The upper mass of clay immediately fell and flowed out over the first for a distance of about 300 ft. The line of fracture in the upper beds was sharply defined and was smoothed by the falling material. (Fig. 3).

A mass of clay had been left originally in the pit as a sort of anchor, dividing the pit into practically two working places. This mass of clay also fell. As the material fell it became confined between the north and south side-walls of the pit, and was thrown up in places to a height of 20 ft. (Fig. 4). The original flowing material was completely covered by the later fall of broken blocks of clay.

The break at the face had a width of approximately



FIG. 4. FALLEN MATERIAL ON PIT

225 ft., being located where the drainage from the surface was the greatest. The area occupied by the fallen material was about 500 x 200 ft., with an average depth of 15 ft. Two men were covered by the fallen material and all attempts to locate their bodies have failed.

This fall of clay is only a repetition of what has occurred at Mechanicsville, Hudson (with loss of life), Catskill, Haverstraw (loss of life), Albany (loss of life), Schodack, Coeymans (loss of life). Perhaps one of the most prominent examples of unstable conditions of the Hudson valley clays and sands is found at Albany, where it has been found impossible to complete the construction of the State Capitol, the foundations of which were laid on heavily faulted deposits. Another example of unstable conditions was had when the power house and other equipment belonging to the Knickerbocker Portland Cement Co. at Hudson were destroyed by a sudden fall. This particular case is an example of what may happen in a section where there was only a slight excavation available for the outflow of the lower beds. At Haverstraw a fall of clay occurred in which there was a heavy loss of life.

All falls of any size have resulted from the flowing out of the lower beds. There is only one way in which to secure protection for foundations or excavations in such deposits, and that is by proper drainage—not by removing water but by preventing water from flowing into the beds upon which the work is being carried. As an example of what conditions may be under such deposits I may mention one case where I had put down a 2-in. hole to a depth of 12 ft. and in coupling my drill connections dropped two sections down the hole; they immediately disappeared.

Plans for Additional Storage for Panama Canal

Eventually additional water will be essential to provide an extension of the water supply to maintain the level in Gatun Lake during the dry season. Investigations made in February of the practicability of diverting into Gatun Lake the Indio River which flows into the Caribbean Sea 20 miles west of the mouth of the Chagres. The project was found impracticable, according to the *Panama Canal Record*, because of the lack of a suitable dam site on the Indio below its junction with the Rio Esterial.

Alternative projects are the construction of a supplementary reservoir above Alhajuela on the Chagres beyond the limits of the lake and of a dam west of Pedro Miguel Lock to incorporate within the lake area a part of the Rio Grande valley above Miraflores Lake. The Alhajuela project would give an additional storage of between 15 and 30 billion cu.ft. (the present dry season storage between the 87- and 80-ft. levels is 31.95 billion cu.ft.) and would also furnish power for electrical development. The Pedro Miguel Project, by decreasing the surges in Gaillard Cut resulting from drafts of water for lockages at Pedro Miguel, should make it possible to raise the maximum elevation to 88 ft. and give an additional 0.5 ft. available depth at low stages of the lake, which would increase the storage range from the present 7 ft. to 8½ ft., or add about 6.7 billion cu.ft. to the storage.

Decision has not been made as to which project, if either, will be recommended to Congress. Under present operating conditions there is no danger of a shortage which would interfere with traffic.

Welded Radio Towers 150 Ft. High Built at Peking

Simple Design Permits Cheap Construction—Main Members of Steel Pipe With Sleeve Joints—Rod Diagonals

By H. S. Bear

Lieutenant, Civil Engineer Corps, U. S. Navy, Great Lakes, Ill.

TWO welded radio towers 150 ft. high, largely made of steel pipe, were built last year at Peking, China, as part of the wireless installation at the American Legation Guard. The station consists of one 30-kw. arc transmitting set and a triangular antenna supported by three steel towers. The main tower, 300 ft. high, situated in the Legation Guard compound, is of structural steel according to the standard design of the Bureau of Yards and Docks, U. S. Navy Department. It was fabricated at Pittsburgh by the Pittsburgh-Des Moines Steel Co., and erected by Etablissements Arnoult, of Peking, entirely with Chinese labor, the erection being completed in 2½ months. The two other towers, Fig. 2, which stand on the top of the Tartar Wall, are only 150 ft. high, and were built by electric-welded construction.

Tartar Wall is 14 mi. in length, in the shape of a rectangle 4 mi. long and 3 mi. wide, and encloses part of the city of Peking. This wall averages approximately 50 ft. in width at the top and 30 ft. in height. It is constructed with brick sidewalls with a batter of about 1:4 and yellow clay filling. Note that all dimensions are approximate because, true to Chinese custom, the wall does not maintain definite lines except in a general way. Part of this wall forms one boundary of the American compound. The two towers are spaced 320 ft. apart and have a total height of 178 ft. above ground.

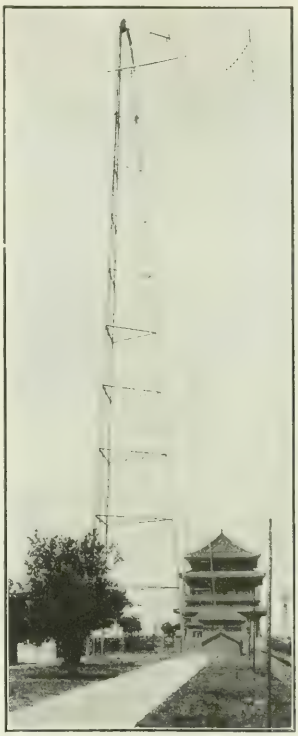


FIG. 2. TWO WELDED RADIO TOWERS ON TARTAR WALL, PEKING

The requirements in this case were: (1) To support a horizontal antenna pull of 3,000 lb. at a height of 150 ft. above Tartar Wall; (2) to use a limited ground space (guys were not desirable); (3) to construct a permanent support; (4) to use a limited amount of funds; (5) to construct within a limited time; (6) the structure to present an æsthetic appearance.

Safety was of first importance because of the proximity of residences and quarters. Items 2, 3, and 6 eliminated the guyed wooden mast. There are no structural-steel fabricating shops in Peking, so that items 4 and 5 eliminated a structural-steel tower. After experimenting and estimating costs, the design as per Fig. 1 with a few exceptions was adopted. Ideas which were gained by experience in the construction of these towers are incorporated in the revised design of Fig. 2.

There are several distinct advantages to be found in the design and construction of this tower. First, all members of the tower are round and hence they offer a relatively small resistance to the wind, which is important as a great part of the stresses produced on such a tower is caused by the force of the wind acting on the tower itself. Second, pipe sections give nearly perfect columns, having the greatest strength possible with a given amount of metal. Third, the details are so arranged as to make use of nearly all scraps resulting from the cutting of the main members. Fourth, electric welding is much easier, quicker and cheaper than riveting, on work of this nature, and if properly done it is just as reliable as riveted work. Fifth, the use of material of light weight permits the easy erection of long shop sections. Sixth, the finished tower has smooth, easy lines and offers a pleasing appearance.

The disadvantage of using standard pipe sections is the thinness of the metal. On this account great care must be taken in the original painting as well as in later repainting. It would probably have been better to have used no pipe under 2½-in. size.

Local conditions governed the design of the foundations and the top piece. Under other conditions both designs might well be changed.

Costs and methods of construction in China are no

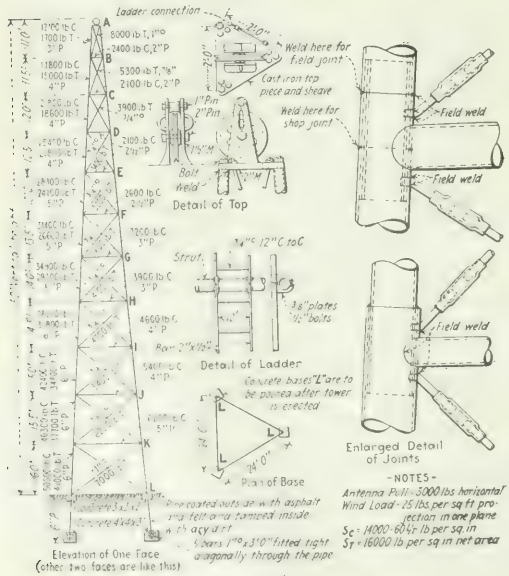


FIG. 1. DESIGN OF WELDED TOWERS

criterion for similar construction in the United States. Steel materials in the open market cost from two to five times as much in the United States. Skilled labor per man per hour is about one-tenth of the cost of American labor, but when quantity of production is considered it is very little cheaper, and when quality is considered it is not as cheap. Unskilled Chinese labor is about one-fifth of the cost of American unskilled labor. However, in the way of general information the following figures may be presented: The two towers, including foundations, all materials and labor and painting, cost the U. S. Government $10,000. Shop work was started on Feb. 15, 1921, and the work was completed on June 15, requiring a total of four months on two towers. The second tower, after gaining experience on the first, was completely assembled in position in seven days and completely welded in another seven days.

Etablissements Arnoult, of Peking, a French-American company employing only Chinese labor, was the contractor for the entire work.

Standardization in Industrial and Social Life

Misconceptions of Its Purpose—How It Quickens Creative Genius and Develops Sound Competition in Industry

By Albert W. Whitney
Chairman, American Engineering Standards Committee

Extract from paper before Annual Meeting of the National Federation of Construction Industries, Chicago, April 4, 1922.

I CAN best get into the heart of my subject by first clearing the field of certain negative ideas, certain misconceptions.

I have in mind the naive and not uncommon conception of standardization as a process that will make everything alike. When standardization has done its perfect work, they say, we shall all wear the same kind of clothes, eat the same kind of food—pellets perhaps—live in the same kind of houses, go to the same kind of schools, and think the same kind of thoughts—and our critics are very sure that these thoughts will not be pleasant—for a world reduced to sameness, a world with the spice of variety removed, they assure us, will be a stupid place! Is this what standardization is really leading us to, or if not, where is it leading? Is it possible to strike a balance between efficiency and freedom or isn't the case so bad as it appears? I venture to discuss this with you as builders, because your buildings must not only be all that is possible in strength and efficiency, but they must express aspiration and spiritual freedom and this is surely impossible if that is what standardization means. We should grow tired of the standard building, even though it might be the most beautiful one possible, just as we should grow tired of Arrow Collar boys.

There must be some resolution of this apparent contradiction by which a process that from one point of view is so fine and wholesome and necessary, from another is so deadening and stupid. As a matter of fact, the difficulty is easily resolved; standardization and spiritual freedom not only can live together, but as a matter of fact they are necessary to each other as parts of the perfect whole and difficulty arises only when either one attempts to occupy more than its proper share of the field.

The difficulty will disappear if we realize three things about standardization: first, it does not belong with the vanguard, it comes along in the rear just ahead of the commissary department; second, it is not exclusive, it does not attempt to pick out the one supreme best, it picks out, instead, many that are good; and third, its judgments are not final but tentative and ever open to revision.

The Process of Achievement—In the march of progress the way is led by the visionaries, those who get the first gleam of the idea, the prophets, the artists and the inventors; their heads are in the clouds but their feet are not always on the ground and so they have to be followed by minor prophets and minor artists and minor inventors who can capture the idea and tame it; then come an army of critics and exploiters and executives and at last the idea is put to work. But it doesn't work smoothly; the prophets and minor prophets and even the executives, who ought to know better, have left the ground in a mess. The good ideas are lost among a litter of impossible ideas, half-baked ideas and ideas in every stage of futility. Somebody must come along and clear up, save what is good and throw the rest into the discard. This is the humble job of the standardizer. He does not pretend to say what is best; he only says to the people with brains but no other senses, "See here, get together, you fellows, and decide how many of these ideas are worth saving; keep what you need but we're going to scrap the rest."

Now the immediate effects of standardization upon the processes of production and distribution make a story which must be the main theme of our discussion tonight, but before getting into that, may I speak of another effect which, although it has had little attention, is particularly interesting, for it bears directly upon the contradiction that I first propounded. It is this: When the deep thinkers and all their class find themselves free of the confusion created by the very fertility and multiplicity of their own ideas, they find that they can turn over the whole subject to a still less important caste, those who look after routine. For instead of designing a truss or a bolt or a generator or a fire-escape, the engineer has now only to specify certain standard types or certain standard features that have already been worked out and the detail can then be left to subordinates.

Now the prime importance of this to progress lies partly in the acceleration and economy and convenience and efficiency that has thereby been produced but to an equal degree it is due to the fact that the attention and energy of those who are on the frontier of knowledge has been set free for still further forays into the unknown.

Standardization, therefore, is not the foe of spiritual freedom, it is the very soil out of which it grows. It does not stifle art, it sets it free. In fact, civilization itself is based upon the ability of the human animal to mount up into the untried upon the established experience of the past.

How Nature Standardizes—This is perfectly illustrated in Nature. We are free to choose by trial the conduct that best fits our circumstances, but when the choice has been made, Nature establishes our reaction under similar circumstances in the form of a habit. The control of this habit is moved down from the brain into the reflex nervous centers and the brain is set free for a more primitive contact with reality. Standardization is thus the habit-forming process in industry. Similarly Nature on a still larger scale has standardized our bodies and even our minds in their fundamentals and yet both our bodies and our minds are free to expand and develop under the quickening influence of new conditions.

You may obtain some conception of what standardization means to industry if you will try to think what a world would be in which there was not this basic standardization of body and mind. Every man would be an individual problem. A surgeon would not dare to operate for appendicitis until he had found out whether this particular man might not have his heart in his stomach. And, if every child's mind were fundamentally different the process of education would be impossible. It is, to be sure, the variety among the people that make up the world that make their charm and it is the variety that is the cutting edge of progress, but we must not forget that this variety could not exist if it were not backed up by the great conservative forces that have been established in substantial uniformity as the result of the world's competitive struggles. To me it was some considerable relief to think myself out

of the thought that standardization meant stagnation and perhaps this may have some similar value to you.

The Key to Present Problems—The result of throwing into the field of routine processes that have heretofore required explicit mental effort not only sets free this mental effort for other purposes, but makes possible mass-production; and indeed, mass-production is impossible without standardization. In the opinion of Mr. Hoover and other students of industry, greater mass-production is necessary under our present post-war conditions if we are to maintain our standard of living and if we are to compete successfully with European industry. The relation between standardization and economy and efficiency in production is too plain to require further consideration.

We may definitely make up our minds that we are beyond the era of the craftsman as respects the basic elements of our individual life. The era of machinery, if its peculiar genius is to be developed, leads us to standardization and mass-production. We still need the craftsman, but his place has been moved on into the field of finer values. It is the underlying basic elements of industry that I am discussing; in this field standardization, simplification and mass-production must be developed to the greatest possible extent.

Benefits of Standardization—We are inclined to feel that these benefits apply mainly to production. This is not so. They are quite as important, both in the field of selling and of buying. The carrying in stock of the wide variety of sizes and grades that have grown up in a given field under the influence of the blind forces of demand, however casual, and competition, however misguided, has not only tied up an immense amount of capital but has taxed storage facilities and slowed up delivery. It is not too much to say that in most lines of business the variety that is found in stocks could be cut down to one-tenth of what it now is and serve perfectly well every reasonable demand.

But it is the buyer quite as much as the producer and the distributor who profits by standardization. The ordinary buyer is not an expert and is, therefore, very largely at the mercy of the seller. He is not able to form an independent judgment of the quality and value of the goods that are for sale and must therefore either buy in the dark or follow the advice of the seller. But if goods are standardized and marked so that they can be identified it is possible for the buyer to familiarize himself with these standard lines, particularly if the unnecessary variety has been eliminated. . He thereby becomes an intelligent buyer; his purchases have greater utility and his discrimination reacts favorably upon the distributor and producer.

Standardization, moreover, restricts competition to a legitimate and useful field. In the hope of attracting attention, goods are often put on sale that are "different" but these differences are not only unessential, they are meretricious. But the seller, by this trick, is able to escape competition on the basis of merit. Standardization will put competition on a merit basis and bring out its highest economic value.

The story of the value of standardization should not be told in cold abstract statements; it should be told in vivid pictures of what it has accomplished. It should be told in the story of the winning of the war. The mining of the North Sea tells a story of standardization; the years delay in the big British drive, a story of standardization in ammunition gone wrong; the history of the War Industries Board is a fascinating story of how industry and consumption were put upon a standardized basis; and now we have the story of how Germany has learned the lesson so well that she is basing her whole program of industrial rehabilitation upon standardization. The effect of standardization upon American industry is to be measured in billions of dollars rather than millions, and to the American people it should bring a happier and richer life.

Training Young Engineers on Railway Maintenance-of-Way Work

Abstract of subcommittee report of Committee on Economics of Railway Labor; American Railway Engineering Association.

ALTHOUGH it is desirable that engineers in the maintenance department should be graduates of some good technical school, these positions should not be limited to graduate engineers, since this would exclude many young men who display ambition to following engineering. Consideration should be given to men who are unable to take a full university course and therefore study engineering with some good correspondence school or university extension course. The engineer who obtains his theory by private study should have as good knowledge of the theory of his profession as his more fortunate co-workers who have had the advantage of a college course.

Every railroad organization has its own ideas and methods on education and training of young engineers for positions of greater responsibility, but it should be possible to agree on a selection of these for general use. Good results may be obtained by periodical meetings of a local organization for the purpose of exchanging views through the medium of papers, reports and discussions. Membership should be offered all officers above the ranks of supervisor of bridges and buildings, supervisor of track, supervisor of water service and supervisor of signals, including assistant engineers in the maintenance of way department. The association should appoint committees following about the same lines of work as in the American Railway Engineering Association.

Young engineers should be required to study and thoroughly familiarize themselves with standard plans and practice, maintenance of way reports and the rules and general instructions governing the maintenance department. It should be the endeavor to arouse and sustain their interest by explanations of work assigned, in order that they may be able to appreciate its relation to the general maintenance scheme. An incentive to work should be offered by encouraging them to take additional responsibilities. Every man should be trained for the next higher position. Probably the best method is to rotate the field and office work, showing a man his mistakes immediately upon completion of each assigned job. The young employee should be encouraged to study maintenance methods from the standpoint of economics, with the idea of developing an analytical viewpoint which is a valuable asset in maintenance-of-way work.

There should be systematic rotation of service for the members of the engineering corps, to include surveying and field work, masonry inspection, building inspection, supervision of construction and work in drafting and designing. After the young engineer has had sufficient experience in office and field work, he should be transferred to a position which will give him experience and training in the handling of men and in practical maintenance work.

A fixed minimum engineering corps should be maintained throughout the year, with definite lines of promotion, to the end that the employee will have an incentive to continue in the service of the railroad. The young engineer should be required to attend division staff meetings and take part in discussions, thereby becoming familiar with the various operating matters discussed.

Division engineers, or corresponding officers, should take a personal interest in the education and development of young engineers, taking them over the road on their inspection trips, discussing with them the various features of the work, and encouraging them to ask questions and offer suggestions, thereby broadening their views on the general conduct of maintenance work. The positions of supervisor of track, supervisor of bridges and buildings, supervisor of signals and inspectors should be filled from the engineering corps on an equal footing with other employees.

Flood Conditions and Flood-Protection Problems

Extracts From a Dozen Papers Read at Dayton Meeting of American Society of Civil Engineers Outlining Main Elements of Situation in United States and Canada

Pacific-Coast Flood Conditions

By C. E. Grunsky
Consulting Engineer, San Francisco

Climate and topography introduce peculiar features into the flood-control problems on the Pacific Coast. The big floods occur in the winter or early spring months as the result of heavy rainfall frequently continuing throughout several days. The flood volume, in the case of those streams whose drainage basins extend into high altitudes where there may be much snow on the ground, may, at times, be considerably augmented by rapid melting under the influence of what is generally termed a warm rain. But, so far as is now known it appears safe to attribute peak discharges to rain of the maximum possible rain intensity.

The big cyclonic storms as they sweep easterly from the Pacific Ocean are usually accompanied by gentle rainfall continuing for several days. As the storm passes and the wind swings from southeast to southwest the intensity of the rain increases, it becomes colder and presently the wind will blow from the northwest and the storm is over. The storm may immediately be followed by another and this by a third. It is the heavy rain in these second and third, or later, storms which produces extreme flood conditions.

There is another noteworthy peculiarity of the Pacific Coast Storms. They are not of the intense type of the Atlantic Coast and Middle West thunderstorms. Thus, for example, 2 to 4 in. of rain in an hour may be expected on relatively small watersheds in the East, while here it is rare that one inch per hour is exceeded.

It may be broadly stated that rain and snow storms which produce flood conditions are most frequent in January. They begin to decrease in frequency and duration in February, they occur rarely in April, and after May 1 no storms are expected which will have any great effect upon the flow of the stream in its valley course. The hydrograph of the San Joaquin and the Sacramento rivers, for example, may show a number of peaks representing the flood stages in winter and then a long sustained moderately high stage usually terminating in July. This feature makes these streams particularly valuable for irrigation, which in central portions of California has thus far been practiced without recourse to storage on a large scale. Even Colorado River and the Columbia partake of similar characteristics, when their lower reaches only are considered. Their flow is but little influenced by the later summer storms in the high Rockies, which are usually of local character and cover but little territory.

Only a word need be said of the effect of deforestation upon the magnitude and frequency of the floods on the Pacific Coast. The lumberman has been active and timber has been removed in the usual wasteful way customary in this country. This removal has nowhere had any demonstrable effect on the runoff from drainage basins of any considerable extent. The clearing for farms has been relatively small and on the general run of cutover lands there is so much young timber and other vegetation that the ground has substantially the same degree of protection as under natural conditions. No facts can be cited which will throw any light upon the effect of the forests either upon the frequency or magnitude of the floods.

Characteristic of the problems on the Pacific Coast the following are noted:

1. The river flows through a valley whose surface slopes from both sides toward the river. Such is the Columbia River in its lower reaches and the Sacramento River in the upper portion of Sacramento Valley, i. e., from Red Bluff down to the mouth of Stony Creek, and San Joaquin River throughout most of its valley course.

2. The river debouches upon valley land with a bed but slightly depressed below the general surface of the ground and fingers out, sending its flood flow into a number of channels which generally lack permanency and overflow at moderate or high stages, sending their waters broadcast overland toward the main valley drain. Such are Calaveras River, east of Stockton; the rivers of Los Angeles and San Bernardino Counties, California, and a number of lesser streams.

3. The river has built up high banks by the deposit of sediment and is flanked by depressions commonly called basins. Of this type is Sacramento River from Stony Creek to Cache Slough.

4. The area to be protected against inundations is a depressed area without a drainage outlet, such as the Tulare Lake region in California and the Salton Basin, which extends from California into Mexico.

* * *

Co-ordination of Irrigation and Flood Protection

By Arthur P. Davis
Director, U. S. Reclamation Service, Washington

(In his paper presented under the title "Flood Problems in the Arid Regions," Mr. Davis gave major attention to the Colorado River situation between Yuma and Volcano Lake, emphasizing the grave menace to the Imperial Valley now existing. As the official report on the Colorado River problem is to be reviewed in these pages within the current month, reproduction of this part of Mr. Davis' paper is unnecessary. His remarks on the flood-protection value of irrigation reservoirs and on the desirability of co-ordinating the functions of detention and supply are therefore given here separately.—Editor.)

Reservoirs provided by the U. S. Government primarily for irrigation have sometimes proven important regulators of flood discharge. In 1909 the spring flow of the North Platte river greatly exceeded any previous record; had it not been for the regulative influence of the Pathfinder reservoir, damages in the valley below by the inundation of farms and towns and the destruction of bridges would have amounted to nearly as much as the cost of the dam. Material benefit in flood protection has resulted from the construction of the Roosevelt reservoir on the Salt River, Arizona, though it was not designed and is not handled for such a purpose. The same is true in a less degree of the Shoshone in northern Wyoming, the Boise in Idaho, and some others.

One reservoir of the Reclamation Service, the Elephant Butte in New Mexico, has been designed and operated for both purposes, primarily for irrigation, and secondarily for flood control. For the latter purpose about 400,000 acre-feet of capacity, one-sixth of the total, are reserved. As the water level appreaches the spillway lip it begins to discharge into tunnels passing under the spillway, and continues to discharge during the rise of the reservoir while filling the 400,000 acre-feet of flood-control capacity. When the spillway begins discharging additional water the wells will be gradually closed at a rate to hold the discharge down to the desired capacity, and as soon as practicable without exceeding that capacity the reservoir is emptied down to the level of the wells.

In past years the floods of the Rio Grande have caused damage to railroads and other property in its valleys to

amounts extending into millions of dollars. These would greatly increase with the increased settlement and development of the valley under irrigation if it were not for the protection of the reservoir.

The Sacramento River in California is subject to great freshets which cause immense damage in its valley, and to control which the state and the United States are expending large sums in building levees and rectifying the channel. The results desired would be promoted and cheapened if the flood-control efforts could be co-ordinated with the storage works planned above, which can be paid for in the main by the irrigation and power interests dependent upon them. The storage proposed would not remedy the flood conditions but would reduce the peaks of the floods if the works were operated with this in view and storage space reserved for this purpose. So far, however, it has not been found possible to co-ordinate the plans of flood control and water storage on this river to the extent that is desirable.

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Farm-Land Protection in the Minnesota Valley

By Adolph F. Meyer
Consulting Engineer, Minneapolis

Each drainage basin subject to floods must be studied as a problem in itself. The cost of every flood-protection project must be justified to those who pay for it. The fact that communities in Ohio have spent 35 million dollars for the control of floods on a watershed of 3500 sq. mi. is not *prima facie* evidence that communities in Minnesota can afford to spend 2 million dollars for the control of floods on a basin of 16,000 sq. mi., although unfortunately some people believe so.

Protection of agricultural lands is one of the flood problems in Minnesota. A typical example is that of about 100,000 acres of rich bottom lands in the Minnesota River valley. Some of these lands are flooded every two or three years, others less frequently. The problem was to determine how much protection offered the greatest return on the investment. Although these studies have not been fully completed the answers are:

First, it does not pay to protect agricultural lands from crop losses through rare floods, i.e., floods that will not recur once in about 15 years.

Second, when lives, farm buildings, city property or other important improvements are not endangered, it does not pay to protect the floor-control structures themselves against floods unlikely to recur once in a century or more.

Third, protection of these agricultural lands must be secured through the construction of manually controlled storage reservoirs combined with the provision of reasonable bank-full capacity in the channels below.

* * *

Cloudburst Floods

By Gerard H. Matthes
U. S. Assistant Engineer, Chattanooga

The object of this paper is to focus attention on the subject of floods caused by localized rains of great intensity, often styled cloudbursts, which affect principally the smaller streams. So far as the author is aware no comprehensive study of such floods has appeared in print. The term small stream is here applied to any watercourse in which the maximum rates of flood flow are caused, not by prolonged and widespread heavy rains as in the case of rivers, but by downpours of exceptional intensity, short duration, and covering areas rarely exceeding 50 square miles. Unscientific as the term "cloudburst" may be, it is a common designation for such rains and has been used freely by engineers.

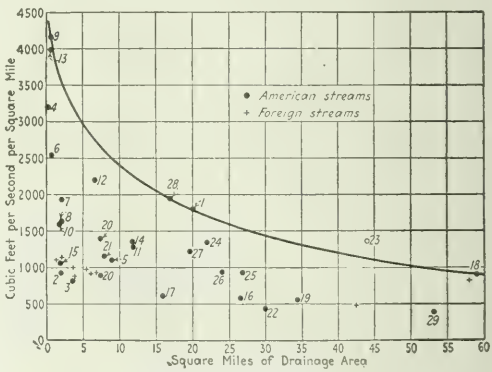
Distribution—Cloudbursts appear to be of common occurrence throughout the entire United States south of the 42nd parallel, some localities being more subject to them than others. In northern latitudes they are not so common, due evidently to the longer winter seasons, during which strong convection currents are rare and the atmosphere is not capable of holding large amount of moisture.

It is certain that topography is one of the governing factors in cloudburst for mation, but the relation appears to be little understood. There is a feeling among some western engineers that cloudbursts are peculiar to the arid regions. This is not borne out by the facts. It is true, however, that in regions of small annual precipitation like the western states, cloudbursts form an important part of the annual rainfall, and exert a marked influence on the erosion features of the country.

The entire east front of the Rocky Mountains in Colorado, especially along the foothills, has long been known as a zone in which cloudbursts are of common annual occurrence. Except for their unusual severity the spectacular storms which took place there in June, 1921, present no novel features in that respect. At the higher elevations in these mountains cloudbursts are comparatively rare.

It is claimed that certain localities because of peculiar topographic conditions are immune from the formation of cloudbursts. Chattanooga, located in a wide valley surrounded by high hills, enjoys this reputation; less than 50 miles to the south, in Georgia, cloudbursts inflict annually much damage. Whether proximity to bodies of water promotes the occurrence of such storms is questionable.

Damage—Cloudburst floods occur nearly always during the growing season, and, next to tornados, are the most destructive agency with which the farmer has to contend. Washouts of railroad and highway embankments, destruction of bridges, culverts, and buildings, and loss of life are common forms of cloudburst damage, which runs up into millions of dollars annually throughout the United States. As in other floods, the invisible damage often is consider-



CLOUDBURST RUN-OFF RECORDS

Numbers on points refer to a tabulaion of storms, not here reprinted.

able. The detouring of trains over neighboring lines, which in many cases costs more than the physical damage suffered by a railroad; interruption and loss of business of all kinds; and finally the cost of human life, are some of the items commonly left out of account in estimating flood damage.

Many cloudburst floods are passed by unnoticed by the press and by government or state bureaus. In fact, it appears to be nobody's business to study cloudburst occurrences. The author believes that the toll taken annually by these floods, if it were better known, would attract greater attention to the problem of providing against them.

Rainfall—The nature of cloudburst rainfall, exceedingly localized concentration at a few points, renders ordinary rain-gage observations of doubtful utility. Self-registering instruments are few in number and not well adapted for clearly registering the tipping of the receiving bucket. In one case, where 0.48 in. of rain fell in 8 min., the chart was so crowded that the ink lines had run together, and only through measurement of the water in the lower container could it be ascertained how many times the bucket had tipped. The chance of obtaining an accurate record of cloudburst rainfall by means of a single rain gage located within the area of heavy precipitation belongs thus far in the category of fortuitous events. An instance where a

fair record of this kind was obtained is the storm of July, 1914, near Cambridge, Ohio, when 7.09 in. of rain fell in 90 min. (C. E. Sherman, Ohio State Univ. Bull. 10, Vol. XX, p. 16.)

Mass Falls—Local falls of water lasting presumably but few minutes and recurring probably at intervals at different points within the area of maximum rainfall seem to occur in some cases. This is evidenced by surface indications in localities not subject to erosion by flow in natural water courses or overflow from the latter. Thus, near Scranton, Pa., the author found deep scars on the high brow of a mountain-side immediately after the cloudburst of July 10, 1914. These were from three to five yards wide and nearly ten yards up and down; many cubic yards of earth had been torn out as if by jet from an hydraulic giant. Similar scars, but of smaller dimensions, were noted by him in Ute Pass, Colo., and at Dotsero, Colo., on other occasions. In none of these cases was there any collecting area situated immediately above these scars that could have produced sufficient concentration of flow on the ground surface.

The question may well be raised whether the study of cloudburst floods can be at all profitably undertaken through study of rainfall records as obtained by the modern system of observing. Statements that six or even ten inches of rain fell within an hour are of small value when accompanied by the further statement that really most of it fell in only a portion of that time. Yet statements of this kind are only too common.

Run-off—There is reason to believe that on small drainage areas high rates of run-off offer more nearly comparable results for different section of the United States than on large areas.

A representative "isolated" cloudburst occurred on July 15, 1914, along the Susquehanna River in York County, Pa., and covered an area of about 30 sq. mi. Data obtained near the mouth of Canodochly Creek gave a precipitation of 6.2 in. in 2 hrs. Data obtained at Bridgeville gave a precipitation of 5.7 in. in 1½ hours. Stream-flow calculations in seven different streams gave the following values in second-feet per square mile, maximum run-off: 5560 (area 0.58 sq. mi.); 2540 (0.67); 1595 (1.66); 1930 (2.06); 1120 (3.24); 359 (13.9); and 172 (18.2). The conditions surrounding the first determination were poor, the inference being that the rate of run-off of 5560 sec.-ft. per sq. mi. from 0.58 sq. mi. is too high. The author has not discarded this measurement, however, as it was made in nearly the center of the area of heavy precipitation, and it seems reasonable to him to expect there a higher rate of rainfall as well as of run-off than at other points in the area. He has arbitrarily discounted the discharge by 25 per cent. The resulting figure, 4160 cu. ft. per sec. per sq. mi. corresponds (at 100 per cent run-off) to 6.5 in. of rainfall per hour, which is not unreasonable for the center of this storm. The second figure quoted, corresponding to 3.94 in. in one hour, also exceeds the larger of the two measured rainfall rates.

Frequency—Perhaps the longest available record of cloudburst floods on a small stream is that of Jones Falls, Baltimore (1754, 1786, 1817, 1837, 1842, 1858, 1860, 1868 and 1887.) Floods occurred nine times in about a century and a half, at intervals averaging seventeen years. This compares closely with the Mill Creek record of Erie, Pa., in which the floods were separated by 15 and 22-year intervals. Examination of the report of the Cherry Creek Flood Commission (Denver) also suggests that cloudburst floods are more common than is usually conceded.

Flood Control—Small streams have not been taken seriously enough in the past. The successful curbing of unruly small streams by some communities is encouraging. Harrisburg, Pa., and Watervliet, N. Y., were among the first to adopt the system of retarding-basin control. In some localities channel improvement and levees may be the only form of protection that can be provided, because of local conditions. The retarding-basin system, however, offers special advantages since the total amount of flood run-off is not large, requiring no basins of extraordinary size.

Design of Structures—In bridge design ample waterways to pass maximum floods cannot always be provided, but bridges can be built to withstand the onslaught of great floods without failing. In the design of culverts over small channels, adequate waterway is often not provided when the conditions would make such adequate waterway entirely possible without unreasonable expenditures. Whether it is better to permit highways and railroad embankments to be washed out at long intervals rather than provide costly structures over small streams is a matter of maintenance policy rather than of engineering, the damage to adjacent property being an important item in such consideration. Good engineering would seem to demand an adequate structure, unless the road or railway is of temporary character. In the design of spillways it has been considered proper to build for the largest flood that is possible of occurrence, and often an additional factor of safety may be introduced. As more data become available on the subject of cloudburst floods the tendency is to build larger and larger spillways.

An occasional flood, like that at Johnstown, becomes historical through medium of school books and literature. Other floods equally serious from the engineers' point of view have been forgotton by the public. Heppner, Ore. and the Oil City disaster are seldom spoken of. Few people residing in San Antonio, Erie, Baltimore or Denver have any appreciation of the frequency with which their cities are visited by cloudbursts floods. The same is true of hundreds of other towns in the United States. But the hydraulic engineer cannot afford to forget. It is his business to provide himself with records that will enable him to make sound recommendations in the matter of flood control. For the larger rivers of the United States he is to-day in fair position to do so, although even here the records for many a river leave much to be desired. For the smaller streams absence of reliable data is appalling.

The Pennsylvania R.R. many years ago adopted the policy of systematically elevating its tracks above the highest known flood marks. Within Pennsylvania it has succeeded in doing so except for a few branch lines of minor importance. It has thus in large measure freed itself from overflow by the flood-ridden rivers of that state. Not so, however, as regards the small streams—these continue to exact their annual toll in the shape of washouts. The same is true of other railroad systems.

In 1883 a cloudburst took out a large embankment of the Delaware, Lackawanna and Western R.R. about one mile east of Moscow, Pa. Again on June 10, 1892, a fill nearly 50 ft. high was washed out in this railroad near Moscow, the culvert at that point being unable to carry the flow from a cloudburst. On July 10, 1914, the same fill went out by the identical process. The question may well be asked: Should bridges of ample span have replaced the culverts, or was the rebuilding of the embankments the logical thing to do?

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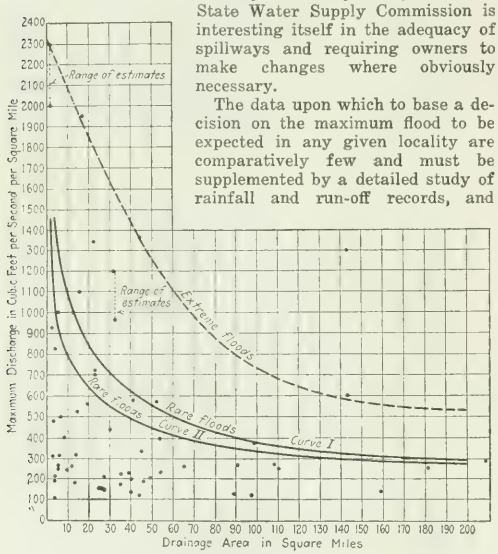
Excessive Small-Area Floods

By Harrison P. Eddy
Metcalf & Eddy, Consulting Engineers, Boston

One of the most important questions to be solved in any flood problem is that of the maximum flood flow for which provision must be made in the works to be designed. In the case of flood-protection problems. It may often be impracticable to provide protection against the greatest flood which must be expected at rare intervals, but the greatest probable flood must nevertheless be considered and the work must be made safe against serious damage under the most trying conditions, even though they do not fully protect the community against loss at such times. In the case of a spillway or waste channel from a dam it may be necessary to make provision for the greatest probable flood, since failure of the dam might result in more serious disaster than would be probable from an inadequacy of stream channel.

A great many dams have been built without adequate spillway capacity. The paucity of information relating to flood flows and necessary spillway capacities is merely all of the treatises upon dams is almost startling. The

old rule that a spillway should be capable of passing 6 in. depth of water upon the drainage area in 24 hr. (¼ in. per hr. or 160 sec.-ft. per sq.mi.) has long been known to be unscientific, and in many cases resulted in totally inadequate provision, yet it is still quoted. Much more liberal provision for discharging storm water than has been common is certain to be required in the future and many existing dams will have to be modified to provide adequate spillway capacity. Some work is already being done in the latter direction, noticeably in Pennsylvania, where the State Water Supply Commission is interesting itself in the adequacy of spillways and requiring owners to make changes where obviously necessary.



MAXIMUM FLOODS FROM SMALL DRAINAGE AREAS

The data upon which to base a decision on the maximum flood to be expected in any given locality are comparatively few and must be supplemented by a detailed study of rainfall and run-off records, and should also be checked carefully against records of excessive floods throughout the United States. In view of the difference in climatic conditions, it is somewhat surprising that the relation between maximum flood discharge and extent of drainage area appears to be approximately the same through the United States, although there may be a decided difference in the frequency with which such floods may occur.

Floods of unusual magnitude, expressed in cubic feet per second per square mile of drainage area, are plotted in the diagram. Three curves are shown. The outermost represents the maximum floods of which apparently authentic records are to be had,—floods which are probably to be classed as "acts of God." In addition to the two floods shown on this curve, support is also given by three additional floods lying well above the curve, one being the flood of 1909 in the Santa Catarina River at Monterey, Mex. These flows are so great that it will probably be impracticable to make provision for protection against flooding resulting from them, but their possibility should be borne in mind in guarding against failure of structures, whose collapse might accentuate the damage. The other two curves, marked "Curve I" and "Curve II," both intended to represent floods of rare occurrence, indicate the magnitude of the flood flows which should in general be provided for in structures intended to minimize flood damages.

Until much more is known about the relations between frequency and magnitude than is now the case, it will still be necessary to rely in large measure upon the scattered records of extreme floods, especially for spillway design.

A most extraordinary flood discharge from a very small drainage area is reported in the Water Resources Inventory report of the Pennsylvania Water Supply Commission, Part VIII, Floods (1917), as follows: "The highest recorded flood occurred on Bull's Run, a small tributary of the Susquehanna River on July 15, 1914, which discharged at the rate of 5,000 second feet per square mile from a drainage area a little over one-half a square mile." This rate of run-off is equivalent to 7.8 in. depth of water per hour upon the drainage area. This would be an extremely high rate of precipitation for a period as short as five minutes, while the period of concentration for a drainage area of 450 acres would probably be not less than 20 minutes. It may be, therefore, that this phenomenal flow resulted from the giving way of some obstruction rather than from the natural run-off following an excessive rain, and this record has accordingly been omitted. As a matter of fact, rates of precipitation as high as 7.80 in. per hour for periods of 20 min. have been reported by the U. S. Weather Bureau but twice during the 18 years 1901-1918 (see *Engineering News-Record*, Vol. 82, 1919, p. 1066): Taylor, Texas, April 29, 1905, 8.25 in. per hour, and Pensacola, Fla., Oct. 20, 1909, 8.64 in. per hour.

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Standing Waves in Rivers

By N. C. Grover
Chief Hydraulic Engineer, U. S. Geological Survey, Washington

The four conspicuous types of standing wave are the hydraulic jump, the sand wave, the tidal bore, and the standing flood wave.

Hydraulic Jump—The hydraulic jump, which is due to a sudden checking of the velocity of rapidly moving water and a corresponding increase in cross-section, may result from a sharp decrease in slope or from an abrupt increase in resistance to flow caused by an obstruction or a series of obstructions in the channel. By facing upstream and having no linear motion it differs radically in appearance from other forms. It will occur where swiftly moving water flowing over a dam strikes the more slowly moving water in the pool below, where the jet of water from an orifice that is partly or wholly submerged strikes the relatively still water into which it flows, and where there is an obstruction or an abrupt increase in frictional resistance to flow. Practically all roughness of the surface of flowing water except that caused by wind or by a sharp drop in the channel is a manifestation in some degree of the hydraulic jump.

Sand Wave—Sand waves occur at high stages of streams heavily loaded with silt, and are caused by the movement of considerable waves of sediment on the stream bed. The observed wave is, however, a wave of water, its causal wave of sand being entirely submerged. The sand wave may be due to the same causes that produce the hydraulic jump. It appears to be caused by an obstruction that is in motion and that vanishes and reappears with the dissipation and formation of waves or dunes of sand on the bed of the river.

Tidal Bore—The tidal bore seems to be peculiar to a region of large tidal fluctuation and is formed in a tidal estuary where there are marked restrictions of channel or in a larger river of strong current that enters the ocean. The effect is a piling up of the advancing tide on the lower layers, which are retarded by the normal current of the river. Many of these bores are destructive and are serious obstacles to navigation and shipping. The name "Amazon" is said by some authorities to be derived from an Indian word meaning "boat destroyer," because of the dangerous tidal bore about 100 mi. above the mouth of the river. This bore occurs in a stretch where the channel is obstructed by islands and the depth is not more than 4 fathoms. It advances at a rate of 10 to 15 miles an hour with a breaking wall of water from 5 to 12 ft. high.

The tidal bore in the Ganges is noted for its magnitude and destructiveness. On the Hugli branch of that river the bore advances 70 miles in 4 hours, or at the rate of 125 ft. a second, indicating a height of wave of about 20 ft.

Standing Food Wave—The standing flood wave occurs in a shallow stream when a large quantity of water reaches the channel while the stage is low. It may be caused by the sudden release of water through the failure of a

storage dam or by heavy local rainfall. The same quantity of water reaching the stream at a higher stage would cause an increase of stage and discharge but might not make a standing wave.

The flood wave appears as a nearly vertical "wall of water" with much splashing and foaming in front, caused by the continual falling of the faster moving water near the top over the slower moving water near the bottom. The water which thus falls becomes a part of the bottom layer of water, and other water from above falls over it.

Obviously, the hydraulic jump and tidal bore form the basis of most discussions of standing waves in rivers, as they may be studied systematically at the will of the observer. The sand wave is in some respects very interesting, but it is of little actual importance to engineers because it occurs only in a few rivers that are heavily loaded with silt and that are therefore generally not utilized in hydraulic developments. The standing flood wave, as it occurs in natural channels, although seen many times and described in general terms, has not been and from its nature can not be studied in detail.

* * *

The Red River Problem

By J. G. Sullivan
Consulting Engineer, Winnipeg

The two important contentious points on which we in Manitoba desire confirmation of our conclusions are,—*first*, does the clearing of timber and the cultivation of land increase the run-off; *second*, what responsibility, if any, attaches to the lands from which the extra water comes.

The Manitoba Drainage Commission has reported on this point: "Our final recommendation in the matter of boundaries is the extension of the boundaries of any drainage district to include all lands whose surplus waters drain into the district and are carried by any artificial channel through it to a natural outlet. This is a natural division of lands; any other division leads to disputes. We do not contemplate that all lands within the new boundaries should be taxed."

In a hearing before a legislative committee on this subject there was contradictory testimony given by old-time farmers. The men from the higher lands testified that the run-off from cultivated lands was much less than from wild lands or timbered lands and stated further that the floods were much greater thirty or forty years ago than at the present time, while the witnesses from the low lands testified to opposite conditions. The contention of the commission and its engineers was that in general the run-off from a cultivated field in the soil of this country is greater from a summer fallow field than from a field of wild land or from timbered land; that, when there is frost in the ground to a depth of 6 to 8 ft., in the case of melting snow under a warm sun or warm rains the run-off from the bare fields is much greater than from the wild lands covered with heavy grass or timber; and that in such cases the danger from floods on the lower lands with the water coming down in a rush when the ditches are full of snow and ice is an annual menace to the lower lands. This argument has been borne out by the experience in this district during the past fifteen or twenty years, the spring flooding becoming more excessive and occurring more regularly as the timber has been cleared and the land put under cultivation.

Winnipeg is located on the bottom of an old lake, and the main stream draining this area has not cut a sufficient channel to prevent dangerous floods. Another adverse feature is that this river flows north. The records of the Red River show that the plain on which Winnipeg is built has been covered with flood water for periods of two weeks or more in 1776, 1790, 1809, 1826, 1852 and 1861. Our present problem is to determine what will be the effect on Winnipeg of works of flood control (other than the constructing of reservoirs) by the people of Minnesota and the Dakotas. The most natural thing to do where natural reservoirs are not available is to increase the carrying capacity of the river by enlarging, straightening and diking. It is possible to decrease the length of the Red River to one half its present length. The distance from Emerson to Winnipeg via rail is 60 miles. The river survey shows a distance of 120 miles and my information is that the same ratio obtained south of the boundary. I am advising the Government of Manitoba that in my opinion the work we are doing within the province, draining land and preventing local flooding in the tributaries of the Red River by double-diking, etc., combined with work that is being done and may be extended south of the boundary, will in time bring about a condition where Winnipeg and other property between the boundary and St. Andrew's Locks will be in danger of damage from floods annually.

* * *

Forests and Floods in Ontario

By W. H. Breithaupt
Consulting Engineer, Kitchener, Ont.

Precipitation and to some extent general weather records extend back about 75 years in Ontario, though at the beginning they were but scant. The Canadian Meteorological service was organized in 1870, but there was observation to some extent for a considerable time before. The average annual precipitation, rainfall and snowfall, has varied from about 30 to over 40 in. Snowfall, in the high altitude region in the northerly part of the area, is heavy, ordinarily 120 to 130 in.; one record (1879) is 153.8 in. The general average of precipitation has varied in cycles, up and down, but there appears to have been no fundamental change since the beginning. During all the time since the first observations there is no record of anything like the extreme precipitations that have several times occurred during this period in the region beyond the lakes.

On the general question of the effect of forestation on stream flow, it is held by some that forests do not retard snow-melting nor prolong the run-off. The most notable proponent of these views was the late Col. H. M. Chittenden. While for the special conditions in the Rocky Mountain region forests may increase the intensity of run-off and bare areas retard, this does not hold in general elsewhere.

Smaller rivers are the component parts of the larger one. The influence of forestation on smaller rivers is so well established as to be almost a truism. The Ontario peninsula was a densely wooded area, of normal forestation. All observers agree that floods are greater and dry-period flow much less than before deforestation, settlement and farming. Former springs and even brooks have totally disappeared. Rivers which in the days of the explorers were canoe navigation routes are now very small streams during the greater part of the year.

All of these rivers have a much smaller summer flow than formerly, and greater floods in the spring. The Grand River drains essentially the easterly part of the peninsula. Its drainage area on the plateau contained more than 400 sq. mi. of swamp area, also covered with dense tree growth, mostly of cedar and tamarack. The old-time high-water channel now overflows almost every spring on snow-melting and breaking up of the ice. The ice is forced aside over the banks and cuts at the trees, which could not have grown up under present conditions. The extreme flood subsiding, the heavy ice formation lies high on the banks for weeks. Even with the smallest snowfalls on record, 1921 and 1922, this overflow and ice shove occurred.

The headwater swamps were particularly valuable as snow retainers and natural reservoirs. Coincident with their drainage during the past 30 years the summer flow of the river dropped to its present low level. Swamp drainage was, mistakenly, assisted by the provincial Government, and thus a valuable asset destroyed.

Seventy-five years ago in the county of Waterloo, an area of something under 600 sq. mi., there were 112 water powers in operation. They supplied power mostly to saw mills and grist mills. Only about 30 percent of these continue today. There are very few sawmills left in the county, as the bulk of the saw logs were long ago used up. The fact is, however, that the brooks supplying some of the smaller water powers are now dry for a large part of the year. Innumerable springs have dried up.

Canadian Flood Problems

By J. B. Challies
Director, Dominion Water Power Branch, Ottawa

River control problems which have thus far been solved in Canada are to a large extent primarily for power purposes. In many cases the incidental result is a bettering of flood conditions. Many Canadian rivers, however, present problems where flood control is of primary importance.

West—In British Columbia a disastrous flood occured last autumn when, following a rainfall of over 15 in. within 26 hours, the Coquitlam river poured down in immense volume, resulting in much destruction. A flood discharge of 24,000 sec.-ft. was reached as compared with a previous recorded high maximum of some 12,000 sec.-ft. A consoling feature was that the dam (hydraulic-fill type, 1200 ft. long, 100 ft. high) controlling the waters of Coquitlam lake stood this most severe test, and that the factors of safety insisted upon by J. R. Freeman have been fully justified by the conditions brought on by these floods. In an adjacent watershed, at Britannia Mines, on the same occasion, even greater calamity was caused by floods, including the loss of 36 lives.

The problems which have to be faced at the delta of the Fraser river in this province are also associated with flood prevention. The discharge of this river has varied from a maximum of some 380,000 sec.-ft. to a minimum of 12,000.

Alberta—In Alberta floods are often the result of high summer temperatures causing an excessive melting of the snows in the mountains. In June, 1915, the North Saskatchewan River at Edmonton rose 38 ft. above low water; 800 families were temporarily rendered homeless by this flood. To the south of this in the same province floods have occured on the Bow river in 1879, 1884, 1897 and 1902, when in each instance a portion of the city of Calgary was under water. Escape from flood in 1915 is attributed to the weather turning suddenly cold during the warm period which caused the Edmonton flood, thus stopping the further excessive melting of snow in the mountains.

Manitoba—Records of floods on the Red River of the North are available from various sources for a great number of years. Those reported as particularly serious occurred in 1776, 1790, 1809, 1852 and 1861, when in each case the plain on which Winnipeg is built was inundated. The river drains to the north and the spring thaw in its upper watershed brings down flood waters to the lower reaches before the complete release of ice has occurred, while the contracted channel below Winnipeg also contributes to flood conditions.

Ontario—Lake of the Woods, between the provinces of Manitoba and Ontario, has lately supplied a typical example of how flood conditions can be materially alleviated by proper storage control by a responsible public organization. In 1916, previous to the placing of the regulation of the lake under the direction of the Lake of the Woods Control Board, a notable flood occurred in this drainage area. In contrast with this, in 1919, when the control board was exercising its jurisdiction, conditions which under natural conditions would have had far more disastrous results were successfully anticipated and coped with, through prompt action at the control works on the basis of telegraphic communications from the various meteorological stations reporting heavy rainfall, although the inflow rate to the lake became double that of 1916.

Farther east, the Grand River should be noted as presenting a flood-control problem. The Grand River lately shows a maximum flow of 37,000 and a minimum of only 24 sec.-ft., and its floods are attributed to the destruction of great forest areas and the drainage of hundreds of square miles of swamps in the headwaters, which have changed moderate floods and sustained flow to destructive spring floods and gradually disappearing flow. Storage works for combined flood control, water power and irrigation have been suggested.

St. Lawrence River—The St. Lawrence supplies an example of floods caused not by excessive discharge but by the blocking of the channel by ice. The disastrous floods on the St. Lawrence in the vicinity of Cornwall in 1840, 1879, 1887, 1895, 1898, 1901 and 1905 were caused by ice jams below. In February, 1887, ice jams caused water to rise 31 ft. above normal summer level, inundating two-thirds of the town of Cornwall.

Quebec—In Quebec province a disastrous flood occurred on the Chaudière river in the latter part of July, 1917, while serious spring floods have been recorded on the same river in 1885, 1896 and 1912. Its most important tributaries, rapidly descending their steep courses, enter the main stream just above a long section of the river with low banks and a narrow channel, where the effect of floods is particularly disastrous. The Chaudière flows from south to north and the spring floods are caused by freshets and ice accumulation from its southern drainage reaching its lower portion before the break-up has occurred. The maximum spring discharge has reached 42,500 sec.-ft., as compared with a minimum flow of only 200 sec.-ft.; the discharge during the summer flood of 1917, following a rainfall of 5.42 in. in 15 hr., was estimated at 125,000 sec.-ft. and caused a rise of 30 ft. with losses estimated at $1,315,000. The Quebec Streams Commission has considered a number of reservoirs for flood control on this river.

Control of the Chateaugay river is also under study by the Quebec Streams Commission. This offers another example of a river flowing from south to north where spring floods are mainly caused by an ice blockade in the lower portion of the stream, and the proposed remedy consists in creating conditions in the rapid upper portion of the stream whereby a more substantial ice cover will be formed, and retarding and properly timing its release in the spring.

* * *

Floods and Co-ordinated River Planning

By Morris Knowles
Consulting Engineer, Pittsburgh

The comprehensive report of the Pittsburgh Flood Commission revealed the need and the bigness of the flood problem of the Monongahela and Allegheny Rivers. Since then, there has been a review by the U. S. Engineer Corps and a recommendation that surveys and plans be made by the War Department. Pennsylvania in 1919 appropriated $25,000 as its contribution for such surveys and plans. A bill in Congress provides for $50,000 to carry on this work and to co-ordinate with the state. It is expected that this bill will pass within the present session.

Great areas at the head waters of the Allegheny and Monongahela rivers have already been acquired by the United States for forest reservations. The Forest Service has recommended the purchase of 500,000 acres in northwestern Pennsylvania and about 1,000,000 acres have been secured at the headwater of the Youghiogheny and Cheat rivers in Maryland and West Virginia. The improvement of the wharves at Pittsburgh, including the reclamation of many acres of unused river front, the erection of dockage facilities and the construction of flood walls to protect low-lying areas are now receiving attention.

This entire movement and program is only one part of the great community planning idea, a development of the idea of so utilizing the great resources of flowing and falling waters as to secure the greatest good and benefits to all the people and to all activities.

We once had the chance in our river valleys to plan for wise occupation and complete development, but frequently this opportunity has been misused—sometimes it may be by a railroad alone, or a canal or an improved river for navigation, or the location of a town or an industry. We now find the problem is increasingly difficult, as is true in all cases of replanning. But still opportunity exists, as with the proposed wall at Pittsburgh, or the elevation of streets out of ordinary flood levels, to plan for thoroughfares, parking, boulevards and terminal facilities. Witness the very attractive river front development at Harrisburg by use of concrete walls and parking, or the convenient and pleasing boulevard drive along the Susquehanna River at Sunbury, placed on top of a river levee. So too, in several river valleys not yet fully developed, there exists still the chance for choosing the wisest development. This is true community or country planning.

ENGINEERING LITERATURE

Sewerage for Students and Engineers

REVIEWED BY JOHN H. GREGORY
Consulting Engineer; Professor of Civil and Sanitary Engineering, The Johns Hopkins University, Baltimore, Md.

SEWERAGE AND SEWAGE TREATMENT—By Harold E. Babbitt, M.S., Assoc. M. Am. Soc. C. E., Assistant Professor, Municipal and Sanitary Engineering, University of Illinois. New York: John Wiley & Sons, London: Chapman & Hall. Cloth; 6 x 9; pp. 531; illustrated. $5 (30s. net).

In his preface the author states that this book is a development of classroom and lecture notes prepared by him for use in his classes at the University of Illinois, and that he has found such notes necessary, since among the many books dealing with sewerage and sewage treatment he has found none suitable as a textbook designed to cover the entire subject. He also states that the need for a single book of the character described has been expressed by engineers in practice, as well as by students and teachers for use in the class-room, and that this book has been prepared to meet both these needs. The book therefore must be considered not only from the standpoint of the instructor but also from that of the practicing engineer.

In the first or introductory chapter the author takes up very briefly the historical side of the subject and then gives certain definitions relating to sewers, a list by no means complete. It is to be regretted that he did not adopt the definitions recommended by the Committee on Sewerage and Sewage Disposal of the American Public Health Association in 1917, although some of the definitions are similar to those recommended by the committee. The next two chapters take up the work preliminary to design and the quantity of sewage to be cared for.

The fourth chapter treats of the hydraulics of sewers. The formulas commonly used are presented. Darcy's and Lampe's formulas are also given but no word of caution is expressed as to the limits within which these formulas apply. A few diagrams are included for the solution of certain formulas; one diagram is plotted with rectangular co-ordinates, the others on the nomographic principle. In the next chapter the design of sewerage systems is considered and following that is a chapter on sewer appurtenances.

Chapter VII, on pumps and pumping stations, is rather disappointing. The author had here the opportunity of being of real assistance to the practicing engineer who is called on to design a sewage pumping station, as there is room for much improvement in the design of such stations. Two chapters are then devoted to materials for sewers and to the design of the sewer ring.

A chapter then follows on contracts and specifications wherein the various parts of a complete contract are discussed. The author gives a set of what are termed "General Specifications" which in reality are those provisions which are commonly called "General Clauses" or "General Provisions." "Technical Specifications" are listed by title only, the reader having to refer to various parts of the book for paragraphs covering the requirements for materials, etc. "Special Specifications" are stated as having to do with problems, methods of construction, or materials peculiar to certain contracts or certain portions of the work. Ordinarily they would be included in the "Technical Specifications" or simply in "Specifications."

Chapter XI, on construction, is 99 pages in length. It could well be cut up into a number of shorter chapters. Then follows a chapter on the maintenance of sewers.

The remaining nine chapters treat of sewage and sewage treatment. A chapter is devoted to the composition and properties of sewage followed by one on dilution. It is to be regretted that more space is not given to dilution, which is a most important branch of the subject, and that more examples of disposal by dilution are not cited.

The discussion of screening and sedimentation gives a general idea of screening, but not much detail, and the same may be said for plain sedimentation. Unconsciously, probably, the author uses the term quiescent sedimentation incorrectly, and no mention is made here of any existing sewage-works employing plain sedimentation.

Uuder septicization, the author takes up the septic, Imhoff, Travis, Doten and Alvord tanks. This chapter needs revision. As it stands the subject is not satisfactorily treated. In speaking of Imhoff tanks, the author states: "As designed by Imhoff and used in Germany the tanks were of the radial flow type and quite deep." This gives a wrong idea. True, Imhoff's tanks are quite deep, and he has built radial flow tanks, but his first actual installation was a longitudinal flow tank and his largest and best installations are also longitudinal flow tanks.

Filtration, irrigation and the contact bed are taken up in the same chapter. The reader will wish these subjects were more adequately treated. The author could well devote a chapter each to the trickling filter and to the intermittent sand filter. There is much more that could be said and certain omissions are noticeable.

A whole chapter is devoted to activated sludge and one to acid precipation, lime and electricity, and disinfection. The reader will understand what these processes are, and a short bibliography on activated sludge is included. Only four pages are devoted to disinfection.

Sludge receives only 12 pages. When it is remembered that the handling and disposal of sludge is one of the most important phases of sewage treatment the space allotted is far too little. One brief paragraph only is given to the separate digestion of sludge. The author seems to have overlooked the fact that this method is in use at two of the largest sewage-works in operation, Birmingham, England, and Baltimore, Maryland.

The final chapter discusses very briefly automatic dosing devices.

After a most careful reading it may be said that, as a textbook, this volume may be made to serve its purpose well, but preferably it should be in the hands of an instructor who has had enough practical experience in sewerage and sewage treatment work to point out to the student wherein, in places, current practice and views

differ somewhat from those set forth in the text. The student should then get a good grasp of the subject. For reference, the practicing engineer will have before him a very readable book which contains much that will be of assistance to him; but he will not find certain kinds of data which should be included in a book of this nature.

In a second edition, the book can be materially improved in a number of particulars. For example, when formulas are cited, scrupulous care should be taken to accurately and fully define the symbols used. This has not been done in the present edition, and with certain formulas the symbols are not defined at all. Again, works which are more typical of good practice could to advantage be substituted for those which have been chosen, and more representative works cited. The book is well printed and bound, and the cuts and drawings are well executed.

Motor Truck Transportation Principles

MOTOR TRUCK TRANSPORTATION: The Principles Governing Its Success—By F. Van Zandt Lane, C.E., Lecturer on Motor Truck Transportation, New York University, Member of the Society of Automotive Engineers. New York: D. Van Nostrand Co. Cloth; 6 x 9 in.; pp. 153; 44 illustrations. $2.

In offering this book as a presentation of the principles of motor truck operation, the author disclaims, at the outset, any "attempt to produce a technical treatise." The 15 chapters cover such subjects as operating-cost factors, cost records, motor trucks and the railroads, highway transport surveys, bodies, loading and unloading devices, maintenance, trailers, tires, and good roads. Illustrations are introduced frequently and have been well chosen to emphasize particular points brought out in the text.

The general character of the text may be indicated by reference to the chapters on operating costs. Here the author shows that costs may be grouped under three headings—investment, fixed, and variable—but he makes no attempt to show by detailed figures from actual operating records the amounts of such costs in specific cases. Rather, he makes a plea for a careful study of the factors entering into costs and urges the importance of keeping cost records. "It is doubtful," says the author, "if any operating costs at all are being kept on as many as 8 per cent of the motor trucks in operation." While the reader is shown the value of cost records, the scope of the book precludes a presentation, for example, of typical blank forms for cost keeping or detailed methods of securing the necessary information and interpreting its meaning.

The chapter on the motor truck and the railroad discusses the relation of these two forms of transportation and points out the conditions under which one or the other may be expected to give the most economical and satisfactory service. Brief reference is made to the subject of store-door delivery and the use of removable truck bodies which have proved so successful in operation at the Cincinnati terminal.

The chapter on highway transport surveys contains a valuable list of items that should be considered in the establishment of highway freight transport lines. The following chapter describes the principal types of bodies with which motor trucks may be equipped for different kinds of service. Brief chapters deal with loading and unloading devices and with truck maintenance, but the treatment of both of these subjects is by no means complete. Arguments for and against the use of pneumatic tires are presented, but this subject is at present in such a controversial state that little would be gained by a fuller treatment than is contained in the book.

The author appears to be an advocate of the national highway system advocated in Senator Townsend's original bills which were defeated in favor of the federal-aid principle. Some of the author's statements regarding highway legislation need amendment in view of developments that have taken place since the publication of his book. Certainly, his statement that the national highway system "is receiving almost universal support" is hardly borne out by the fact of its subsequent defeat. Needing amendment also is the statement that the present federal-aid laws do not provide for maintaining the highways. In the Federal-Aid Highway Act passed last November great stress is laid upon the subject of maintenance; in fact, the definite requirement is made that adequate maintenance funds be provided before the allotment of federal money to the states.

On the whole, the book states concisely the principles of motor-truck operation in a general way and avoids details as to the ways by which such principles are put into practice. No mention whatever is made of the matter of motor-vehicle legislation, a subject of vital interest at the present time to both motor-truck operators and highway engineers. A brief chapter dealing with restrictions on weight, size, and speed of vehicles, as provided for in the various state laws, would have been a desirable addition to the book. The literature on motor-truck transportation is meager and Mr. Lane has done well to put on record the general principles involved.

Original Studies in Hydraulics

Reviewed by ROBERT E. HORTON
Consulting Hydraulic Engineer, Voorheesville, N. Y.

HYDRAULICS OF PIPE LINES—By W. F. Durand, Ph. D., Professor of Mechanical Engineering, Stanford University, California. [The Glasgow Text Books in Civil Engineering. Edited by G. Moncur, B. Sc., M. Inst. C.E., Professor of Civil Engineering in the Royal Technical College, Glasgow.] New York: D. Van Nostrand Co. Cloth; 6 x 9 in.; pp. 271; 134 line cuts. $4.50.

While designated by the name "Hydraulics," a considerable part of the book relates to details of design and construction, but it is not to be considered a complete treatise on this subject even for steel pipe lines; rather it apparently represents the results of the author's own studies and research. It is in such books that the fullest and most authentic information on special subjects is usually obtainable and this one is no exception. Engineers having to do with the design of steel pipe lines, especially for waterpower development, will undoubtedly welcome the author's treatment of the subjects of surge tanks and water hammer.

The book opens with a chapter on the hydraulics of flow in pipes. Some of the existing pipe flow and friction formulas are presented and discussed. The Manning adaptation of the Kutter formula, which has recently grown rapidly in favor is not included. The discussion of head losses due to curves in pipe lines is unusually complete and brings the experimental data to date. Transverse velocity curves in pipe lines and the relation of discharge to energy delivered are briefly treated. The delivery of water from one reservoir to another through a pipe line receives considerable attention as a basis for later chapters. Apparently a total loss of the velocity head at the delivery end in the case of a sub-

merged pipe discharging into a reservoir is assumed. Wisler's experiments *Engineering News-Record*, Dec. 1, 1921, published since Durand's book was written, indicate that this is not correct. Valves and sudden enlargements are treated as in most standard works on hydraulics, but Archer's recent and probably more accurate formula for head loss at sudden enlargements is not included.

The dominant feature of the book is the treatment of surges and water hammer. The problem of the surge chamber is discussed clearly, with good illustrative diagrams and no more advanced mathematical discussion than is necessary. Various formulas for calculating the maximum surge are given, together with methods of solution of surge tank problems by approximate integration. The differental surge tank, however, receives much less attention than it apparently deserves.

Water hammer in pipe lines is treated at length and in an unusually clear and complete manner, with numerous good diagrams illustrating the effect of change of various factors, especially the rate and time of opening and closing of valves.

Next follows a chapter on the stresses in pipe lines, particularly those due to bends, which is probably more complete than is elsewhere available. The design of steel pipe lines is well covered, including ordinary and expansion joints, air vents and other details. Other brief mention is made of details of design of wood stave or concrete pipe. The hydraulics of oil pipe lines is given a chapter. Certain details of hydraulic theory are presented in appendixes. The book closes with a compact index.

City Planning and Transportation

Reviewed by Harold M. Lewis, Civil Engineer, New York City

STADTEBAU—Von Otto Blum, Dr.-Ing., ord. Professor an der Techn. Hochschule in Hannover, G. Schimpff, well, ord. Professor an der Techn. Hochschule in Aachen, und W. Schmidt, Dr.-Ing., Stadtbauinspektor in Stettin. Handbibliothek fur Baulngenieure. Boards; 7 x 10 in.; pp. 478; 482 text illustrations. Berlin: Julius Springer.

First to appear in a series of hand and reference books to be published under the general heading of "Railroads and City Planning," by far the largest part of this volume is devoted to a study of the transportation systems of the modern large city, while less than a third of it is devoted to general principles of city planning. In American books on this subject there is generally not this distinction between different parts of the problem. The volume is of value mainly as a general reference book. The data collected are clearly set forth, with the aid of many illustrations and tables.

Of especial interest is the fact that some indication is given of the effect of the World War on the development of German cities. Great emphasis is placed on the need of plans which shall remedy the extreme proverty of the great mass of the German people, and on the fact that any immediate projects must be for moderate developments.

The first part of the book is on city planning in general. Here, after outlining the history of the growth of cities, the author enunciates the general principles to be observed in laying out a large community. It is assumed that the city planner will have that same authority for local restrictions which was so well developed in Germany before the war and which was used to good advantage in regulating the growth of the larger German cities. The American reader must remember that many of the restrictions which it is stated should be imposed, may have to be somewhat altered to be adapted to the rulings of American courts.

The inter-dependance of the city and its railroads is described in considerable detail and a plea is made for co-operation for their mutual advantage. The statement that the width of roadway in main traffic streets in the average city is generally too wide rather than too narrow seems a radical one for either the German or American city, and the authors' argument that the more the traffic is restrained laterally the better it can be regulated seems to lead to more delay than regulation. A variety in street arrangement and adornment is urged, and the absence of any real necessity for a symmetrical arrangement of roadways, walks or planting is pointed out. The resulting development of unsymmetrical streets is a typical German feature. It is stated that, as a general rule, streets less than 20 to 30 meters in width should have not more than one row of trees and that these should be placed where they receive a maximum of sunlight. While a strong plea is made for the one-family house, it is conceded that the apartment and multiple house is a modern necessity.

The second section of the book is devoted to the city transportation systems and is the most complete part of the volume. The subject is treated under City Railroads, Street Railways, Buses, and Water Transport. Many of the data furnished are brought down to 1920 but any costs given are based on pre-war figures. Several curves show variations of traffic. Track layouts at stations and connections are fully described. There are many illustrations showing standard equipment and construction in German, English and American cities. About twenty pages are devoted to the legal and political sides of city transit companies, including a summary of the laws under which German companies can be incorporated, and the advantages and disadvantages of central government, city and private ownership.

The third and last part of the book is devoted to city highways. After reviewing the different types of conveyances and the forces to be overcome in propelling them, there is a summary of the different types of city pavements. A short description is given of the different types of sidewalk construction, and street cleaning and refuse disposal are very briefly touched upon.

The book should be of considerable interest to city planners and engineers. While the view point of the authors is in many cases limited to German conditions, the data presented are representative and most of the principles given are general ones, and are clearly explained with more than usual detail.

Unusual Stream Flow Investigations

STREAMFLOW EXPERIMENTS AT WAGON WHEEL GAP, COLO. Bulletin [illegible] Department of Agriculture. Boards; 6 x 9 in.; pp. 35; [illegible] text illustrations. Washington: Government Printing Office.

For the purpose of amassing data on the effect of forest cover on stream flow and erosion, the United States Forest Service and Weather Bureau have been co-operating for a dozen years or so at a station established for the purpose in the Rio Grande National Forest near Wagon Wheel Gap, Col. Quoting now from the report listed above:

The plan, broadly stated, was to select two small [illegible] watersheds, similar as to topography and forest cover; to

observe carefully the meterological conditions and the streamflow for a term of years under similar conditions of forest cover; then to denude one of the watersheds of its timber and to continue the measurements as before for an indefinite period, or until the effects of the forest destruction upon the time and amount of streamflow, the amount of the erosion, and the quantity of silt carried by the streams had been determined.

After eight years of continued streamflow measurements and nearly nine years of meteorological observations, it was decided that the first or preliminary stage of the investigations had been completed and that one of the drainage areas should be deforested except for a strip of timber not to exceed 25 ft. in width on either side of the stream which was to be left for a single season, complete cutting to be effected in the autumn of 1920.

The pamphlet reviews all the conditions of the experiments, including the building of dams and weirs, and the establishing of gaging and meteorological instruments. The geology of the two drainage areas and other governing conditions are briefly described. Rainfall and run-off figures are given and also some silt measurements. A series of sixteen "rules" to be observed in studying these and similar data are presented and explained.

Altogether the study, even in its preliminary stages, is unusual and seems to be highly commendable. The observations and deductions from the second stage of the investigations—with one drainage area deforested and the other still forested—will be awaited with interest. Necessarily some years must elapse before anything like definite conclusions can be reached. An interesting subject for speculation is what if any correction factors will need to be introduced on account of changed conditions—such as continued growth on the forested area during the second stage as compared with the forest conditions on both areas in the first stage.

Electric Welding in Railway Work

ELECTRIC ARC WELDING—By E. Wanamaker, Electrical Engineer, Chicago, Rock Island & Pacific Railroad and H. R. Pennington, Supervisor of Electrical Equipment and Welding, Chicago, Rock Island & Pacific Railroad. New York: Simmons-Boardman Publishing Co. Cloth; 6 x 9 in.; pp. 254; 167 halftones and linecuts. $4.

Although this book deals with the principles and methods of electric welding, in the application of the process it refers mainly to locomotive repairs. Autogenous welding, which in recent years has had a remarkable development for the repair of fractured and worn metal parts, includes the three methods of thermit, gas and electric welding. Only the last of these is treated in the book under review.

The principles of arc welding and the apparatus and accessories required are covered by the first few chapters. In a lengthy chapter on the training of operators, the necessity of employing careful and conscientious men is emphasized, since the quality of a completed weld can hardly be determined by inspection and many operators work under foremen who are not familiar with the process and are unable to judge the results. Separate chapters are devoted to explaining the carbon arc and metallic arc processes.

After a discussion of the welding of iron, steel and non-ferrous metals, the application of arc welding is described. Except for brief mention of welded truss and structural connections this matter relates mainly to the repair of fractures in numerous parts of locomotives. Mention is made also of the practice of building up worn wheel flanges by the arc welding process. Nothing is said as to the wide range of application of this process in various lines of heavy machinery, in pipe work, in shipbuilding, in making rail joints or in building up worn frogs and switches, although much work has been done in the two latter lines, especially by street railways. In general, therefore, this book is more particularly for the railway mechanical engineer or official.

The American Railroad Problem

RAILROADS AND GOVERNMENT: Their Relation in the United States, 1910-21—By Frank Haigh Dixon, Ph.D., Professor of Economics, Princeton University. New York: Charles Scribner's Sons. Cloth; 6 x 9 in.; pp. 384. $2.75.

There is need for work of the sort that Prof. Dixon has done in this book. So closely is the industrial welfare of the nation bound up with the condition of the railroads that we have come to understand that prosperous railroads mean a prosperous people. Today the railroads are in bad shape and their problem is the problem of every American citizen. But the average citizen is not expert in railroad matters. When confronted by a crisis such as that of the present he finds it difficult to pass intelligent judgment, largely because of his unfamiliarity with the circumstances that have led up to it. Herein lies the value of Prof. Dixon's work, for in "Railroads and Government" he offers to the general reader, who neither is nor wishes to become a railroad specialist, a concise, illuminating and altogether readable review of the whole subject of railroad regulation.

Sketching briefly the genesis of the Interstate Commerce Commission and its struggle for recognition between 1887 and 1910, Prof. Dixon begins his task with the act of 1910. In a hundred pages he reviews succinctly the operations of the commission during the six years immediately preceding the war; its groping toward a constructive rate policy, the vicissitudes of the "long and short-haul clause" as variously applied, and the multifarious administrative activities that devolved upon it, ranging from the award of medals for daring to catch-as-catch-can wrestling with perverse coal carriers wriggling to evade the commodity clause. Among the forward-looking undertakings of the commission are included the establishment of uniform accounting systems and the physical valuation of the railroads. Answering the question as to whether this last gigantic undertaking has been worth while, Prof. Dixon says:

> Property value officially determined has been transformed from the dream of a few idealists into the corner stone of our regulation policy. It constitutes the ultimate determinant of rates. It sets the limits to the financial policy of consolidation and dampens the ardor of the financial juggler. It will be a substantial aid in all future capitalization. Finally, its influence upon railroad accounting should be healthy and farreaching. . . . Anything that contributes to the soundness and scientific exactitude of accounting increases the efficiency of public regulation.

This story carries us to the labor hold-up of 1916. In discussing the influences that brought about the surrender of the national administration to the railroad unions, Prof. Dixon, so far as we can see, has failed to note the one factor that in the judgment of many was decisive; i.e., an impending national election.

Another hundred pages is devoted to a consideration of the war period and federal operation. Although

we are still somewhat too close to the event to permit the drawing of definite unbiased conclusions as to these subjects, the author has performed a worth-while service in making available to general readers this review of events and of contending arguments. The remainder of the book is devoted to the problem of reconstruction and to an exposition of the railway act of 1920. He estimates what may be expected from its operation and dares a glimpse into the future. The several plans that have been submitted for the reorganization of the railway system are reviewed, notably those of the Director General of Transportation, the Interstate Commerce Commission, the Association of Railway Executives, the National Transportation Conference of the Chamber of Commerce of the United States, and the Plumb Plan as sponsored by the railway labor unions.

In his look into the future the author suggests a line of development based upon the acceptance of the following propositions: (1) That the railroads cannot be operated privately without sufficient earnings to insure a constant stream of new capital into the industry. At present this must be at least 6 per cent. (2) If this cannot be earned government aid must be sought, which will mean in turn, taxation, ownership and possibly operation. Government ownership Prof. Dixon holds to be a hazardous experiment, and government operation he would consider to be disastrous. (3) As there is no assurance that 6 per cent can be earned continuously at present rates and as higher rates would probably be less productive, necessary earnings must be assured through savings in operating expense. (4) These results cannot be attained by minor economies, but must come through nation-wide co-operation.

Altogether, Prof. Dixon seems to have succeeded admirably in the purpose expressed in his preface: "We are entering, then, upon a new phase of the railroad problem, in which knowledge and sound wisdom are called for from the electorate. It has been the wish of the author to contribute his mite to an intelligent understanding of the issue."

For Factory and Shop Managers

INDUSTRIAL FATIGUE AND EFFICIENCY—By H. M. Vernon, M.A., M.D.; Investigator for the Research Fatigue Board. London: George Routledge & Sons. New York: E. P. Dutton & Co. Cloth; 6 x 9 in.; pp. 264; diagrams. $3.

Fatigue resulting from excess of work or lack of rest, as it affects the efficiency of factory and shop workers, is discussed by the author with the authority of his experience as investigator for the Industrial Fatigue Research Board of Great Britain. All the deductions are based on actual shop and factory records. Laboratory studies, scientific management and vocational selection are not considered. Mostly, also, the records are those of indoor occupations except in the case of some shipyard studies. The chapter on "Work Spells and Rest Periods" and that on "Lost Time and Its Causation," are those from which the construction works manager will perhaps draw the most information applicable in his specific problem of maintaining efficiency.

Railway Water Treatment Chemicals

Standard specifications for chemicals to be used in the treatment of railway water supplies have been framed by a committee of the American Railway Engineering Association and are given in the December *Bulletin* of that organization (431 South Dearborn St., Chicago). Separate specifications for soda ash, hydrated lime, quicklime, and sulphate alumina fill a total of about eight pages.

Information on the Lighting of Buildings

In continuance of earlier bulletins entitled "Lighting Data" issued by the Edison Lamp Works, Harrison, N. J., there has recently been published a pamphlet taking up public buildings, churches and residences. The information is compiled by A. L. Powell and others.

Water Resources of the Mahoning River

Those desiring copies of the report upon the development of the water resources of the Mahoning River, mentioned in this section March 16, p. 457, should address E. H. Braunberns, director of public service, Warren, Ohio, instead of the author of the report.

Author of New Book on Railway Signaling

The new book entitled "Railway Signaling" reviewed in these columns by J. A. Peabody on Jan. 19, p. 110, was written by Everett E. King; instead of by "Kink," as a typographical error made the name appear.

PUBLICATIONS RECEIVED

COLORADO BOARD OF EXAMINERS FOR ENGINEERS AND LAND SURVEYORS, 1921—Paper; 6 x 9 in.; pp. 60. Denver.

First report. Contains revised act creating board, rules adopted by board and "Roster of Licensed Engineers," totaling 689, of which 25 are non-residents. The roster gives kind of engineering followed and address.

THE COLORADO RIVER AND ARIZONA'S INTEREST IN ITS DEVELOPMENT—By G. E. P. Smith. Bulletin No. 95, The University of Arizona, Agricultural Station. Paper; 6 x 9 in.; pp. 10.

CO-OPERATIVE COMPETITION: A Discussion of the Acute Legal and Economic Perplexities Confronting Trade Associations. With an Introductory Article by Herbert Hoover. Reprinted from the New York *Evening Post*. Paper; 9 x 11 in.; pp. 56. 25c.; $20 per 100 copies.

Stimulating discussions designed "to support the legitimate activities of trade associations" and to bring them and their benefits before the public. Secretary Hoover urges that trade associations should stabilize business and that the place of these organizations in law and their functions as well should be determined. Standardization of products as an industrial gain is presented by F. M. Feiker, vice-president McGraw-Hill Co. A uniform system of accounts for trade associations is urged by Prof. M. T. Copeland, Harvard University. Charles R. Stevenson, of the Stevenson Corporation, Industrial Engineers, favors curbing all trade and industrial competition and fair-price fixing. A wide range of pertinent topics is discussed by the other contributors.

DIE SPEZIFISCHEN WÄRMEN DER GASE UND DAMPFE—By A. Schlest, Dipl.-Ing. Lehrer an der Technischen in Moskau. Leipzig und Wien: Franz Deuticke. 6 x 10 in.; pp. 46. 12 text figures.

THE DISTRIBUTION OF GAS—By W. Hoh, M. Inst. Gas E., Superintendent [illegible] Department, Lecturer on Gas Distribution at the University of [illegible]. Cloth; 6 x 9 in.; pp. 169, 143 [illegible].

[illegible] British treatise, coming eight years after the third edition, obsolete [illegible] on Industrial Matters. [illegible] noted in these columns March 16, 1921.

DOCK AND HARBOUR AUTHORITIES DIRECTORY. Being a List of Members of [illegible] Ports of the World and [illegible] Officers. London: The Syndicate Publishing Co. [illegible]; pp. 165. 10s. net.

[illegible] 16 pages of the [illegible]

DOCK AND LOCK MACHINERY—By W. Henry Hunter, M. Inst. C. E., M. Am. Soc. C. E. [The Glasgow Text Books in Civil Engineering. Edited by G. Moncur, B.Sc., M. Inst. C. E., Professor of Civil Engineering in the Royal Technical College, Glasgow.] New York: D. Van Nostrand Co. Cloth; 6 x 9 in.; pp. 196; 97 illustrations. $4.50.

DULUTH-SUPERIOR HARBOR—Statistical Report of Marine Commerce of Duluth, Minn., and Superior, Wis., 1921. With Supplementary Report of Commerce of Keweenaw Waterway, Michigan. Prepared under the Direction of E. H. Marks, Major, Corps of Engineers, United States Engineer Office, Duluth, Minn. Paper; 6 x 9 in.; pp. 23.

ECONOMICS OF HIGHWAY TRANSPORT: Preliminary Topical Outline—By Lewis W. McIntyre, Associate Member, Am.Soc. C.E., Assistant Professor of Civil Engineering. Prepared for the Highway and Highway Transport Education Committee, Willard Building, Washington, D. C. Paper; 6 x 9 in.; 25c.

For distribution to (1) engineering students to help them get an idea of the scope of the highway transport field and (2) college instructors in highway transport to aid them in formulating courses. The syllabus is supplemented by problems.

THE EDUCATION OF HEALTH OFFICERS—By George C. Whipple, Professor of Sanitary Engineering, Harvard University. Reprint from *Public Health Reports*, U. S. Public Health Service. Paper; 6 x 9 in.; pp. 32.

ENTROPY AS A TANGIBLE CONCEPTION—By S. G. Wheeler, Eng. Lieut.-Commander, R. N.; Lecturer in Engine Design, Royal Naval Engineering College, Keyham, Devonport. New York: D. Van Nostrand Co. Cloth; 6 x 9 in.; pp. 76. $3.

An elementary treatise on the physical aspects of heat, entropy, and thermal inertia, for designers, students and engineers, and particularly for users of steam and steam charts.

6 x 9 in.; pp. 782. New York: The Macmillan Co. $4.
Professor of Political Economy, Columbia University. Cloth; 6 x 9 in.; pp. 782. New York: The Macmillan Co. $4.

ESSENTIALS IN THE THEORY OF FRAMED STRUCTURES—By Charles A. Ellis, A. B., Vice-President, The Strauss Bascule Bridge Co.; with American Bridge Company 1901-08; Assistant Professor of Civil Engineering, University of Michigan 1908-12; Designing Engineer, Dominion Bridge Co. 1912-14; Professor of Structural Engineering, University of Illinois, 1914-21. New York and London: McGraw-Hill Book Co. Cloth; 6 x 9 in.; pp. 330; illustrated. $3.50.

THE FOREST PRODUCTS LABORATORY, 1910-1920—By the Decennial Committee, Howard F. Weiss, Chairman, Madison, Wis. Cloth; 7 x 10 in.; pp. 196.

A record of the decennial celebration July 22, 1920.

FUEL AND LUBRICATING OILS FOR DIESEL ENGINES—By W. Schenker, Chief Engineer (Diesel Engine Department), Sulzer Frères, Société Anonyme, Winterthur, Switzerland. New York: D. Van Nostrand Co. Cloth; 6 x 9 in.; pp. 114; illustrated. $3.

GAS CHEMISTS HANDBOOK—Compiled by the Chemical Committee, Technical Section of the American Gas Association, E. C. Uhlig, Chairman Editorial Committee. Cloth; 6 x 9 in.; pp. 608; illustrated. New York: American Gas Association. $6 in United States and Canada; $6.50 elsewhere.

Broader than gas works practice. Covers coal, coke, gas oil, purification material, illuminating gas; ammonia, light oils, etc., tar and other gas-making by-products; water, paint, lubricants, solder, pipe deposits, refractories, cement and lime, ferrous metals. There are a dozen authors besides a second dozen contributors.

HANDBOOK OF AUTOMOBILES 1922. (Foreign Edition)—Compiled by The National Automobile Chamber of Commerce, New York City. Paper; 5 x 8 in.; pp. 281; illustrated. 50c.

Contains the principal specifications of 155 passenger automobiles, 70 commercial cars and trucks and 5 electric vehicles, together with information as to cost. This edition, the nineteenth, includes for each truck the gross weight (chassis, body and load) which was not given in previous editions and which is particularly useful to highway engineers who are concerned with traffic studies or motor vehicle legislation affecting loads.

HARNESSING AUSTRALIA'S GREATEST RIVER.—Being an Account of the Great Scheme Undertaken by the Governments of the Commonwealth of Australia, and of the States of New South Wales, Victoria, and South Australia, With a View to the More Profitable Use of the Waters of the River Murray. Together with Appendices, Describing Some Results Obtained from Irrigation Works Carried Out in the Individual States of New South Wales, Victoria, and South Australia, and the Construction of the Terminal Wheat Silo at Sydney, N. S. W., Melbourne and London: The Industrial Australian and Mining Standard. Paper; 10 x 14 in.; pp. 51; maps, diagrams and half tones. $2 net from Brentano's, New York City.

Describes a vast combined irrigation and navigation project involving storage in Lake Victoria and in an 1,000,000-acre-feet reservoir on the Murray River, besides the construction of minor works; also other descriptive matter listed in sub title. First published in 1920 shortly after starting work on the Hume dam to form the reservoir mentioned; now available in America, as stated in the heading.

THE IMHOFF SEWAGE TANK IN AMERICA: A Decade of Operation Reviewed—By Peter Gillespie, Professor of Chemistry, University of Toronto (Ontario). Paper; 6 x 9 in.; pp. 24. Address the Author.

LES CHAUSSEÉS MODERNS—Per P. Le Gavrian, Ingénieur en Chef des Ponts et Chaussées. Paris: J.-B. Bailliere et Fils. Paper; 6 x 9 in.; pp. 431; half tones and line cuts. Paper, 40 fr.; flexible binding, 50 fr.

MECHANICAL WORLD YEAR BOOK: 1922. Thirty-fifth Year of Publication. All rights reserved. Published by Manchester Emmott & Company, Limited, "Mechanical World" Office, 65 King Street, London, 20 Bedford Street, W. C.

MESSUNG GROSSER GASMENGEN: Anleitung Zur Praktischen Ermittlung Grosser Mengen Von Gas-Und Luft-Strömen in Technischen Betrieben—Von L. Litinsky, Oberingenieur. Leipzig: Otto Spamer. Paper; 7 x 10 in.; pp. 274; illustrated.

THE MODERN CITY AND ITS GOVERNMENT—By William Parr Capes, Secretary New York State Conference of Mayors; Director New York State Bureau of Municipal Information. New York: E. P. Dutton & Co. Cloth; 6 x 9 in.; pp. 269; 15 organization charts. $5.

MODERN GASWORKS PRACTICE.—Second Edition, Entirely Rewritten and Greatly Enlarged. By Alwyne Meade, Assoc. Inst. C. E., Engineer of the Wapping Works of the Commercial Gas Co. London: Benn Brothers, Limited. Cloth; 7 x 10 in.; pp. 815; half tones and line cuts. 55s.

Apparently a thorough-going treatise on British gas works practice. Extensive revision and a 50 per cent increase in size was found necessary by the author to meet the "upheaval" in "gas works methods" that had taken place in the four years since the first edition.

MORTALITY STATISTICS, 1920—Washington, D. C.: Bureau of the Census. Paper; 9 x 12 in.; pp. 112.

NEW YORK STATE DEPARTMENT OF HEALTH, 1920—Report of Division of Sanitary Engineering. Albany, N. Y. Cloth; 6 x 9 in.; pp. 465.

OHIO CONFERENCE ON WATER PURIFICATION, 1921—Columbus, Ohio: State Department of Health. Paper; 6 x 9 in.; pp. 39.

ON CERTAIN OF THE MORE COMPLEX STRESSES DISTRIBUTION IN ENGINEERING MATERIALS—Report of Committee (Prof. E. G. Coker, Chairman) of British Association for the Advancement of Science (Burlington House, Picadilly, London, W.1). Paper; 5 x 8 in., pp. 68; illustrated. 3s.

Nine contributions submitted at the 1921 meeting, including discussions of distribution of stresses in flanged pipe, in cylinders and pipes with eccentric bore, in high-speed disks, in multiple-connected plates, etc., and review of "stress concentrations in theory and practice."

THE PRACTICAL CHEMISTRY OF COAL AND ITS PRODUCTS—By A. E. Findley and R. Wigginton. London: Benn Brothers. Cloth, 6 x 9 in.; pp. 140; illustrated. 12s. net. Based on the laboratory course in fuel technology at Sheffield University England. Designed for chemists at gas works and coke ovens.

PRINCIPLES OF ELECTRICAL ENGINEERING—By William H. Timbie and Vannevar Bush, Associate Professors of Electrical Engineering Massachusetts Institute of Technology. Cloth; 5 x 8 in.; pp. 513; illustrated. New York: John Wiley & Sons. London: Chapman & Hall. $4 net.

A first college course with 500 "live problems"; deals with principles only, except as applications are used for purposes of illustration.

PROCEEDINGS OF THE NATIONAL LIME ASSOCIATION: Nineteenth Annual Convention. Hotel Commodore, New York City. June 15th, 16th and 17th, 1921.

PULLING TOGETHER—By John T. Broderick, with Introduction by Charles P. Steinmetz, Ph.D. Schenectady, N. Y.: Robson & Adee. Cloth; 5 x 8 in. $1.

A short chatty exposition of employee representation in industrial management, written in the form of a dialogue in a Pullman smoking compartment.

QUARRY ACCIDENTS IN THE UNITED STATES—By William W. Adams. Washington, D. C.: Bureau of Mines. Paper; 6 x 9 in.; pp. 66.

RESEARCH LABORATORIES IN INDUSTRIAL ESTABLISHMENTS of the United States, Including Consulting Research Laboratories—Originally Compiled by Alfred D. Flinn, Secretary, Engineering Foundation. Revised and Enlarged by Ruth Cobb, Research Laboratory Information Service, Washington, D. C.: National Research Council of the National Academy of Sciences. Paper; 6 x 10 in.; pp. 135.

SIERRA LEONE GOVERNMENT RAILWAY: General Manager's Report on the Accounts and Working for the Year 1920.

STANDARD SPECIFICATIONS FOR ROAD, BRIDGE AND CULVERT CONSTRUCTION: Edition 1922, Kansas State Highway Commission—Compiled by M. W. Watson, State Highway Engineer, W. V. Buck, Assistant State Highway Engineer, and F. W. Epps, Bridge Engineer. Lawrence, Kansas. Paper; 8 x 11 in.

STATE ENGINEER & SURVEYOR OF NEW YORK: Report for 1919-20—Albany, N. Y. Cloth; 6 x 9 in.; illustrated. Vol. 1: General Report; pp. 221. Vol. 11: Practical Operation of Hinckley Reservoir, by W. B. Landreth and F. Edward Gibson, and Stream Gagings, 1920, by D. H. Daley; pp. 437. ALSO: Stream Gagings for 1919, by Jacob Labishiner; pp. 461.

SURVEY OF NORTHERN AND NORTHWESTERN LAKES—Detroit, Mich.: U. S. Lake Survey Office. Paper; 8 x 10 in.; pp. 464.

THE TRANSITION SPIRAL and Its Introduction to Railway Curves with Field Exercises in Construction and Alignment—By Arthur Lovat Higgins, M.Sc., A.R.C.S., A.M. Inst. C.E., Assistant Lecturer in Engineering in the Victoria University of Manchester, and formerly Assistant to the Professor of Civil Engineering in the Queen's University of Belfast; Author of "The Field Manual." Cloth; 5 x 7 in.; pp. 111. New York: D. Van Nostrand Co. $2.50.

THE TRANSPORT SITUATION IN THE REPUBLIC OF COLUMBIA AND THE TREATY PAYMENTS—By R. W. Hebard, of R. W. Hebard & Co., 40 Rector St., New York City. Paper; 6 x 9 in.; pp. 40; folding map.

An interesting analysis of the engineering work which should be carried out in Columbia. Timely, because of the $25,000,000 payment to be made to that government by the United States in five annual installments. Money will probably be spent in public works.

WISCONSIN STATE BOARD OF HEALTH: Report for 1912-20—Madison, Wis. Paper; 6 x 9 in.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Decries Evasion of Professional Obligations

Sir—The editorial and Mr. Carmiencke's very able letter in your issue of March 30 on the subject of architectural responsibility has brought home to every engineer and architect in this country the vital fact that the architectural profession is now allowing to exist among its membership a condition that will very shortly shake the foundations of the Octagon Building itself, if possible. This condition, however, exists not only among the architects; it has crept very insidiously into the ranks of the engineering profession, also. Yet, the remedy lies close at hand.

Let us analyze briefly this condition and the remedy to be applied. Not every college graduate or technically trained man becomes an engineer or an architect in the private practice of his profession based upon years of accumulated experience and a close study of his work. Rather does he come to this as a last resort, and why? Because as a graduate he accepts at once an offer from some corporation that specializes in some particular engineering or architectural product. His technical training then becomes submerged in the details of some individual specialty, he throws off responsibility as a duck does water and the broad training for which his college or technical school has endeavored to prepare him becomes narrowed to some individual effort of salesmanship.

Or, up from the ranks of the draftsmen, technically trained or otherwise, come a few bold fellows who branching out for themselves with a few of their former employer's clients as a starter soon are involved in a mass of problems, any one of which in our progressive age is a special study. Where does he turn for help? Naturally, to the specialized individual described in the foregoing paragraph, thereby engaging in a practice which is proper to a certain extent only.

Then follows the rapid development of the condition which undoubtedly is responsible for many of our present-day disasters, i.e., the absolute dependence of the so-called architect or engineer with insufficient training and experience upon the sales engineer, fabricating engineer, building product salesman and whatnot, for layouts that should be properly the business of every well trained professional architect or engineer.

In using the term "disaster" I am referring not only to a structural disaster, such as the Knickerbocker catastrophe, but also to the tragedies and abortions of bad architecture, ill-designed commercial and industrial plants, expensively designed layouts and all of the long lists of uneconomically planned structures as well.

Not until the professional architect or engineer studies earnestly each phase of his professional practice and becomes thoroughly familiar with all problems the solution of which is intrusted to him should he assume the responsibility that should properly be borne by him. If he has not sufficiently trained help within his organization, he has always the option of associating with others more experienced along certain lines. This is not uncommon practice among the higher types of professional men.

Relegate to their proper spheres by state license, the contractor with "architect" after his name, the salesman who will design an entire plant in order to sell a grab bucket or belt conveyor, the heating contractor who will give you a free design (expensively equipped) in order to get your inside consideration, and a regiment of other fabricating designers and "designing" contractors to whom the average architect or engineer now delegates more than two-thirds of his proper office work, and then bills his client the regular 3 per cent for "plans and specifications."

The remedy lies close at hand, but depends largely upon the desire of the professions as a whole to raise their own standards above mere commercialism and by co-operation to enact the proper laws to define responsibility so that the public, at least, will know where it rightly belongs. The standards of the two professions have been very high as to ethics and practice. It is up to the coming generations to keep them there.

A. R. JAMES.

Cleveland, Ohio, April 7.

Structural Inspection, Design and Specification

Sir—The writer is much impressed by the very thorough examinations and reports made by the Association of General Contractors and by the American Association of Engineers of the causes of failure of the Knickerbocker Theater. All engineers, arcnitects, contractors, and owners should pay strict attention to the lessons to be learned by such occurrences. This is not the first failure that has occurred recently that has been the direct result of insufficient attention to "engineering detail." Every person connected with the construction of structures of all kinds is "directly responsible" for the work upon which they are engaged. Architects' fees are not adequate compensation when they have to repay the engineer for adequate service on his part and engineers should not be considered a "Strain Sheet Only."

Modern structures of magnitude are largely a matter of structural engineering. This is true of not only the design of the structural framework but of the design and stability of bearing and non-bearing walls, fire-protection, and general adequacy of structures as a whole. Structural engineers with a true "structural sense" are born not made. The conscientious application of all the principles of structural dynamics to all parts of structures is necessary in order to produce structurally safe buildings. Factors of safety are not provided in order to allow for inequalities of design or imperfections in workmanship.

The factor of safety, so called, is necessary to shorten the mathematics of design to a point where the labor involved is not so extended to be impractical. Many structures designed under the ordinary rules of dynamics are barely sufficient for the purposes for which they were designed. Others may safely bear several times their designed carrying capacity. This condition is the direct result of the rules as ordinarily stated not being intended to cover a wide range of possibilities. In all the writer's experience, covering the design and construction of hundreds of structures of all kinds, he has never seen one specification or building regulation that could adequately cover all possible details of all parts of structural design. Indeed if they were to be so drafted they would be far too long, unwieldy, and inadequate, and could not possibly supplant the need for proper and adequate attention to all the features of design and construction.

It is manifestly impossible to write such a document. However, it is just as manifestly possible to prepare and supervise properly all details of construction in a wise and safe manner. This work must be done on all structures to render them safe. Modern history is replete with failures occasioned by inadequate supervision of all work of construction, caused more than a little by the foolhardy stinginess of owners who refuse to pay the right price for the right kind of services. Let all parties realize that the only safe structure is one that is put up "right." And particularly let financial interests note that cheap engineering, cheap architectural services, and inadequately compensated contracting are a mighty poor bargain.

Pittsburgh, Pa., April 3. JOHN A. FERGUSON,
Consulting Engineer.

Reforestation by Utilities Company

A reforestation program that contemplates the setting out of 200,000 white pine and spruce annually has been formulated by the Northern New York Utilities, Inc. The work will be under the direct charge of William Hines, superintendent of the company at Belfort, N. Y John N. Carlisle is president of the company.

NEWS OF THE WEEK

New York, April 20, 1922

Hoover Confers with Trade Association Executives

Offers Facilities of Commerce Department for Distribution of Statistics to Producers and the Public

At the invitation of the Secretary of Commerce about 400 officers of trade associations met in Washington, April 12, to discuss with the Secretary the gathering and distribution of trade statistics. The meeting was held as a result of suggestions made to Mr. Hoover by about 20 associations. The conference resulted in an offer by the Department of Commerce to place its facilities at the disposal of those associations which wished to use it as the instrument for giving publicity to their statistics.

Secretary Hoover in opening the meeting registered again his view of the value of and need for trade associations and enlarged upon their many activities, beneficial to the public, which have not been called into question by the public or by the law officers of the government. He declared that less than twenty per cent of the trade associations have ever gathered statistics, and that the officers of the government do not believe that the functions of open-price associations "are in the public interest whether they are used in violation of the law or not." He pointed out that the membership of associations is predominantly made up of the smaller establishments which are unable through individual action to bring about the favorable conditions that can be developed through trade associations. Big business, on the other hand, "can establish its grades and standards and can employ its own research laboratories. Little business can only hope to be equally informed and to make equal efforts to promote its welfare through trade associations."

AFFIRMATIVE STATEMENT NEEDED

In the discussion by trade-associations officials the expressions on statistical activities were favorable to publicity. There was insistent demand, however, that the government establish some mechanism by which business could know "where it is at." This same need for informing business as to permissible practice was emphasized also in the address made to the conference by Chairman Gaskill of the Federal Trade Commission and by Senator Edge of New Jersey. Chairman Gaskill declared that there must be an affirmative statement of the fundamentals of the competitive system, to replace the present negative declaration, and also means for current interpretation of the laws regulating business. Senator Edge referred to his resolution (introduced in the House by Representative McArthur) calling for a study of trade associations by a congressional commission and looking toward the establishment of mechanism for keeping business informed on the lines within which it may properly operate.

In concluding the meeting Secretary Hoover pointed out that the department had no power to force associations to clear statistics through the government and that it did not propose in any way to put pressure upon the trade associations. If the associations believed that it would be helpful for them to use the facilities of the government, the Department of Commerce stood ready to assist them.

Gen. Goethals Approves Columbia Basin Irrigation Project

The Columbia Basin project, to irrigate nearly 2,000,000 acres of land at a cost of $250,000,000, is approved in a report made by Gen. George W. Goethals, consulting engineer, New York City, to Dan A. Scott, director of conservation and development of the State of Washington. Gen. Goethals recommends a gravity supply from the Pend Oreille River rather than pumping from the Columbia River. He estimates that the gravity project can be carried out in six years, at a total cost of $254,170,351 or $145.56 per acre, and advises that in the interest of ultimate economy the project be executed in its entirety instead of piecemeal.

He advises that the work be undertaken by the federal government, as an independent project like the Panama Canal and the Alaskan Railway, as it is beyond financing by the State of Washington or by the revolving fund of the United States Reclamation Service. Pumping from the Columbia would irrigate less land at a higher acreage cost—$159 to $172 per acre against about $146 for construction and $1.56 to $1.86 against $0.48 for annual operation and maintenance cost.

To Improve Irrigation District

Work which it is estimated will cost in the neighborhood of $10,000,000 is planned by the Merced Irrigation District, California. The work includes the construction of a concrete dam 310 ft. high and 900 ft. long containing approximately 350,000 cu.yd. of concrete. The dam will store 250,000 acre-ft. Construction of diversion intakes and tunnels and a power house of 45,000-hp. capacity is a part of this improvement. The estimates for the power house and dam construction amount to approximately $6,000,000.

Other work planned by the district includes the construction of approximately 100 miles of canals and the installation of several large booster plants, estimated to cost $2,000,000. To make it possible to build the dam and flood the Merced River canyon, it will be necessary to move the Yosemite Valley R.R. from Merced Falls to Detwiler. The estimated cost of this work is approximately $2,000,000.

R. C. Starr, of Thebo, Starr & Anderton, consulting engineers, San Francisco, is chief engineer for the district.

Mississippi River in Flood

As a result of heavy rains in the basins of every tributary of the Mississippi river, an unprecedented volume of water must be carried to the sea between the levee lines which now are unbroken from the Ohio river to the Gulf, with the exception of a seven-mile gap at the Atchafalaya river. The high water in the lower Mississippi is certain to be of more than the usual duration, thereby putting an extra strain on the levees, which have not yet been brought up to the standard prescribed by the Mississippi River Commission.

At Natchez, all records were broken on April 17 when the water reached a stage of 53.8 ft.; the weather bureau predicts that a stage of 54.3 ft. will be reached there. The crest at New Orleans is expected to measure 22.7 ft. which is 0.7 ft. higher than the water ever has risen at that point. The crest of the flood, when it passed Memphis, recorded a stage of 40.7 ft. At Greenville, Miss., the highest reading has been 51.3 ft. At Arkansas City, on April 17, a stage of 57.5 was reached, with the prediction favoring an increase in the flood height.

Heavy Rainfall at Houston

Between the hours of 9 a. m. to 5:30 p. m. on March 25 a rainfall of 7.15 in. was recorded in Houston, Texas. The streets resembled rivers. All street car traffic was suspended during the day and was only resumed after 4:30 p. m. Sewer man-holes in the lower part of the city became gushing springs due to the pressure from the water from the higher portion of the drainage uptown.

Between 12:00 noon and 12:05 0.40 in. of rainfall was recorded. Block pavements were torn up and floated away from the streets on which they were laid. Many basements were filled with water and after the flood, the fire department had to be called to pump water out.

Big Flood in Illinois River

Flood records of the Illinois River seem likely to be broken by the flood of April, 1922, which at some points is reported to have reached the height of the great flood of 1844. After that the highest record was reached in 1916 (see *Engineering News*, March 23, 1916, p. 550). In the present flood several levees have broken, causing the inundation of large areas of farm land and serious damage to early crops. Some of the river towns have suffered severely and on April 17 the river appeared to be still rising.

May Close Engineering College

A. B. Dinwiddie, president of Tulane University, New Orleans, La., announces that the engineering and medical colleges may have to be closed for lack of funds.

Many Exhibits Offered in Cement Trial

Most of Time Consumed in Reading Into the Record Minutes of Association Meetings

Only three witnesses have been examined by the government so far in its case against the cement manufacturers of the Eastern district, trial of whom on a criminal charge began recently before Judge Knox in the Federal Court, New York City. The three witnesses examined are Arthur J. Whipple, former sales manager of the New York metropolitan district for the Alpha Portland Cement Co., Miss Marybelle Phalen, secretary of the Cement Manufacturers Protective Association, and George Howard Elliott, formerly in the sales employ of two of the defendant companies and now vice-president in charge of sales of the Whitehall Cement Manufacturing Co., Cementon, Pa.

Most of the time during the past week has been employed by the government in offering in evidence various correspondence passing between member companies of the protective association and excerpts from the protective association minutes. More than 150 such exhibits have so far been offered. Included in the exhibits are trade-acceptance forms, uniform cost sheets, minutes of the meetings of the credit managers branch of the protective association and of the sales managers branch, a plan covering the protective association organization, its constitution and by-laws, cards upon which members of the association reported data regarding specific job contracts, monthly summaries of contracts, quarterly reports of the association on commitments and cancellations, and freight books used in computing delivery prices.

First Witness

The examination of Mr. Elliott by the government was largely centered about a discussion of the manner in which delivery prices of cement were figured. Mr. Elliott testified that while in charge of sales for one of the defendant companies in the Philadelphia district, he was supplied from the home office the Universal and Lehigh base prices from which, with the aid of a freight-rate book, he supplied a delivered price.

In his cross-examination Mr. Elliott asserted that the company with which he is now associated went through a great deal of trouble in 1920 in securing fuel and transportation. From a usual price of $1.75 to $2.50 a ton at the mine, his company's cost of coal jumped to $10.50 at the mine during 1920. To live up to its contracts the Whitehall company even purchased and remodeled freight cars.

In its examination of Mr. Elliott the defense stressed the difficulties that the cement companies went through in securing fuel, labor, and transportation facilities, and the fact that cement, because of its having to meet standard specifications of manufacture and because of its wide distribution was necessarily a product to be handled mostly by dealers.

In the examination of Miss Phalen, the government sought to make plain to the jury the organization details of the Cement Manufacturers Protective Association, acquaint the jury with individuals attending the protective association meetings, and generally to explain the various forms and blanks circulated by the association to its members for the interchange of trade information.

Examination of individual defendants will probably be undertaken by the government within the next few days.

Illinois Sells $6,000,000 Highway Bonds To Yield 4.11 Per Cent

A block of $6,000,000 20-year serial 4 per cent road bonds was sold by the State of Illinois, April 13. The price was 98⅞, netting $5,932,000, and yielding 4.11 per cent. There were 42 bidders. These bonds are a part of the $60,000,000 authorized by popular vote on Nov. 5, 1918. An earlier installment of $500,000 was sold at 94.02, or a 4.80 to 4.60 basis. The 4,800-mile road system for which the $60,000,000 was voted, and the six months' educational campaign preceding the vote were outlined and commented on editorially in *Engineering News-Record*, Oct. 24, 1918, pp. 740 and 747.

Examination for Chief of Bureau of Health, Philadelphia

A non-assembled examination for the position of chief of the Bureau of Health, Philadelphia, open to non-residents under conditions that would admit engineers and others educated and trained in public health work, is to be held by the Civil Service Commission of Philadelphia. The salary is $4,000 per year. Candidates must submit written applications to the commission by May 5, accompanied by (1) a statement of their training and experience, and (2) a 3,500-word discussion of a practical problem. Those who obtain a rating of 70 per cent in (1) and (2) will be asked to appear for (3) an oral interview on personal fitness. The weights to be given the three heads are 4.5, 3 and 2.5. Full particulars may be obtained from the Philadelphia Civil Service Commission, Room 875, City Hall, Philadelphia.

Let Contracts for Cast-Iron for Hudson Vehicle Tubes

Contracts for the segmental cast-iron rings and steel shields to be used in building the 29½-ft. Hudson River vehicle tunnels have been awarded by Booth & Flinn, Ltd., and the construction of the building to house the compressed-air power plant on the New York side of the work is nearing completion. The shields, six in number, will be built by the Merchant Shipbuilding Corp., of Chester, Pa.

The rings in the twin tubes call for 105,000 tons of cast iron and 10,000 tons of cast steel, the latter to be used at points where the tunnels pass from hard into soft ground. About 60 per cent of the tonnage of metal for the rings will be supplied by the Bethlehem Steel Co., of Bethlehem, Pa., and the remaining 40 per cent by Davies & Thomas of Catasauqua, Pa.

The contractors will use on the Hudson tunnels the air-compressing plant formerly used on the East River tunnels which has just been purchased from The O'Rourke Engineering Construction Co.

Bates Road Tests Pass First Stage

Loaded Trucks Make 1,000 Trips Over Experimental Route of 63 Sections in Illinois

The first 1,000 trips of loaded trucks over the Bates test road in Illinois has resulted in injuries to ten sections of pavement. In the first 1,000 trips the load on each rear wheel was 2,500 lb., or 250 lb. per in. width of tire and on each front wheel was 2,250 lb. or 500 lb. per in. width. With improved weather conditions the second 1,000 trips will be undertaken with rear-wheel loads of 3,500 lb., and front-wheel loads of 2,300 lb.

The trucks make regular trips up one side of the road and back on the other side over the 63 sections comprising the 2-mile test road, at constant speed of 15 miles per hour. By means of guide lines, painted near each side of the pavement, the trucks are held to a straight course such that the center line of travel of the outside rear wheels is 6 in. from the edge of the pavement on all sections except those having macadam bases. On the macadam base sections the first 500 round trips were made with the trucks traveling near the center of the pavement except at passing points. The last 500 trips were made with the center of the wheels traveling at a distance of 18 in. from the edge of the pavement over the macadam base sections. This path of travel will be maintained throughout the remainder of the test.

How Failures Are Determined

In the case of rigid pavements traffic breaks are considered failures when the area of the section broken free from the rest of the pavement is so small that subsequent application of the same wheel load depresses the section, thus causing undue impact on the broken sections as well as on the adjacent pavement. The Bates road tests confirm observations, made on heavy-traffic roads, that such breaks are quickly followed by progressive failure of the adjacent pavement, no doubt on account of the impact which results. On the rigid pavements corner breaks only have occurred.

In the case of the so-called flexible surfaces, such as asphaltic concrete and bituminous-filled brick on a concrete base, failures are recorded when the base becomes broken in the manner previously described.

In the case of the asphaltic concrete and bituminous filled brick sections laid on macadam base, failure is recorded when a sufficiently marked disturbance of the wearing surface occurs as to indicate plainly that subsequent applications of the same load will cause disintegration of surface and base.

Conclusions from the failures so far recorded are uncertain until the full records of the tests have been studied.

Federal Vehicle Registration Proposed in Bill

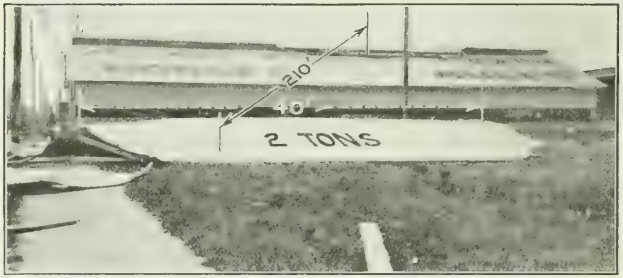
A bill providing for the federal registration of motor vehicles and the payment of a tax of $2 is provided for in a bill introduced in the House of Representatives by Mr. Mills, April 10. The revenue collected would "be used in the construction of post roads."

Tornado Sweeps Through Beaumont, Texas

Sweeping through Beaumont, Tex., in a path barely 200 ft. wide a tornado March 25 had a tendency to expand all of the structures with which it came in contact. It is reported that persons standing within 50 ft. of the path of destruction were in a dead calm. Apparently the balloon shaped "twister" was largely a small vacuum. When the air in a building could find no other outlet toward the vacuum it made one by blowing off a roof or the side of a wall.

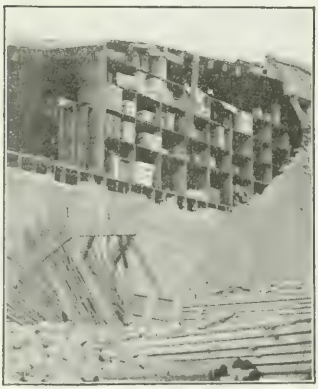
A garage was completely carried away leaving a car untouched standing on jacks. A section of a galvanized roof weighing 2 tons was carried 210 ft. while a barn adjacent with a large vent in the roof 10 ft. in diameter was untouched, a newly added argument to the age-old theory that nature abhors a vacuum.

The path of the tornado paralleled Fannin and Bowie Sts. in a northeasterly direction for thirteen blocks from the Missouri, Kansas & Texas Ry. to the Naches River. A rice mill, grain elevator and hardware building and half a dozen residences were badly damaged by the tornado.









EFFECTS OF TEXAS CYCLONE
(1) Two-ton piece of roof carried 210 ft.
(2) Galvanized roof stripped from rafters.
(3) Collapsed frame building adjacent to untouched metal covered structure.
(4) Brick wall pulled out by vacuum.

Port Bonds Bring Premium

Bids were opened on March 27 at the office of City Manager Ashburnet on the first issue of Norfolk's (Va.) port-development bonds. The issue consisted of $1,250,000 worth of 5 per cent 28-year bonds. They were bought by B. J. Van Ingen & Co., New York City, who submitted the high bid of 105.67.

New Jersey's Road Bond Issue

The bill passed over the veto of the Governor by the New Jersey legislature March 17, as noted in the March 23 issue of this journal, p. 502, provides for the submission of a $40,000,000 highway bond issue to popular vote at the next election in November. The financing plan must be ratified by the voters of the State before it becomes operative.

To Confer on State Parks

A conference in the interests of state park deveoplment will be held at Bear Mountain Inn, Palisades Interstate Park, New York, from May 22 to 25. This is the second conference on this subject, the first having been held in Des Moines, Iowa, January, 1921. The officers of the conference are Hon. John Barton Payne, chairman, formerly Secretary of the Interior; Stephen T. Mather, director, National Park Service, vice-chairman; and Edgar E. Harlan, Des Moines, Iowa, secretary.

Atlanta To Choose Between Three City-Charter Plans

At a special election to be held May 16 the voters of Atlanta, Ga., will vote on three charter plans: (1) An amendment of the present charter, vesting in the city council the powers and duties of all the existing boards except those controlling the sinking fund, library and schools; (2) a mayor, a council of 12 members and 5 directors of administration; (3) a mayor, 12 councilmen and a city manager, the mayor to appoint the manager with the approval of the aldermen and the manager to appoint all department heads except the controller.

Topographic Survey Allotment Is $105,000 Under Budget

(*Washington Correspondence*)

In the Interior Department appropriation bill as finally agreed to in conference, $325,000 is allotted to topographic surveys. This is an increase of $50,000 over the amount carried by the House bill. The budget proposed $430,000 for topographic surveys. An amendment was inserted in the bill in the Senate which provided $400,000 for that purpose. In conference, however, the amount was reduced to $325,000.

The failure to provide adequately for topographic maps in the regular appropriation bill will make it necessary, in the opinion of L. W. Wallace, the executive secretary of the Federated American Engineering Societies, to put additional pressure behind the Temple bill. That measure provides for the completion of the topographic map of the United States within a period of twenty-years. It is estimated that the work will cost $37,200,000.

Muscle Shoals Is Topic of Engineering Discussion

The outlook for the successful commercial operation of Muscle Shoals as a nitrate producer is extremely gloomy according to W. S. Landis, chief technologist of the American Cyanamid Co., in a discussion of Muscle Shoals as a power and nitrate producer at the joint meeting of the New York Section of the American Institute of Electrical Engineers and the Metropolitan Section of the American Society of Mechanical Engineers held in New York City, April 14. Mr. Landis said that the total commercial consumption of ammonium nitrate was about 20,000 tons per year, whereas the Muscle Shoals plant was capable of producing 110,000. As to cyanamid, the commercial consumption of which is 40,000 tons, he said the cost of producing it was much less, for instance, at the Niagara plant of the American Cyanamid Co. than at Muscle Shoals. Production of ammonium sulphate could perhaps be most seriously considered for Muscle Shoals, according to Mr. Landis, but even that product could be secured in sufficient quantities to meet commercial demands as a byproduct of the coking of coal.

Major-Gen. C. C. Williams, Chief of Ordnance, U. S. Army, without special reference to the Muscle Shoals project, asserted that he would like to see the fixation of nitrogen established on such a commercial scale that the government in times of stress would not have to worry about fixed nitrogen for munitions.

Brig.-Gen. Harry Taylor, Assistant Chief of Engineers, U. S. Army, reviewed the history of Muscle Shoals from a power-producing standpoint and indicated the power possibilities of the Tennesse River in the vicinity of Muscle Shoals.

In opening the discussion of the general subject, Francis E. Frothingham of Coffin & Burr, bankers, New York City, made a plea for the acceptance by the government of the offer of the Alabama Power Co. as against the offer made by Henry Ford. He asserted that the licensee of the government in the Muscle Shoals project should be that organization which could develop to the maximum the possibilities of Muscle Shoals to the best interests of the public and he believed that the Alabama company was that organization. He characterized Mr. Ford's offer as wild and visionary and a challenge to all notion of reality.

E. A. Yates of Wood, Hulse & Yates Co., engineers, New York City, whose investigation of power possibilities in the South has covered a period of ten years, asserted that there was plenty of justification for the maximum power development at Muscle Shoals due to the call for heavy service upon existing facilities.

Motion pictures of the Muscle Shoals development were shown.

Metal Fatigue Testing Equipment Deeded to Illinois

Equipment used in the investigation of the fatigue of metals which was loaned to the University of Illinois Engineering Experiment Station some time ago by the Engineering Foundation Board has been given outright to that institution.

Tennessee Highway Department To Be Reorganized

A bill providing for the reorganization of state highway department of Tennessee was signed by the Governor March 24. Under the new act the Governor receives authority to name a highway commission of five members, one of whom shall be a highway engineer who will have the title of state highway commissioner.

New Jersey Water-License Fee To Be Contested by Newark

The validity of the New Jersey statutory requirement providing a license fee of $1 per million gallons on certain excess water diversions for municipal supply is to be contested in the state and if need be the United States courts by the city of Newark, N. J. It appears that the State Board of Conservation and Development has $18,104 of total claims against Newark for water taken from the Pequannock River since 1907.

Plan Test of 12-Mile Oiled Road

Arrangements have been made by the Engineering Experiment Station of the University of Illinois whereby a 12-mile experimental oiled road will be constructed this season.

The purpose of the tests is to determine, if possible, the relative merits of different kinds of road oils; the best method of applying the oil; the annual cost per mile of a well-maintained oiled road; and the number of days per year that an oiled road may be expected to be in good condition. The road chosen for the tests begins at a point about 2 miles northwest of Champaign on the Bloomington road, known as Five Points, and extends north a distance of 12 miles.

The experimental work will be under the supervision of Professors W. M. Wilson and C. C. Wiley, representing the Engineering Experiment Station of the university, and R. F. Fisher, County Superintendent of Highways, representing Champaign County.

Ontario to Investigate Queenston-Chippawa Project

The Ontario Government has appointed a Royal Commission to investigate the Queenston-Chippawa power development scheme of the Hydro-Electric Power Commission. The commission is to consist of Walter D. Gregory, barrister of Toronto, chairman; Michael J. Harvey, civil engineer of Port Credit; Lloyd Harris of the Massey-Harris Co., Brantford; James A. Ross, manufacturer of Toronto; and Robert A. Ross, consulting engineer of Montreal. The commission is given very wide powers including the investigation of all estimates given from time to time in connection with the Chippawa power development, and the reasons for their increase, the total cost of the undertaking completed, the output capacity, the methods of construction, supervision and management, the extent to which the price of power will be affected by the cost of the work, the investigation of any other power development undertaken by the Hydro-Electric Power Commission, and generally all matters of expenditure and administration by that commission.

Dr. Mansfield Merriman Honored by New York Lehigh Club

Nearly three hundred were present at a dinner tendered on April 18 at the Aldine Club, New York, to Dr. Mansfield Merriman, author of many engineering text books and for more than a quarter of a century professor of civil engineering at Lehigh University. Held under the auspices of the Lehigh Club of New York, the dinner offered an opportunity for engineers of every branch of the profession to pay tribute to Dr. Merriman.

Those who spoke represented the many activities which have engaged his interest during a long professional life and expressed their sense of obligation to him as engineer, author, and educator. Lewis D. Rights, president of the club, presided and the formal speakers included Prof. H. S. Jacoby of Cornell University; Prof. Frank P. McKibben of Union College; John R. Freeman, president, Am. Soc. C. E.; Robert Ridgway, vice-president, Am. Soc. C. E.; George H. Pegram, past-president, Am. Soc. C. E., and Walter J. Douglas, consulting engineer. Dr. Merriman addressed "his boys" and was afforded an enthusiastic and affectionate response.

Brief informal tributes were offered by Prof. F. V. Larkin of Lehigh University; Arthur P. Davis, past-president, Am. Soc. C. E.; Prof. Milo S. Ketchum, University of Pennsylvania; Prof. C. S. Fox and Prof. Wm. Esty of Lehigh University; George W. Fuller, consulting engineer, and Willard Chevalier, of *Engineering News-Record*. Letters of felicitation were read from Dr. H. S. Drinker, president of Lehigh University; Dr. C. R. Richards, Prof. A. N. Talbot, University of Illinois; Prof. Ira O. Baker, University of Illinois; Gustav Lindenthal, consulting engineer; Prof. Herman Schneider of the University of Cincinnati and others.

Highway Industries Exhibitors Form Organization

Following the creation of a temporary Exhibitors' Committee at the Good Roads Show held in Chicago in January in connection with the convention of the American Road Builders' Association a permanent organization, to be known as the Highway Industries Exhibitors' Association, has been formed. The following twelve directors have been named:

H. B. Baker, sales manager, Holt Manufacturing Co., Peoria, Ill.; E. L. Benedict, vice-president, National Steel Fabric Co., Pittsburgh; Frank Dunn, president, Dunn Wire Cut Lug Brick Co., Conneaut, Ohio; F. G. Hudson, Western manager, *Engineering News-Record*, Chicago; H. S. Greene, sales manager, Barber-Greene Co., Aurora, Ill.; K. H. Talbot, manager of field service Koehring Co., Milwaukee.

Also, H. R. Snow, manager, Autocar Sales & Service Co., Chicago; S. F. Beatty, vice-president, Austin-Western Road Machinery Co., Chicago; E. O. Wood, vice-president, Russell Grader Manufacturing Co., Minneapolis; C. N. Leet, vice-president, Milwaukee Locomotive Manufacturing Co., Milwaukee; C. B. Fee, manager of road department, Portland Cement Association, Chicago; and J. Hittel, Western manager, Asphalt Association, Chicago.

Commission-Manager Government To Continue at Grand Rapids

By a small majority, the voters of Grand Rapids, Mich., have voted to continue under the present commission-manager form of government.

Wisconsin To Attack Chicago's Use of Drainage Canal

Reports from Madison, Wis., state that the attorney general of Wisconsin is about to bring action before the United States Supreme Court to restrain the State of Illinois and the Sanitary District of Chicago from using 10,000 sec.-ft. of water from Lake Michigan, in defiance of a long-standing order of the Secretary of War reducing the draft there to 4,167 sec.ft. Over two years ago Judge Landis, of the United States District Court, announced that he would enter an injunction against the state and district from drawing the excess water, but no further action has ever been taken.

The State of Wisconsin holds that the excess draft seriously damages the state and other states bordering on the lakes and will endeavor to get the other states to join in the action.

Philadelphia Zoning Commission To Resume Activities

Since the City Council of Philadelphia referred back to the Zoning Commission the proposed ordinance drawn by the latter body with instructions to eliminate the central section of the city from the zoning regulations, the work of the commission has been checked. An ordinance has just been drawn which is said to be acceptable to the City Council and which appropriates $10,000 for hearings, exhibits and the employment of an engineer, at $3,000 a year and assistants. The ordinance contemplates a hundred hearings in public halls through out the city with the use of photographs, lantern slides, and blueprints to explain the zoning ordinance and its effect.

To Study Hydraulics of Channels

An investigation of flow of water in channels has been started by the division of agricultural engineering, U. S. Department of Agriculture, in the Little River Drainage District, Missouri. This results from recognition of the fact that more complete knowledge is needed concerning the amount of water that can be carried by channels built for flood protection under various conditions. The annual loss to agriculture from floods is enormous and many communities are seeking the advice of the Department of Agriculture in regard to flood control and prevention, some of the projects involving very large areas. In many cases it will be necessary to construct large channels to carry off the flood waters and better knowledge is needed concerning how large to make them under the various conditions encountered.

In the Little River project there is a leveed flood channel 200-250 ft. wide by 32 miles long. Studies will be made of rainfall, slope of the channel, conditions retarding flow and the amount of water discharged. The results will be used to work out a formula for the design of such channels.

Baltimore Establishes Street-Width Limits

The Board of Municipal Engineers, Baltimore, has adopted a standard for the width of streets, placing the minimum as 50 ft. between building lines and 114 ft. as the maximum. Plats of developments which must be passed upon by the city will be approved only if they conform to this rule, recently adopted. The 114-ft. streets provide for parking with car tracks in the street center, if necessary.

Engineering Societies

Calendar

Annual Meetings

NATIONAL FIRE PROTECTION ASSOCIATION, Boston, Mass.; Annual Meeting, Atlantic City, May 9-11.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, Philadelphia, May 15-19.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Annual Convention, Salt Lake City, Utah, June 5-7.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Annual Convention, Portsmouth, N. H., June 21-22.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, University of Pittsburgh; Annual Convention, University of Illinois, June 20-23.

The Philadelphia Section, Am. Soc. C. E. will hold its regular meeting May 1 at 8 p.m. at the engineers club. John R. Freeman, president of the American Society of Civil Engineers will give an illustrated talk on engineering and industrial problems in China and the Far East.

The Utah Section, Am. Soc. C. E. has elected the following officers: President, B. W. Matteson; vice-president, H. L. Baldwin; secretary-treasurer, H. S. Kleinschmidt.

Personal Notes

ARTHUR L. MULLERGREN, announces the opening of consulting offices in the Gates Building, Kansas City, and Equitable Trust Building, New York. He will specialize in power plants and public utilities as to design, management and appraisals. He has been associated in Kansas City with W. L. Benham, in the firm of Benham & Mullergren, where he handled the electrical end of the partnership.

LELAND G. MERRILL, city engineer of Parkersburg, West Va., resigned to accept a position with the West Virginia State Highway Commission.

MAURICE H. MANEY, architect of Dorchester, Mass., has been appointed building commissioner of the building department of the City of Boston, by Mayor Curley. Mr. Maney succeeds Herbert A. Wilson, civil engineer of Boston.

F. H. ROOD, formerly assistant engineer of tests of the Pittsburgh Testing Laboratory, has resigned to accept a position as Research Engineer, Office of Public Roads, with headquarters at Harrisburg, Pa.

R. T. BROWN, chief field engineer of the highway department of South Carolina, has tendered his resignation effective May 1. Thereafter he will be associated with J. T. Plott of Greensboro, N. C., in contracting work. AMBROSE HARWELL, former division engineer, will succeed Mr. Brown as chief field engineer.

E. R. CONANT has resigned as town manager of Mansfield, Mass., to become Surveyor of the recently created Highway Department of Manchester, N. H. He has charge of street construction and maintenance, street cleaning, sewer construction and maintenance, and garbage collection and disposal.

CHARLES T. MOLLETT, has recently been appointed building inspector for the City of Stamford, Conn., succeeding Charles Z. Joyce, who resigned to enter the contracting field for himself.

G. E. HEEBINK has been appointed building inspector for Beloit, Wis., succeeding J. G. Marekres, recently resigned.

C. T. FOGLE, formerly in charge of the plant of the American Barytes Corp., Eldon, Mo., has resigned to engage in engineering and contracting with his own organization under the name of the C. T. Fogle Engineering and Construction Co., Jefferson City, Mo.

JULIAN MONTGOMERY, city engineer of Wichita Falls, Tex., for the past two years, has resigned to enter private practice. His assistant, F. M. Rugely, has been appointed city engineer.

ROBERT WHITTTEN, formerly secretary of the New York Committee on the City Plan and of the New York Commission on Building Districts and Restrictions, has opened offices in Cleveland, Ohio, for private practice in city planning and zoning.

J. B. CARSWELL was recently elected president of the Association of Canadian Building and Construction Industries. He received his training as civil engineer at Glasgow (Scotland) University, of which institution he is a graduate. He went to Canada 12 years ago and engaged in general contracting in Montreal. He later joined the engineering staff of the Grand Trunk Railway, following which he represented the firm of Ross, MacDonald & Co., in Ontario, for a period of five years. During this period, Mr. Carswell had under his charge the erection of the Royal Bank Building, the Central Technical School and the new Union Station, etc. At the outbreak of war he became chief engineer of the aviation department of the Imperial Munitions Board. While with the board he built all the flying camps in Canada, using the designing and construction staff of the Carswell Construction Co. of Toronto.

J. T. ELLISON, chief bridge engineer of the Minnesota State Highway Department, has been appointed assistant state highway commissioner by C. M. Babcock, commissioner. Mr. Ellison, who is a graduate of the University of Minnesota and has been with the state highway department for more than a decade, will continue to serve as bridge engineer in addition to his new duties.

EUGENE YOUNG, secretary of the Minneapolis Builders' Exchange, will leave that position May 1 to do special work for the Associated General Contractors of America, in Washington, D. C. He has been connected with the Minneapolis Exchange since its organization sixteen years ago.

J. C. VINCENT, for eighteen years employed by the Twin City Rapid Transit Company as electrical engineer, has been appointed by the Minneapolis City Council hydraulic and electrical engineer to make plans for developing power at the government dam in the Mississippi River between Minneapolis and St. Paul. He will collaborate with the "high dam" engineer of the city of St. Paul in working out a plan by which the water power might best be used for the benefit of the two communities in case the federal government decides to lease it to them.

JOHN H. DENNIS, who has been with the state highway department in Michigan since 1914, has been appointed county engineer of Genesee County, Mich.

E. C. CONSTANTINE, formerly resident engineer for the Thompson-Starrett Co., at Detroit, Mich., has been made a member of the firm of Straley Bros., engineers, Buffalo, N. Y.

FRANK W. BRODERICK has been appointed building inspector for the Bureau of Building, Syracuse, N. Y.

EZRA SHOECRAFT, city engineer of Flint, Mich., since 1913, has tendered his resignation, effective May 1. His successor has not yet been named.

BUSINESS NOTES

THE PENNSYLVANIA PUMP & COMPRESSOR CO. announces the opening of its Chicago office under the management of H. H. Montgomery.

GORDON PATTERSON, who was at one time with the Carbic Mfg. Co. as district manager at Chicago, has returned to the company as district manager of the New York territory. During the war he was assistant to the general manager and secretary of the McDougall-Duluth Shipbuilding Co.

THE SHARON PRESSED STEEL CO. announces the appointment of W. C. Ames as district sales manager in Chicago and Ralph E. Phillips in New York City.

THE AIR REDUCTION SALES CO., New York, announces that it has acquired all the assets, including the patents, trade marks and trade names of the Davis-Bournonville Co., Jersey City, N. J.

OBITUARY

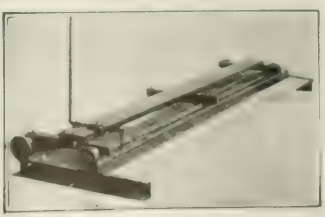
ALEXANDER CRAWFORD CHENOWETH, inventor of the concrete pile which bore his name, died in New York April 13, in his 73rd year. He was educated at RensselaerPolytechnic Institute and in his earlier years was engineer on the Croton aqueduct. Later he became connected with the U. S. Engineer Department in the work around New York harbor. Some fifteen years ago he perfected the Chenoweth concrete pile, which is formed by revolving a concrete covered wire mesh on a mandrel, thus reinforcing the cylindrical section spirally. The same idea he applied later to the manufacture of flexible reinforced-concrete mattresses for river bank protection.

WILLIAM JOHN JACKSON, division engineer of the Minnesota division of the Chicago & Northwestern Ry., died of pneumonia at Winona, Minn., March 13. Mr. Jackson was born at Chicago on Jan. 7, 1873, and after education in the public schools and at the University of Illinois, he began his engineering work in April, 1899, as tapeman on the Chicago & Northwestern Ry. At the time of his death he was division engineer of the Minnesota and Dakota division to which position he was appointed in 1913.

EQUIPMENT AND MATERIALS

Hand-Operated Belt-Float

On many concrete-paving jobs it has been found that a final belting some little time after the pavement has been struck off, tamped, and surfaced, does much to prevent hair cracks and to give a good surface. Time does not allow the finishing machine to go back and do this final belting, and it is primarily for this work that the float-bridge has been developed by the Lakewood Engineering Co., Cleveland, Ohio. The device also gives the contractor doing hand finishing a one-man belting device. An-



other advantage of the float bridge is that it provides a strong bridge across the road, carried on wheels traveling on the side forms, which is easily moved by one man.

The float-bridge, as shown by the view, is exactly what the name implies —a hand-operated belt-float and substantial bridge combined. One man operates the lever which moves the belt back and forth across the pavement, at the same time automatically advancing the machine a little with each stroke. The traction mechanism can be instantly thrown out of gear so that the float-bridge can be pushed forward or backward. The belt can be raised off the pavement and is automatically held up until released.

Unusual Concrete Distributor for Road Work

A batch distributor which travels on the forms, spreads the concrete the full width of the slab and strikes it off to crown has been developed by the Austin Machinery Corp., of Chicago. The machine consists of a trough mounted on a carriage driven by a gas engine. The engine gives the trough a lengthwise reciprocating motion as it travels, shaking the contents down to even level



and keeping them mixed. In operation the trough is charged directly from the mixer spout. It then travels to the place where the concrete is wanted and is dumped by being overturned. This piles the concrete in a ridge across the pavement which is leveled down by the strike board as the machine moves back for a new batch. Use of the machine, it is intended, will do away with bucket and boom and swinging chute distributors now employed on paving mixers.

Out-of-the-Ordinary Trade Publication

Information regarding construction work on 1,000 miles of highway, in the building of which its trucks were used, has been collected by the AUTOCAR CO., Ardmore, Pa., in a sixteen-page booklet, profusely illustrated.

Buckets for dredging and particularly buckets in sizes beyond the ordinary for handling garbage, city refuse and other light material are illustrated in a catalog published by the VULCAN IRON WORKS, Jersey City, N. J. A 5 cu.yd. orange peel for handling refuse attracts especial attention.

The EDDY VALVE CO., of Waterford, N. Y., has put out a new pocket size, cloth bound price list and catalog which supersedes all previous publications.

In a handsomely printed book published by the ROBERT L. STILLSON CO., New York, John K. Mumford tells the story of wire and wire rope under the title of "Outspinning the Spider." The story is that of the Roebling works and their product with an account of the early labors of John A. Roebling and of his first great engineering work, the Brooklyn Bridge.

Artistic illustrations of slate roofs and a score of pages of description, roofing details, slate specifications and estimating data are contained in a handsomely printed pamphlet just published by the VENDOR SLATE CO., Easton, Pa.

Business Side of Construction

Facts and Events that Affect Cost and Volume

How Tariff Bill Affects Construction Material

Would Right House Plan To Base Duties on American Valuation—To Permit President To Modify Rates

In an effort to meet an unprecedented economic situation, the Senate Finance Committee, after nearly nine months of study, has reported out an elastic tariff. Ad valorem rates have been based on the foreign values of imported merchandise. The American valuation plan as embodied in the bill passed by the House was abandoned because of the limited number of exactly comparable domestic and foreign products and the difficulty and probable litigation involved in defining comparability to the satisfaction of importers, domestic manufacturers and customs officials.

Elasticity in the tariff has been provided, the committee believes, by authorizing the President to modify rates within prescribed limits; to change the basis of ad valorem duties on certain items from the foreign value to the value of the domestic article in the American market; to impose penalty duties and prohibit the importation of particular goods; to impose additional duties against any country which discriminates against us.

Items of particular interest to the construction industries carry the following rates:

Roman, portland and other hydraulic cements, in barrels, sacks or other packages, 5c. per 100 lb., including the weight of the barrel or package; in bulk, 4c. per 100 lb.; other cement, not specially provided for, 20 per cent ad valorem.

Plaster rock or gypsum, crude, 25c. per ton; ground or calcined, $1.40 per ton; white non-staining portland cement, 8c. per 100 lb., including the weight of the container; Keene's cement and other cement of which gypsum is the component material of chief value, valued at $14 per ton or less, $3.50 per ton; valued above $14 and not above $20 per ton, $5 per ton; valued above $20 and not above $40 per ton, $10 per ton; valued above $40 per ton, $14.

Freestone, granite, sandstone, limestone, lava, and all other stone suitable for use as monumental or building stone, except marble, breccia, and onyx, not specially provided for, hewn, dressed, or polished, or otherwise manufactured, 50 per cent ad valorem; unmanufactured, or not dressed, hewn, or polished, 15c. per cubic foot. Slates, slate chimney pieces, mantles, slabs for tables, roofing slates, and all other manufactures of slate, not specially provided for, 15 per cent ad valorem.

Beams, girders, joists, angles, channels, car-truck channels, tees, columns and posts, or parts of sections of columns and posts, deck and bulb beams, and building forms, together with all other structural shapes of iron or steel, not assembled, manufactured or advanced beyond hammering, rolling, or casting, seven-twentieths of 1c. per pound; any of the foregoing if machined, drilled, punched, assembled, fitted, fabricated for use or otherwise advanced beyond hammering, rolling or casting, 30 per cent ad valorem; sashes, frames, and building forms, of iron or steel, 40 per cent ad valorem.

(*Continued on p. 673*)

Portland Cement in 1921

Preliminary estimates by the United States Geological Survey, given in the table, show that the production of portland cement in 1921, 98,293,000 bbl. was more than 98 per cent as great as that in 1920, the "record" year. Total shipments in 1921, about 95,051,000 bbl., were nearly 99 per cent of those in 1920.

The stock of finished cement at the mills at the end of 1921, about 11,938,000 bbl., showed an increase over the stock at the end of 1920 of more than 33 per cent. This stock exceeded the average at the end of each of the years 1917 to 1921 by 27 per cent.

The average factory price in bulk at the mills for the whole country was $1.87 per bbl. in 1921, as compared with $2.02 in 1920.

The accompanying tables show by districts the actual production, shipments, value, and stocks of portland cement for 1920, and estimates for 1921.

CEMENT PRODUCED, SHIPPED, AND IN STOCK IN THE UNITED STATES IN 1921 AND 1920

	Production		Shipments		
Commercial District	Quantity (Barrels)	Stock at End of Year (Barrels)	Quantity (Barrels)	Value	Average Factory Price Per Barrel (Excluding Cost of Container)
Lehigh district (eastern Pennsylvania and western New Jersey)	23,648,000	2,818,000	22,933,000	$39,674,090	$1.73
New York	5,295,000	736,000	5,040,000	9,576,000	1.90
Ohio and western Pennsylvania	9,055,000	967,000	8,819,000	15,256,870	1.73
Michigan and northeastern Indiana	6,189,000	806,000	6,099,000	11,039,190	1.81
Illinois and remainder of Indiana	14,939,000	1,859,000	14,413,000	24,213,840	1.68
Maryland, Kentucky, Virginia and West Virginia	4,604,000	490,000	4,482,000	8,202,060	1.83
Alabama, Tennessee and Georgia	4,220,000	312,000	4,097,000	7,948,180	1.94
Iowa, Minnesota and Missouri	10,519,000	1,814,000	9,959,000	17,627,430	1.77
Kansas, Nebraska, Oklahoma and Texas	8,438,000	1,079,000	8,018,000	17,799,960	2.22
Colorado and Utah	1,865,000	204,000	1,626,000	4,254,580	2.33
California	7,073,000	502,000	6,934,000	16,294,900	2.35
Washington, Montana and Oregon	2,448,000	351,000	2,431,000	6,101,810	2.51
1921, Total	98,293,000	11,938,000	95,051,000	177,988,910	1.87
1920, Total	100,023,245	8,941,046	96,311,719	194,439,025	2.02
Percentage of change in 1921	—1.7	+33.5	—1.3	—8.5	—7.4

Figures for 1921 are based to a large extent on reports of producers of cement but in part on estimates and are subject to revision.

How Freights Affect Retail Cost

Freight cost as a consumers' burden has been studied by the Association of Railway Executives, with the result that the average freight cost on all materials and supplies going into a typical 6-room brick house in Philadelphia, to cost $8,300, is shown to amount to $370, or 4½ per cent. The Illinois Central R.R. shows freight costs on all food composing a $1.25 meal at Springfield, Ill., to be 1½c.

Foreign Work Being Done by New York Contractors

In view of a number of inquiries as to which New York contractors are doing foreign work, *Engineering-News Record* has compiled the following data:

Name and Address of Contractor, New York City	Kind of Work	Where Work Is Located	Cost	When Started	When Expected to be Finished	Name of Owner
Foundation Co., 120 Liberty St.	Library	Louvain, Belgium	$1,000,000	March, 1922	1½ years	Louvain University, Louvain, Belgium
Turner Construction Co., 244 Madison Ave.	5-story concrete warehouse 2-story superstructure of pier	Havana, Cuba		March, 1922	About 1 year	Havana Docks Corporation, Havana, Cuba
Snare & Triest, 8 W. 40 St.	Terminal including warehouse and docks	Havana, Cuba	2,000,000	March, 1921	March, 1923	Ward Steamship Co., foot of W. 11 St., New York
Snare & Triest, 8 W. 40 St.	3 concrete piers	Neuivitas, Cuba	1,000,000	March, 1921	March, 1923	North Coast Ry. of Cuba
Stone & Webster, 120 Broadway	Hydro-electric device for generating power for industrial purposes	Mountain region near Tokio, Japan	3,000,000	July, 1921	1½ years	Asano & Co., Tokio, Japan
Geo. A. Fuller, 175—5th Ave.	3 office buildings, modern American type	Tokio, Japan	15,000,000	1½ years ago	October, 1922	Owners' names withheld
Geo. A. Fuller, 175—5th Ave.	1 office building, modern American type	Kobe	Collectively	1½ years ago	October, 1922	Owners' names withheld

Representative Recent Public Bond Sales

Sales of long-term municipal bonds in the United States, for March, 1922, exceed $117,000,000 as against a total slightly over $67,000,000 for February, 1922. Among the important issues of the month were: Missouri, $15,000,000 5s; Detroit, Mich., $14,500,000 4.5@5s; Oklahoma City, Okla., $2,709,000 5s.

Among the most important issues in April are State of Illinois, $6,000,000 4s at 98.875. A new issue of New York City long-term bonds, covering $25,000,000 for dock improvement and $20,000,000 for the Catskill water supply, will be offered on April 25. Following are some representative sales:

REPRESENTATIVE BOND SALES OF MARCH AND APRIL, 1922

State	Purpose	Amount	Maturity	Rate Per Cent	Basis	Net Per	Dated
Illinois.....	Highways	$6,000,000	1929—40	4 4	80@ 4 60	98 875	May 1, 1922
Carbon, Pa.....	Highway	350,000	$175,000—1937 $58,000—1942—47 $59,000—1952	4½	4.25	103 371	Apr 1, 1922
Clermont, Ohio..	Roads	18,000		6		105 02	
Defiance, Ohio....	Roads	86,000	$ 5,000—1923—24 $12,000—1925—26 $13,000—1927—30	5½	5	102 17	Apr 1, 1922
		48,000	$3,000—1923—24 $7,000—1925—30				
Freeborn, Minn...	County ditch	85,000	$5,000—1928—32 $6,000—1933—42	4½	4.67	100 75	Apr 1, 1922
Graham, Ariz....	Highway improvmnt.	500,000	$25,000 yearly— 1923—42	6	5.49	103 75	Mar 1, 1922
Kenton, Ky.....	Rd. & bridge	500,000	1927—50	5	4.58	104 90	Apr 1, 1922
Ohio, Texas	Highway	95,000		5		101 50	
St. Francis Levee Dist. Ark	Levee	121,000		5½	..	101 08	
St. Louis Co., Mont.	Roads	1,500,000	1931	5	4 585	103	Jan 1, 1921
Shelby, Tenn....	Jail	200,000	1932—39	4½	4 68	100 76	Mar 1, 1922
Grafton, Lorain Co., Ohio....	Rd. improvmnt	10,000	1923—32	6	5.57	102 17	Apr 1, 1922
Battle Creek, Ia..	Water mort.	9,000	1930	6		97	Dec. 1, 1921
Bexley, Ohio.	Improvement	77,000	1923—32	6	5 31	100 94	Apr 1, 1921
Burlington, N. J.	Temporary improvmnt	76,000	1928	5	5 01	102 53	Jan 1, 1922
Burlington, Vt...	St. improvmnt.	50,000	1937	4½	4 35	104 53	Apr. 1, 1922
Chapel Hill, N. C	Public imprvmnt.	31,500	$1,000—1925—35 $2,000—1936—45	6	5 83	101 54	Jan 1, 1922
E. Cleveland, O..	Electric lights	12,000		6		105 125	Apr. 1, 1922
Fall River, Mass.	Public imp't.	300,000	$30,000 yearly— 1924—33	4½	4 24	100 06	Apr. 1, 1922
	Sewer	175,000	$6,000—1923—47 $5,000—1948—52	4	3 99	100 06	
	School	125,000	$7,000—1923—27 $6,000—1928—42	4½	4 24	100 06	
	Highway	340,000	$68,000—1923—27	4½	4 48	100 06	
Greensboro, N. C	Sewer & water	180,000	$10,000—1924—33 $20,000—1934—37	5½	5 22	100 38	Apr 1, 1922
Loveland, Wyo.	Paving	75,000		6		101 38	Nov 1, 1922
Memphis, Tenn..	City improvt.	1,250,000	1922—62	4½		101 067	Jan 1, 1922
	Streets	175,000	1923—27	6		101 067	
Minneapolis, Minn.	St. imp't.	948,140	1923—42	4½		98 8996	Nov 1, 1922
Monroe, Penn. Co.	Water works	225,000	$6,500—1927—60 $4,000—1961—71	6	5 73	101 11	May 1, 1922
Orangeburg, S. C	St. imp't.	250,000	1923—42	5		103 78	Mar 1, 1922
Oxford, Ohio....	Water works		$2,000—1941 $3,000—1942—47	6	4 99	104 50	Apr 1, 1922
	Sewer	56,000					
St. Paul, Minn...	Water works	500,000	1952	4½	4 24	104 30	Apr 1, 1922
Schenectady, N. Y	Construct.	47,000	1923—35	4½			
Stamford, Conn.	Public impv't.	150,000	1923—47	4½	4 19	102 47	Apr. 1, 1922
Troy, N. Y.	Park impv't.	100,000	1923—42	4½	4 19	102 47	Apr. 1, 1922
Yonkers, N. Y.	Street impv't.	8,000	1923—27	5	4 19	102 47	Apr. 1, 1922

Large Contracts Let

Among the week's announcements of contracts awarded in Construction News, pp. 1-1 to 1-24, are the following large projects: A subway at Rochester, N. Y., to Scott Bros., Arlington Block, Rome, N. Y., $1,183,000; a hotel at Chicago, to H. Eversen Co., 139 North Clark St., $1,000,000; a hotel at Chicago, to B. W. Cornell Co., 10 South La Salle St., $1,500,000. Baseball Stadium at New York, N. Y., for Amer. League Baseball Club of New York, 226 West 42nd St., stadium, west of River Ave. between East 157 and 161 Sts., to White Construction Co., 95 Madison Ave., $700,000.

How Tariff Bill Affects Construction Materials

(*Continued from preceding page*)

Railway fishplates or splice bars, tie plates, made of iron or steel, one-fourth of 1c. per pound; rail braces, and all other railway bars made of iron or steel, and railway bars made in part of steel, T rails, punched iron or steel flat rails, seven-fortieths of 1c. per lb.

Surveying intruments and parts thereof, philosophical, scientific and laboratory instruments and apparatus, 55 per cent ad valorem. Tracing cloth, 5c. per square yard and 20 per cent ad valorem.

Sawed boards, planks, deals, and other lumber, not further manufactured than sawed, planed and tongued and grooved; clapboards, laths, ship timber, free: Provided, That if there is imported from the United States any of the foregoing lumber, planed on one or more sides and tongued and grooved, manufactured in or exported from any country, dependency, province, or other subdivision of government which imposes a duty upon such lumber exported from the United States, the President may enter into negotiations with such country, dependency, province, or other subdivision of government to secure the removal of such duty, and if such duty is not removed he may by proclamation declare such failure of negotiations, and in such proclamation shall state the facts upon which his action is taken together with the rates imposed, and make declaration that like and equal rates shall be forthwith imposed as hereinafter provided; where upon, and until such duty is removed, there shall be levied, collected, and paid upon such lumber, when imported directly or indirectly from such country, dependency, province, or other subdivision of government, a duty equal to the duty imposed by such country, dependency, province, or other subdivision of government upon such lumber imported from the United States.

Shingles also are on the free list.

Car Surplus, Shortage and Freight Loadings

Reports of the Car Service Division of the American Railway Association show that loading of revenue freight for the week ending March 25, 1922, totaled 846,035 cars, the heaviest loading since the week ending October 29, 1921, and a gain of 22,666 cars over the preceding week. Compared with the corresponding week in 1921, a period of severe industrial depression, the increase is 159,468 cars. The total shows a decrease, however, of 49,351 cars from the same week in 1920.

All districts except the Northwestern made a better showing than in the previous week. That district reports a decrease in all commodities except merchandise, l.c.l., while grain and grain products and forest products each showed a decline of approximately 900 cars compared with the previous week.

In the total for the United States grain, grain products and live stock show a reduction in loadings compared with the week of March 18, but all other commodities show an increase. Coal made the largest gain, or 13,903 cars. Miscellaneous loading was 8,688 cars more than in the preceding week, totaling 268,807 cars, the best record thus far this year.

Serviceable surplus cars totaled 219,483 for the week ending Mar. 23, an increase of [illegible] compared with the previous week. Of this total 87,453 were box cars, 8,764 coal cars and the balance miscellaneous. Coal car surplus increased 5,961 cars from the preceding week while box cars decreased 1,903.

CAR SURPLUS AND SHORTAGE FOR WEEKS ENDING MARCH 16 TO 23, 1922

											—Total All—	

Tennessee Highway Department Wins Rate Case

The suit brought by the Tennessee Highway Department to enjoin the Interstate Commerce Commission from putting into effect an order increasing freight rates on shipments of stone and gravel 25 per cent within the state has been decided in favor of the highway department. The federal judge rendering the decision held that inasmuch as the I. C. C. act of Congress permitted rate reductions on governmental shipments, the commission had no power to prevent a similar reduction when some governmental authority paid the freight. The decision therefore affects only those shipments of stone and gravel which are contracted for by the state at the quarry or pit.

It is estimated that the state will save an average of $3,000 per mile as a result of the decision.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for in Construction News, pp. 181 to 193, are the following:

A church and office building at Chicago, $3,000,000.

An office building at Greensboro, N. C., $1,000,000.

A high school at Columbus, Ohio, $1,200,000.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of April 6; the next, on May 4.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$2.48	$3.35	$4.00	$2.38	$2.66	$3.30	$3.10	$3.25	$3.75
Structural rivets, 100 lb	3.35	3.90	5.50	3.00	3.90	4.45	4.50	3.75	6.50
Reinforcing bars, ¾ in. and larger, 100 lb	2.38	3.25	3.50	2.28	2.56	+3.47½	2.75	3.25	2.75
Steel pipe, black, 2½ to 6 in. lap, discount	61%	61.15%	45%	59½%	61.9–5%	44%	58.8%	53%	30.00
Cast-iron pipe, 6in. and over, ton	47.30	−42.00	48.30	43.10	+48.00	52.00	48.00	51.00	55.00
Concreting Material:									
Cement without bags, bbl	2.40	2.39	2.25	1.97	2.24	2.90	2.73	2.94	2.50
Gravel, ¾ in., cu.yd	1.75	1.85	2.25	2.00	1.50	2.50	2.25	1.50	1.50
Sand, cu.yd	1.00	1.15	2.25	2.00	1.00	1.10	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd	1.75	1.90	2.73	1.60	2.25	3.50	2.25	3.00	2.00
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	48.00	−36.00	33.50	41.00	38.00	34.75	28.00	20.00	47.00
Lime, finishing, hydrated, ton	15.80@16.80	18.00	25.00	18.00	29.00	24.00	22.00	27.00	21.00
Lime common, lump, per bbl	2.75@3.18	1.25	2.50	1.40	1.40	2.70	1.75	2.75	11.00
Common brick, delivered, 1,000	19.40@19.90	9.00	11.15	11.00	15.00	12.00	15.00	14.00	16.00
Hollow building tile, 4x12x12, block	Not used	.07975	.115	.0821	.0752	.08	....	.12	.095
Hollow partition tile 4x12x12, block	.11120	.06525	.115	.0657	....	.10	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal	+.84	+.93	1.09	.90	+.97	1.05	−.94	.86	1.05
Common Labor:									
Common labor, union, hour	.75	.35	.....	.80	.....	.50@.55	.56¼	.50@.60	....
Common labor, non-union, hour	.....	.20	.25	.72½	.40@.50	.35@.40	.47½@.50	.50	.20@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or − signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft lengths or over.

New York quotations are delivered except tiles, which are "on trucks." Common lump lime per 280-lb. net; both lump and hydrated quoted f.o.b. cars New York. Sand gravel and crushed stone are quoted alongside dock. Cement and steel pipe delivered to contractors on job. Gravel ready mixed $2 per cu.yd.

Chicago quotes hydrated lime in 50-lb. bags; common lump line per 180-lb. net.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed store quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars. other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net Lumber prices are to contractors in yards at San Francisco. Lumber price is for No. 1 fir, common.

Seattle quotes on Douglas fir instead of pine. Common lump lime per 180-lb. net Hollow building tile delivered.

Montreal quotes on fir instead of pine. Sand, stone, gravel and lump lime per ton. Lime and tile are delivered; cement, sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 97.85 cents). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net.

Changes Since Last Week

Mill prices of structural shapes and reinforcing bars continues at $1.50 per 100 lb., Pittsburgh, with steel prices generally tending upward. Reinforcing bars quoted in Denver at $3.47½ as against $3.32½ per 100 lb.

Atlanta quotes cast-iron pipe, 6-in., at $42 as against $42.50 per ton, and long leaf yellow pine, base sizes, at $36 as compared with $38 per M. ft. b. m., one week ago; higher prices anticipated in other building materials, particularly hollow tile. Cast-iron pipe quoted in Minneapolis at $48 as against $46.50 per ton.

Raw linseed oil in 5 bbl. lots is quoted at an advance of 1c. in New York, 2c. in Minneapolis and 3c. in Atlanta; decline of 2c. per gal. quoted in San Francisco.

Final settlement in the Cleveland building trades' controversy has been reached. Under date of April 13, 1922, the 1921 wage scale became effective for the balance of the present year.

Carpenters' unions in Rochester have gone on strike, following the employment, by contractors, of non-union workers on several large construction jobs.

Following the example set by union bricklayers recently, the San Francisco plumbers have refused to work with non-union men. In sympathy with this movement against the "American" or open shop plan, the steamfitters, elevator constructors, granite cutters, painters and plasterers are discussing plans for adopting a like policy.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren *Editor*

Volume 88 — NEW YORK, APRIL 27, 1922 — Number 17

Hydro-Electric Records at Niagara

NIAGARA FALLS continues to be the show place of hydro-electric development. Two years ago the record size turbines, 35,000 hp., were installed on the American side; last year, the record passed across the river and international boundary to the 55,000-hp. units of Ontario's Queenston plant, and now the Americans are about to build the largest water wheels ever attempted, the 70,000-hp. reaction turbines for an extension which not only contains these record wheels but is fed by a remarkable siphon tunnel of the largest rock section ever built, with the exception of the huge ship tunnel for the Rove Canal at Marseilles, France. The history of Niagara shows a constant increase of the unit of power from the unit of flow, and in that effort each step forward in hydro-electric knowledge and design has been utilized. So far only the Canadians have gone to the full head utilization, but that, of course, must come on both sides of the border. The next step then will be an international agreement for the use of more water which, as Col. Warren's war-time report pointed out, can be granted with no damage to scenic beauty if proper, and simple, structural precautions are taken to distribute the sheet of water over the crest of the falls. The time will come, and it is not in a hypothetical future, when Niagara, continuing to be the tourist's goal, will be turning into useful work two millions of coalless horsepower.

Municipal Bond Rate Falls

RECENT sales of municipal and state bonds promise well for an increase in construction work. Quite recently, Illinois sold $6,000,000 highway bonds, limited to a 4 per cent interest rate and running from 7 to 18 years, at a yield rate of from 4 to 3.95 + per cent. Of 20 bond sales reported in the New York *Times* for the week ending April 21, seven were offered at 4 to 4½ per cent but 12 sold to yield less than 4½ per cent. Only three of the issues were offered at as high a rate as 6 per cent. These were all county road bonds. In general, a comparison of interest and yield rates indicates that many public officials are limited by law to interest rates higher than the money market demands, or are poorly informed as to money conditions, or fearful of their selling bonds below par.

Cleaning Up the Building Situation

EVEN the man in the street who thinks but little about labor or industrial problems knows that the building industry in this country reeks with the criminality of output restrictions. Yet, even our largest cities have gone along enduring these conditions—giants bound by a system of labor pirates. Yet there is a way out. San Francisco showed it and now, as told in this issue, Chicago is freeing itself from the yoke. It is notable that in neither instance was there a war on the unions. In fact, in the Chicago case such unions as have accepted the Landis award are retained as the medium for negotiation and operation between employer and employee. Only when the unions have refused to accept the award has the trade been classed as "open shop" and the unions been eliminated. What has been done in San Francisco, what is under way in Chicago, can be done in other cities. It requires much courage and the banding together of high-minded citizens who are prepared for a fight to the finish. Such a group of citizens will be assured of public support, even as they were in San Francisco and Chicago. The conditions that obtained in those two cities are duplicated to the same or a less degree in other large cities. The San Francisco and Chicago campaigns should be clarion calls to action.

Contributions from Practice

MANIFOLD opportunities for contributing to the advance of engineering knowledge by observation and experiment occur in the daily course of construction work. There are unsettled questions at almost every stage of engineering enterprise, and the engineer is compelled to dispose of them in his particular application by approximation or compromise. Recognizing clearly that more precise knowledge would be of value, he yet overlooks the fact that he can himself help in obtaining such knowledge by a properly planned bit of incidental research. Broadly speaking every piece of engineering work brings with it opportunities for research of this kind. In our last issue (p. 638) an instance was presented of how the opportunity was utilized, and means were provided at little cost for gathering most valuable data on stress distribution in a skew arch bridge. Facts determined from measurement on actual structures, or what we may call full-size facts, are the ones that inspire the most confidence and have the most direct and lasting influence on engineering practice. If the engineer will turn from the regular course of his professional duties long enough to perceive the unsolved problems contained in his structure, and arrange the tests and observations to throw light on them, his work will develop such facts and thereby will become of lasting benefit to the profession and to the world. We have faith that in time it will become axiomatic that every large engineering work shall be made the occasion also of scientific investigation. When that time comes—we need hardly say it is not yet here—the contributions to knowledge from the field of practice will dominate the field of engineering progress.

The Promise of Genoa

IT IS true that the United States is practically self-sustaining and that it is quite possible for all of us to make a reasonably decent living by doing each other's chores. But it is equally true that we never can enjoy great prosperity unless there exists a market that can absorb the fruits of our excess productive capacity.

For the time being a combination of causes prevents this, so the eyes of American industry are turning toward Genoa as the only agency in sight that can help us. As this is written the news from Genoa is of uncertain portent. By the time this is printed the Genoa conference may have gone up in a puff of smoke. Yet there is much reason to hope that many vexing questions will be ironed out and that, at the very least, a foundation will be laid for a future conference in which the United States may play an important part. To the average American, Genoa seems a long way from home. To the American engineer the interests there represented and the problems there discussed may seem of but remote concern. But this will be changed if he will but remember that until those interests are reassured and those problems solved there can be no adequate market for our surplus products, and that until there is such a market there can be no return of the national prosperity that will stimulate production and encourage expansion. It is to these activities that the engineer and his associates of the constructive industries must look for individual prosperity.

A Distinctive College Magazine

THOSE who have watched the development of the College of Engineering and Commerce of the University of Cincinnati expect from it the unusual. There is always something fresh about Cincinnati's approach to its problems. The same characteristic of distinctiveness is found in the magazine which the students of the college started last fall. The standard form of engineering-college publication is that of a technical magazine. Effort is made, of course, to carry to the alumni and the students a story of recent happenings in the institution, but by and large the distinctive features are technical. Not so with "The Co-operative Engineer," as the Cincinnati magazine is called. It purposes to portray the activities and thinking of the student. It recognizes that they are dealing with technical studies, in training for a technical career, but it appreciates, also, that they are human beings with all of the reactions incident to the glowing period of student days. Consequently student activities come in for a heavier share of attention than would normally be expected in an engineering-college publication. That alone would mark the publication as "different." The chief distinctive feature, however, lies in the effort to have the students record the reactions upon them of this work in the industries (which takes up half of their time). This contact in the hands of men with quick perceptions furnishes much human material.

Data on Truck Loading

TRUCK overloading is the subject of outstanding interest in the analysis of Connecticut's highway traffic census which Prof. J. Gordon McKay of the University of Wisconsin is making and which will shortly appear in these pages. The count made last year on two of the state's trunk-line highways leading from Hartford respectively to New York and Boston showed that every third truck was loaded beyond rated capacity and that overloading occurred with pratcically all types of commodities, thus disproving the belief often expressed that overloading is confined largely to building materials, including sand, stone, brick, cement, and lumber.

In the second Connecticut census, covering the New York traffic, of the total number of trucks loaded in excess of 25,000 lb. gross weight, the state limit, 88 per cent were also overloaded beyond the capacity of the truck. Figures from this census showed, however, that only 51 out of 2,183 trucks, or 2.3 per cent, exceeded the maximum allowable gross weight limit of 25,000 lb. and only 4.2 per cent exceeded in capacity the 5-ton truck. On this basis the 28,000-lb. gross weight limit recommended in the proposed uniform vehicle law would have little effect on present traffic in Connecticut.

The figures go further than capacity overloading and gross weight overloading. In the second census the limit of 800 lb. per inch width of tire was exceeded in 12 per cent of the cases for front axle and 35 per cent for rear axles, the range of overloads running from 800 to 1,500 lb. per inch of width for the front axle, and from 800 to 1,925 lb. for the rear axle.

By far the great majority of body widths are 7 ft. 6 in. or less.

Local conditions must be taken into consideration in applying to other localities such results as were secured in Connecticut. That state has been active in enforcing its motor-vehicle laws, and consequently it might be expected that truck overloading as shown by the census here discussed would be less than in a state where the motor-vehicle law enforcement machinery was practically inoperative.

There have been so many traffic censuses consisting only of numerical counts of vehicles that the Connecticut results and their analysis, involving weights of trucks, sizes, tire widths, type of commodity carried, etc., go a step beyond what has been done before in this country, at least on a large scale. The present analysis does not deal with the ton-mile figures, length of haul and other features involved in a comparison of transport by motor truck and by rail. Possibly this phase of the question will be treated in a supplementary report. On the whole the analysis represents a pioneer effort to furnish specific, instead of general, data upon which to base discussion of highway transport by truck.

California Faces State Ownership

NEXT November the citizens of California have to decide whether they want to plunge headlong into the most stupendous experiment in state socialism this country has ever seen. The majority of those voting can pledge the resources of the state to the amount of $500,000,000 to be expended by five appointees of the government in any way they think "necessary or convenient for the conservation, development, storage and distribution of water, and the generation, transmission and distribution of electric energy." There would be no preliminary trial, no study by authorized experts, no legislative or gubernatorial veto. By virtue of the initiative law, the proposed constitutional amendment, if adopted, is self-executing.

There will be those who seek to prevent so extraordinary and, we think, so dangerous a step by shrieks of "socialism" and "look at Russia." That will not do much good. But the people of California, who by the curious developments of ultra-democracy must now decide this intricate economic question, may well be confronted with what the adoption of the amendment would entail.

They might be asked to look at Ontario, the only other

North American state which conducts a hydro-electric business and see there the pyramiding expenses which have just led a hitherto friendly government to appoint a Royal Commission to study into a Frankenstein power commission which threatens to absorb the province that created it. They might well study their fellow state of North Dakota, led by visions of successful state ownership into near bankruptcy to be saved only by a recall of its radical leaders and a reversion in policy. They may, indeed, be asked to remember the federal adventure in the business of running the railroads, with all the disasters of subservience to labor and overwhelming deficits. And finally they may think of the federal post-war operation of ships. These are actual experiemnts in what California would so hastily try. Do any of them warrant a great state sailing off so lightly into an uncharted political and economic sea?

Possibly the public utilities of California have not been perfect in their attitude to the people. They are very large and very powerful and power breeds overconfidence. But the people of California will not be punishing these utilities by voting to take them over. The public utility business is not so profitable but that its owners could well afford to take the full value the state is obliged to pay for their property and go into some other business with more profit. The ones who will be punished are the taxpayers who will have to pay for the property and who will have to stand by and see an ungoverned commission wield the resources of the entire state.

California has since its earliest days been the home of private initiative. It would mark a decided change in the temper of its people if it were next November to become the first of our American commonwealths to go into the business of generating and marketing water and power. Hazardous as the experiment is it may, if attempted, have one good result—to serve as a warning to the other states on what not to do. That, though, would be poor consolation to the victims—the people or the industries, or both, of California.

Special Privilege Pleads Its Case

IN HIS testimony before the Lockwood Committee in New York Samuel Gompers has voiced an astounding doctrine. The committee is now considering regulation of the building trades unions in which its recent investigation has disclosed vicious and oppressive abuses arising mainly from unscrupulous exploitation of the restrictive powers of the unions.

Mr. Gompers admits the existence of these evils. He deplores them. But he objects vigorously to any effort to correct them through the agency of the law. He believes in legal regulation for trade associations of employers, but not of employees. He believes in wage contracts that will bind employers as to minimum wages but will not bind employees as to maximum wages. Rather than tolerate an appeal to the courts, in a trades union controversy Mr. Gompers would leave its members without redress for wrongs committed against them by their associates. Even though a man should be expelled wrongfully and thereby deprived of a chance to earn a living it were better that the legislature should not "interfere."

Mr. Gompers professes to believe, in effect, that trades unions should be above the law, above the obligations of contract, above the canons of common decency.

This extraordinary position he justifies on the ground that the labor movement is "a rough struggle of the masses to find their way out," whatever that may mean. He would have us deal gently and sympathetically with breakers of wage contracts because we "are dealing with human beings who are benefiting by the competition of contractors." Employers should not be protected against wage-extortion, as this would interfere with "the development of human aspiration to get more out of life." When the community would invoke the law to protect itself against waste, oppression and blackmail, Mr. Gompers blandly admonishes us "to have patience and to bear with the ills we have rather than to fly to others we know not of." Mr. Gompers, in short, invokes the discredited philosophy of 1914. He would have organized labor "hack its way through" wholly wanting in respect for the opinions of mankind and treating its contracts as "scraps of paper."

The welfare and the progress of American labor do not lie along this road. The justification of the trades union is not be found in this doctrine. Fortunately for the American workman there is developing a type of progressive labor leader who is coming more and more to realize that in order to obtain the protection of the law the good citizen submits to its restraint. Employers generally, we believe, will be glad to deal with organized labor that seeks no special privilege but is willing to stand with them on a common platform of lawful rights and lawful obligations.

Proposed Model Drainage District Law

FORTY-EIGHT legislative assemblies constitute as many American experiment stations in legislation and there is an equal number of fields for testing the laws once enacted. The system has advantages and disadvantages. On the one hand it gives a free hand to meet the widely diverse conditions of a country so large and varied in population, geographical, climatic and other conditions as is America. It also affords chance o watch the results of many variations in law principles and methods, and in administrative practice. On the other hand it leads to confusion and conflict, especially as much of the legislation in the various states or the nation is crude, haphazard, governed by matters of temporary expediency and too often framed with ignorance or contemptuous disregard of what has been tried somewhere. Fortunately leaders arise at intervals here and there who realize the need for clear thinking and sound practice based on a careful study of the laws of the various states.

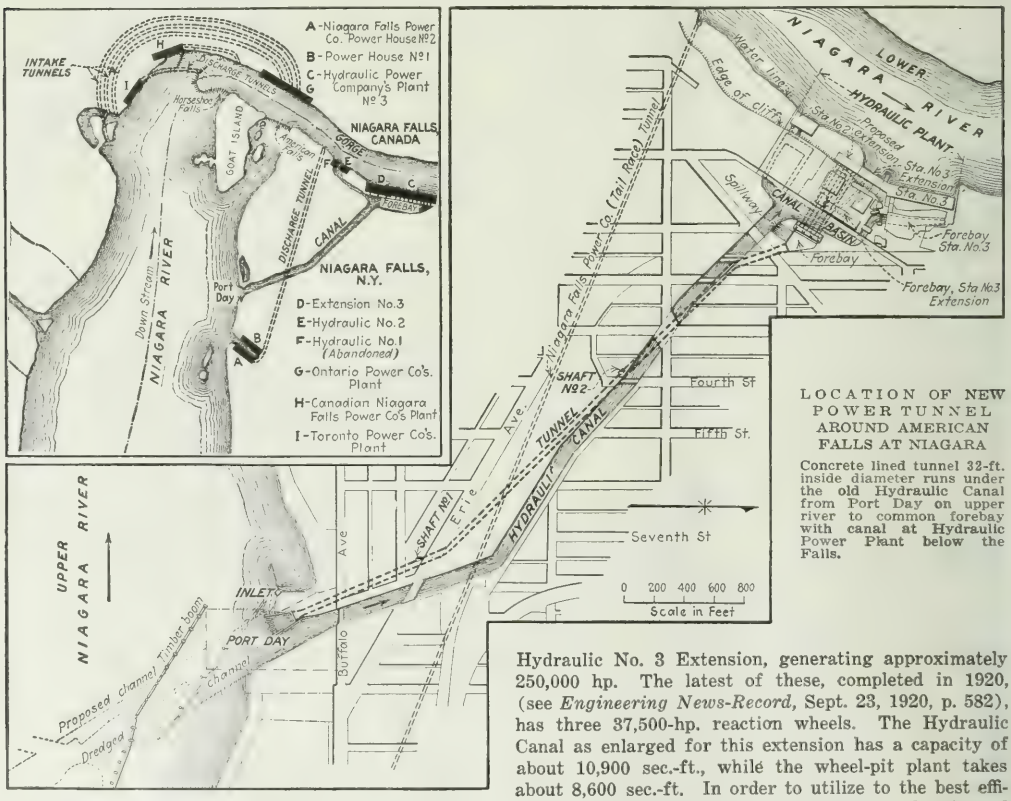
Such a man is Jacob A. Harman. of Illinois, and such a study has resulted in the proposed model state drainage law set forth by him elsewhere in this issue. The law is based on long and varied experience in connection with land drainage and drainage assessments in a number of states. It is notable for its recognition of some of the fundamental principles of representative government that have been quite overlooked in connection with drainage, flood protection, and other joint or district public improvement projects, and also for giving the engineer his logical place and influence.

Mr. Harman's article will repay study, not merely by those concerned with land drainage, but also by all who have to do with the planning and execution of large joint municipal or other district works or are concerned with sound principles of government.

Driving a 32-Ft. Hydraulic Pressure Tunnel Around the American Niagara

Additional Flow of 10,000 Sec.Ft. to Supplement Present Hydraulic Canal—210,000 Hp. in Three Reaction Turbine Units — Full 36-Ft. Width Driven in Heading 18 Ft. High

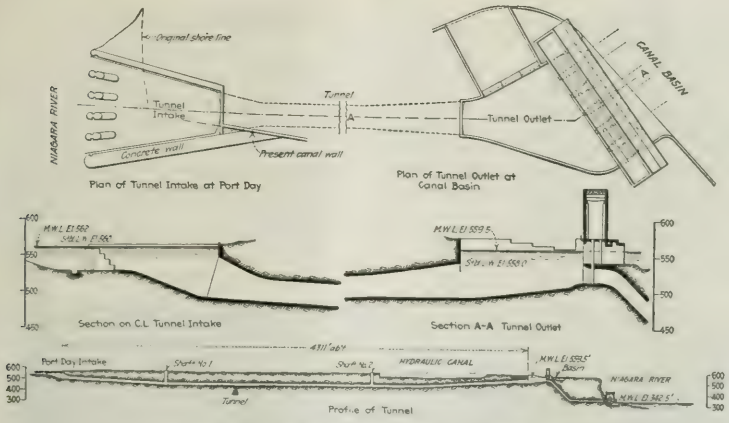
A ROCK tunnel 32 ft. in diameter inside the concrete lining, and 36 ft. inside the rock break line, is being driven for a distance of 4,300 ft. around Niagara Falls on the American side. It is in effect a siphon tunnel dipping down from the level of the upper river to a maximum depth of 130 ft. and rising to practically upper river level again at the forebay of the power plant, an extension of Hydraulic Plant No. 3 of the Niagara Falls Power Co. The flow through the tunnel, 10,000 sec.-ft. is to be utilized to supplement that of the Hydraulic Canal, which the tunnel practically parallels at a lower level, and the additional flow is to be utilized in a new power plant containing three 70,000-hp. reaction turbines, the most powerful water-power units ever built.



LOCATION OF NEW POWER TUNNEL AROUND AMERICAN FALLS AT NIAGARA

Concrete lined tunnel 32-ft. inside diameter runs under the old Hydraulic Canal from Port Day on upper river to common forebay with canal at Hydraulic Power Plant below the Falls.

This tunnel is the first step in the latest development of the power of Niagara by the Niagara Falls Power Co., which is operating under a federal water power license authorizing it to divert 19,500 sec.-ft. from the river. At present this company operates the old Niagara Falls Power Co.'s wheel-pit plant and the group of Hydraulic Power Co. plants below the Falls under a consolidation of the companies which took place during the war. The former plant has a capacity of approximately 115,500 hp. and takes water from the upper river at the power house, dropping it through penstocks to turbines in the wheel-pit from which the water runs in a tunnel to the river just below the Falls. The lower plants are served by the Hydraulic Canal which runs through the city of Niagara Falls from Port Day on the upper river to a forebay on the bluff, about ½ mile below the Falls, whence water is taken through penstocks to riverside power houses. There are here three plants, known as Hydraulic No. 2, Hydraulic No. 3, and Hydraulic No. 3 Extension, generating approximately 250,000 hp. The latest of these, completed in 1920, (see *Engineering News-Record*, Sept. 23, 1920, p. 582), has three 37,500-hp. reaction wheels. The Hydraulic Canal as enlarged for this extension has a capacity of about 10,900 sec.-ft., while the wheel-pit plant takes about 8,600 sec.-ft. In order to utilize to the best efficiency the 19,500 sec.-ft. permitted by the federal license, the company decided to relegate the wheel-pit plant, where the power production is only about 12 hp. per second foot, to a standby status and to build another lower river plant where, with modern machinery, about 22 hp. per sec. foot can be developed under the 217-ft. head available. To obtain the additional flow through the existing Hydraulic Canal would have required a substantial enlargement, which meant either additional property for lateral expansion or extensive dredging for deepening. After comparative analysis, the pressure



PROFILE OF NIAGARA POWER TUNNEL

tunnel, largely within the property already owned by the company, was selected as more economical than canal enlargement.

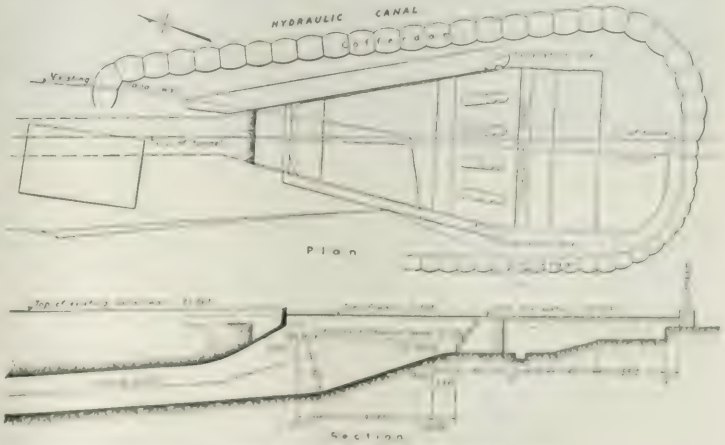
This tunnel has a capacity of at least 10,000 sec.-ft. Its inlet is alongside the inlet of the Hydraulic Canal at a mean water elevation of +562 (U. S. Lake Survey datum; adjusted levels of 1903). It descends on a 5.5 per cent grade for about 950 ft. to a level 2,300 ft. long (bottom elevation +437.0). It then rises on a 6 per cent grade to the forebay (mean water elevation +559.5). In plan the tunnel follows closely the line of the canal, the exact line being shown on the accompanying map.

In section the tunnel has a semi-circular arch and trapezoidal base with rounded corners. Inside the concrete lining (18 in. in the base and 24 in. in the arch) the maximum dimension each way is 32 ft., giving a cross-section of 875 sq.ft. The rock break is about 36 ft. in diameter, making it one of the largest rock tunnels on record. The concrete lining is not reinforced, except for the arch ribs used to hold the rock, as described hereinafter.

The intake consists of a spreading mouth cut into the rock bottom of the river and controlled by concrete side walls and gate piers in which are placed slots for future shut-off gates. The arch portal of the tunnel here is a built-up concrete structure extending a short distance beyond the rock face of the tunnel opening. The exit of the tunnel is an open forebay cut in the rock just back of the present forebay basin and opening into that basin so that the forebay of the joint power plant will be filled from both tunnel and canal. Across the forebay is the gate house controlling the entrance to three penstocks, which are 21-ft. circular concrete lined tunnels driven through the rock of the cliff on a 45-deg. downward slope to a practically level (2 per cent grade) tunnel leading to the river edge power house, where each tunnel leads water to a 70,000-hp. turbine. Tailwater elevation is +342.5 (mean). This power house will be next to and connected with the existing power-house structures of the company.

Construction is being attacked from both ends of the tunnel and from two shafts. At the upper river the intake is being built behind a coffer-dam and the tunnel carried through to just beyond the portal. From each of the shafts, located as shown on the map, at about the third points on the tunnel, the section is being carried in both directions and at the lower end the forebay is being dug, the natural rock barrier being left between the new and old forebay and the tunnel heading being carried backward from the new excavation. On the river edge the power-house foundations are being built and the headings for the penstocks are being driven along the horizontal tunnel section and upward to the forebay.

One of the views shows the work at the intake and one of the drawings the details of the protective work there. An inclosing coffer-dam of the cellular sheetpile type made familiar in the raising of the battleship "Maine" is built around the entire intake structure. This dam, of 14-in. x ⅜-in. arch web Lackawanna steel sheetpiles, is driven into the limestone rock of the Niagara district in about 10 to 26 ft. of water and filled by dumping in river sand and gravel brought down by scows from Buffalo. This filling is to be removed later by pumping. Inside the coffer-dam the area was laid dry and rock excavation to grade made in the open. Here, also, were built the guide walls and the gate piers shown in the drawing. Seamy rock was encountered at the portal of the tunnel and extensive grouting opera



INTAKE DETAILS AT UPPER RIVER

tions through pipes entirely surrounding the intake area were required in order to keep the water down.

At the lower end the forebay excavation was made over an area about 270 ft. long and 180 ft. wide, steam shovels on crawler treads dumping into trucks which took out the spoil on an inclined roadway running out of the excavation.

The tunnel is being carried through in both directions from each of the shafts with an advance heading of the full arch and a following bench of the full trapezoidal base section. Shaft No. 2 was carried down in full section clear to the sump chamber below the tunnel bottom grade. Shaft No. 1 was carried only to arch bottom grade, and the heading started from that level. The heading is made for the full arch section, that is a semi-circle of 18-ft. radius. Jackhamer drills are mounted by twos and three on columns, of extra heavy 3-in. wrought-iron pipe, braced between roof and floor and the operators work from platforms on the columns. About ten drills are used for each heading and 80 holes averaging 10 ft. in depth are drilled to a round.

Men are working in two 9-hr. shifts, with an hour for lunch, an hour for dinner, and two hours between shifts. The day crew does the drilling, the heading is shot at 4:30 p.m., and the night crew does the mucking. Advance is being made at the rate of about 9 ft. per day, around 180 yd. in place and 350 yd. broken rock per heading.

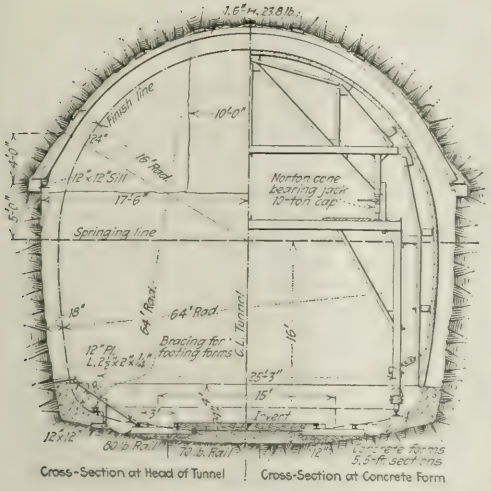
The roof is being held with special steel arch ribs with timber lagging as shown in one of the views and in one of the drawings. As the heading is driven a bench is left along the side on which are placed longitudinal 12 x 12-in. sills as seats for the steel arch ribs. These ribs come in three sections and are made of 6-in. 23.8-lb. H-beams bent to the arch curve, and are spaced about 4 ft. on centers. These ribs are carried up close to the face and swung in place with gin poles in about ½ hr. without any other than man power. Lagging consists of 3 x 8-in. timbers extending over three ribs. At every sixth rib is an opening left to the rock face as a space for the bulkhead of the concrete forms.

Narrow-gage track extends from the shaft up to a switch with two tracks at the heading and spoil is carried away from the heading in 4-yd. cars drawn by electric locomotives. These cars are loaded at the heading by compressed-air driven shovels with ¾-yd. buckets traveling on crawler treads. These shovels have a maximum 360-deg. swing. Their mobility, due to the crawler tread, permits them to readily reach any part of the face. After the arch is carried through the entire length the remaining bench will be carried through in one operation.



AT THE HEADING OF THE 32-FT. POWER TUNNEL AROUND NIAGARA FALLS

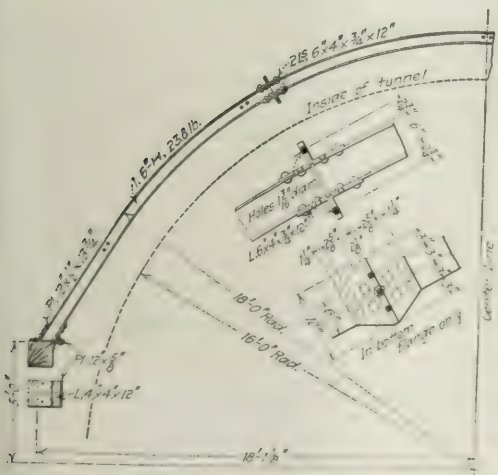
Jackhamer drills mounted on columns braced between top and bottom of section. Entire 18 x 32-ft. section shot at once.



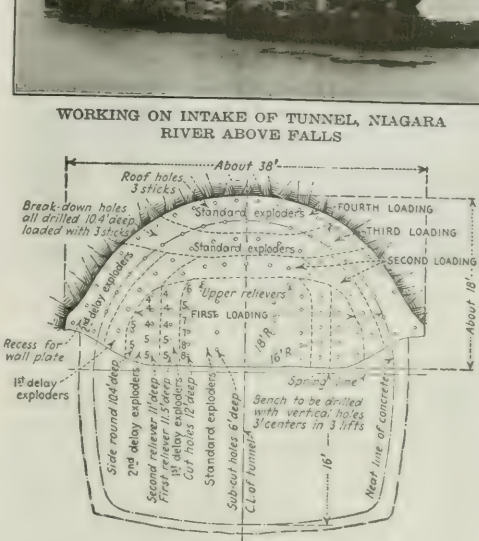
CROSS-SECTION OF TUNNEL SHOWING OUTLINE OF CONCRETE FORMS

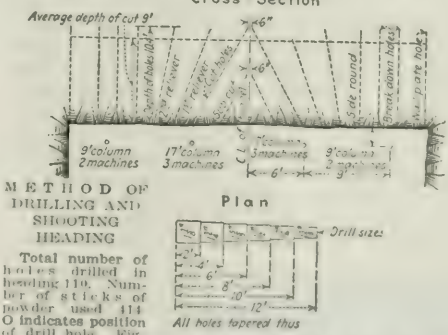


WORKING ON INTAKE OF TUNNEL, NIAGARA RIVER ABOVE FALLS



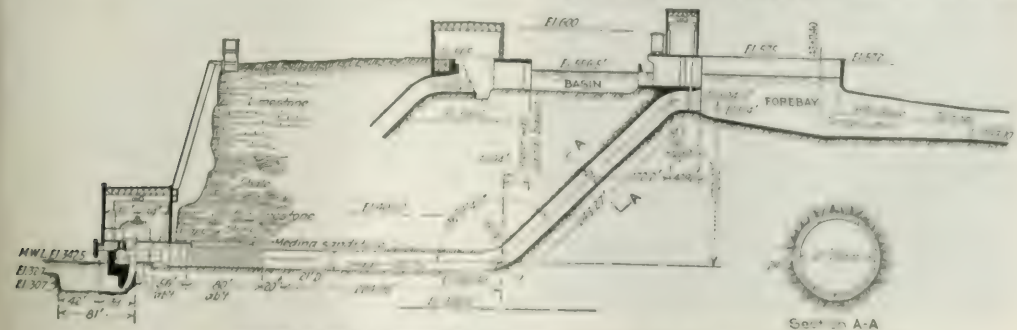
DETAIL OF RIBS FOR ROOF SUPPORTS OF TUNNEL



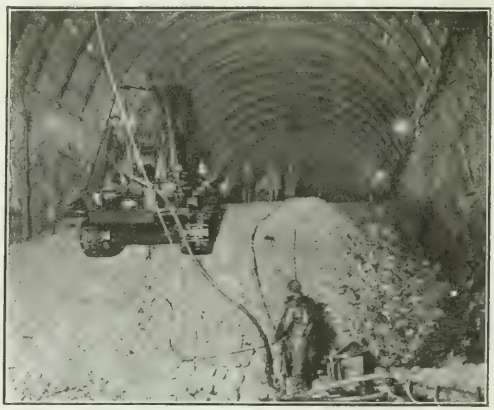


METHOD OF DRILLING AND SHOOTING HEADING

Total number of holes drilled in heading 119. Number of sticks of powder used 414. O indicates position of drill hole. Figures near holes indicate number of sticks of powder used. 3 sticks of powder used in holes not marked. Powder containing an exploder is counted as 1 stick. Powder data: Size 1¼ x 8 in. Strength 60%. Pounds per stick 0.51.



POWER-HOUSE LAYOUT OF LATEST NIAGARA DEVELOPMENT

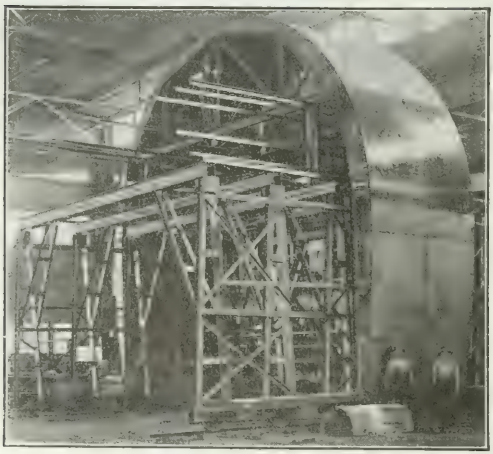


STEAM SHOVEL CRAWLING UP SLOPE BETWEEN BENCH AND HEADING
Note arch ribs and lagging in the arch in the background.

Compressed air for operating the rock drills, drill sharpeners, hoists, shovels, pumps, etc., is furnished by three batteries of compressors, each battery consisting of two 200-hp. electrically driven units. Air aftercoolers are connected between the compressors and air receivers, and in some cases air reheaters are also used. Pump and drainage equipment is as follows: Inlet—two 12-in. pumps, two 10-in. pumps and one 6-in. pump. Shaft No. 1—One 4-in. discharge 500-gal. per min. pump. Shaft No. 2 discharges through drainage tunnel into tailrace tunnel of Niagara Plant. Outlet—one 10-in. pump working and space for one 10-in. additional. There is some water in the Niagara limestone formation here, but the conditions were not unusually severe.

The drilling diagram with data regarding blasting is shown in the right-hand column of page 681.

Concrete lining will be placed behind movable forms of the type shown in the view and one of the cross-sections of the tunnel, although this work has not yet started. These forms, made by the Blaw-Knox Co. of Pittsburgh, are 25 ft. long and travel on rails set on sills at the bottom of the tunnel. Their design and operation can be readily understood from the cross-section.



FULL SECTION OF CONCRETE LINING FORMS SET UP IN SHOP

The penstock is being driven in heading and bottom bench from the lower level. When the upslope is reached the section is carried through in a lower heading, in size 7 ft. high by 14 ft. wide, and the upper part of the arch broken down later, allowing the rock to fall down the slope into a hopper at the bottom, where it is loaded into 8-yd. cars which take it out to the river edge and where it is dumped alongside the bank.

The work was started in the spring of 1921. At present the intake work is well along toward completion, the tunnel is 40 per cent completed, and the penstocks 35 per cent completed. Work has not started on the gate-house structure.

The new work at Niagara Falls is being carried on by the Niagara Falls Power Co., of which John L. Harper is vice-president and chief engineer. Construction work is under the direction of O. D. Dales, construction engineer, and the contract for the entire construction is held by the Read-Coddington Engineering Co. of Niagara Falls.

How To Develop Water in Pre-Glacial Valleys

Abstract of paper presented to Illinois Section, American Waterworks Association, by W. D. P. Warren, Consulting Engineer, Decatur, Ill.

KEEPING in mind the fundamental principles governing the development of a shallow ground water supply (water shed area, rainfall, run-off, percolation and storage available) and realizing the relation to these factors of the deposits in the pre-glacial valley, the methods of development may be summarized as follows:

1. An examination of the extent of all possible watershed areas within reasonable distances should be made. As a rough rule, a city of 2,000 population can economically develop a well supply at a distance of not over 5 miles, while a city of 50,000 might economically develop a well supply 15 to 20 miles away, depending upon the availability of natural reservoir sites relative elevation and cost of land.

2. An examination of well records, test holes, borings and other data in the territory under consideration should be made. Such records can often be secured from coal, oil or gas companies, local well drillers and, in Illinois, through the State Geological Survey. Some such records are confidential but the portion relating to the depth of the glacial drift usually is not so held, and can generally be secured for use in the investigation of a municipal supply.

3. A thorough study of all available records with a view to determining the dip of the rock or shale at the base of glacial drifts in the location of a pre-glacial valley is essential. This study should be made before the location of any additional drill holes is considered. Often the elevation disclosed by the records of two or three old holes will indicate the direction of the pre-glacial valley. Further investigation should definitely establish the boundaries of the valley.

4. The location of test holes should be made in accordance with the foregoing data and these test holes should furnish sufficient additional data upon which to determine the possibilities of any sites under consideration.

5. When the complete data as to the fundamental principle are before one, the conclusion can then be reached as to the value of such a supply compared with a surface supply.

Status of Federal-Aid Road Funds

To the end of February, 1922, Congress has appropriated $339,875,000 as federal aid for road building in the several states. Of this amount the sum of $214,723,000 has been set aside to pay for work already undertaken.

Plain Concrete Sewer Acts as Beam After Washout

By Orrin E. Stanley
Sewer Engineer, Portland, Ore.

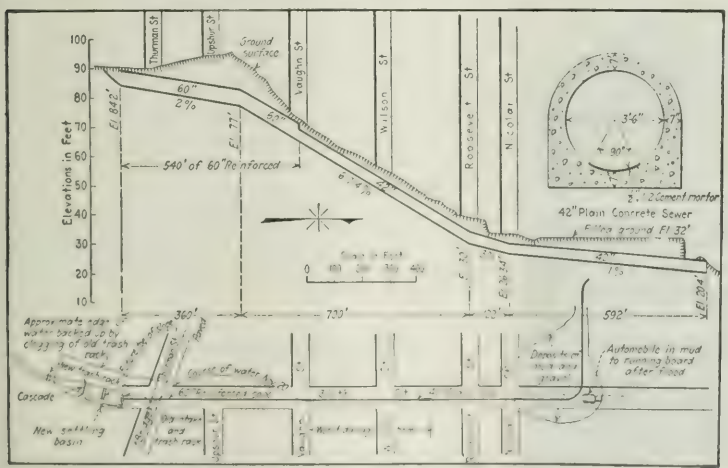
A MONOLITHIC concrete sewer in Portland 42 in. in diameter, with 7-in. walls, left unsupported for a length of 40 ft. by having the earth washed from under it by a recent freshet, remained practically true to line and grade, and stood without cracking until temporary supports could be placed under it a day or two later. A 50-ft. span of the same cross-section cracked at the middle and ends of the suspended section and leaked through the middle crack at the bottom of the sewer.

The washout which exposed the sewer and carried away the supporting material occurred Nov. 20, 1921. About 4 in. of water had fallen in the three days' storm. Throughout the forenoon and early afternoon of Nov. 20 the rain froze as it fell, coating everything heavily with ice. In the middle of the afternoon the rain increased in intensity and was accompanied by a marked rise in temperature, melting the accumulation of ice, and adding its volume to the rain which was falling. This caused a flood condition in the drainage area of 1,400 acres tributary to the sewer, so the trash rack at the inlet was completely clogged with debris brought down by the freshet. The rapidly rising water sought out the old bed of the creek and followed it around the high point of ground at the end of Upshur St. to the newly filled trench at Vaughn St., where it poured down a 7 per cent slope and rapidly cut away the comparatively soft material from around and under the sewer.

The Balch Gulch storm sewer at Portland, Ore., which withstood this severe test so successfully, is essentially a long culvert, having no manholes in its entire length of 1,774 ft. It was built in the summer of 1921 and carries the water of Balch Gulch from the toe of the slope of a future fill in Thurman St. to the west edge of filled ground west of 31st St. and north of Nicolai St. Here it empties into the old creek which meanders over the flat lands to the Willamette River approximately a mile distant. Owing to the undeveloped state of the drainage district, as well as the low value of the lands which must be traversed by this sewer when built, it was decided to construct only this short section at this time. From Vaughn St. to the outlet the sewer follows the line of an old flume which was installed to care for the water of the creek when its bed was filled several years ago. In some places the bottom of the concrete sewer rested on gravel fill above the old bed of the stream. This loose material was easily washed out, leaving the sewer resting only upon occasional points of rock and hard clay.

Early the morning following the freshet men were sent to open the intake and let the water again flow through the sewer. After this had been accomplished, the work of placing temporary cribbing under the longest spans was begun and permanent repairs were soon started. Concrete piers 1 ft. thick, extending the full width of the sewer, were built every 10 ft. for a distance of 350 ft. These varied in height from 1 to 5 ft. Their footings, which were 2 ft. wide, were carried down to hard material. The cracks in the barrel of the sewer were covered with heavy collars of concrete.

A "settling basin" protected on the sides with plank walls, was constructed above the intake. This basin is 33 ft. wide and 100 ft. long. It has a comparatively flat slope, and the water falls into it over a cascade built of planks spiked to long stakes driven in the creek bed. At the lower end of the basin, where the grade is steeper for about 20 ft., the bottom is protected by a plank floor. An additional trash rack was built across the basin 50 ft. from the old one at the end of the sewer, and a third one was placed 200 ft. farther up the creek This upper screen has its bars spaced 8 in. apart.



PLAN, PROFILE AND SECTION OF SEWER WASHED OUT AT PORTLAND, ORE.

The 60-in. reinforced-concrete sewer and most of the 42-in. plain concrete sewer were undamaged, and but little damage was done to the latter, although two stretches of it were left without support. The only streets paved are Sherman, Wilson west of 30th, Nicolai, and (planked only) 30th Street, north of Nicolai.

This caused a flood condition in the drainage area of 1,400 acres tributary to the sewer, so the trash rack at the inlet was completely clogged with debris brought down by the freshet. The rapidly rising water sought out the old bed of the creek and followed it around the high point of ground at the end of Upshur St. to the newly filled trench at Vaughn St., where it poured down a 7 per cent slope and rapidly cut away the comparatively soft material from around and under the sewer.

More than 3,000 cu.yd. of material were required to backfill the washed-out gully. This was replaced by teams at a cost of 65c. a yard. The clearing of the pavement was done by force account teams and all other work was done by the Bureau of Maintenance of the City of Portland under the supervision of O. Laurgaard, city engineer. The total cost of labor and materials on the job exceeded $6,000.

Licensing Laws in Sixteen States

The following sixteen states have enacted engineering license laws, according to a compilation just issued by the American Association of Engineers: Arizona, Colorado, Florida, Indiana, Iowa, Louisiana, Michigan, Minnesota, New Jersey, New York, North Carolina Oregon, Pennsylvania, Tennessee, Virginia, and West Virginia. The foregoing information is correct as of Feb. 22, 1922.

FROM JOB AND OFFICE

Hints That Cut Costs and Time — *For Contractor and Average Engineer*

Protection of Tanks Saves Gasoline From Evaporation

BY R. Z. KIRKPATRICK
Chief Hydrographer, Panama Canal

LOSS FROM evaporation of gasoline in large storage tanks in the Panama Canal Zone was reduced practically two-thirds by encircling the tanks with corrugated iron and corrugated asbestos.

In the accompanying view is seen the type of protection given the new 220,000-gal. gasoline storage tanks. The tanks are 40 ft. in diameter and 24 ft. high and are connected by pipe lines to and from oil cribs for taking gasoline from tankers or delivery to ships. When the tanks were unprotected it was found by a test taken



COVERING REDUCED GASOLINE LOSS TWO-THIRDS

over an average of thirty days that there was a loss of 25 gal. per day through volatilization. The first attempt to reduce this loss led to painting the tank white and protecting it at the top by the hood shown in the view. Such protection reduced the volatilization 20 per cent.

Later the two lower petticoats were added, cutting the actual evaporation losses to 8¼ gal. per day. The upper petticoat and the hood were made of corrugated asbestos and the two lower petticoats of corrugated iron.

Multiple Steel Slabs For Large Column Bases

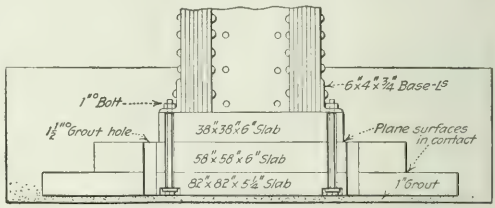
BY EUGENE W. STERN
Consulting Engineer, New York City

A COLUMN BASE which I have been using in my practice for some time past consists of layers of rolled-steel slabs, one on top of the other. All surfaces coming in contact are of course planed.

For light loads a single slab can be used, and this has been the practice among some designers, but the usual method to increase the spread of the footing under heavy loads has been to place steel grillage beams under this slab.

The reason for discarding my grillage type of column base (shown in *Engineering News*, May 23, 1912, p. 984), is that the rolled slabs are cheaper and take up much less depth. The latter is an important consideration where rock excavation is necessary for footings.

The drawing shows a base 82 in. square, as built, supporting a column having a load of 3,400 tons. The



HEAVY COLUMN BASE OF STEEL SLABS

foundation is hard rock. If this base were properly made of grillage beams, it would cost almost double. As compared with steel castings, the slabs are cheaper and more dependable.

As regards the method of calculation, I will leave this to the mathematical experts to enlighten us. I myself believe that in the case of an unyielding foundation the cantilever method is perfectly safe with 16,000 lb. per sq.in. unit stress.

Three-Point-Problem Applied to Transit Surveys

BY J. R. JAHN
Williams and Jahn, Consulting Engineers, Berkeley, Cal.

THE THREE-POINT PROBLEM has been used in the field for years by plane-table topographers as a means of locating on the map the position in the field occupied by the instrument. For them the graphical solution is satisfactory and convenient. Among surveyors who use the transit the problem has had but slight use due to the involved mathematical processes that would ordinarily be substituted for the graphical method of the plane table. The writer has been using the three-point principle in transit surveys for years and believes that others will be interested in its application.

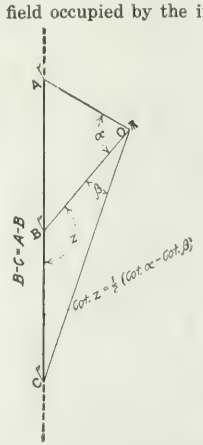


FIG. 1. CASE I. FLAGS ON STRAIGHT LINE

The advantages of the three-point problem method are: (1) The saving of time in traversing and measuring back-bearings and, (2) the greater accuracy in rough country which results from the substitution of an accurate instrument and a trained instrument man for the usual method

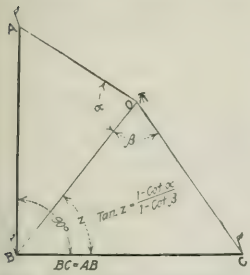


FIG. 2. CASE II. FLAGS ON RIGHT-ANGLED LINES

of measuring distance by tape. The method is not adapted to subdivisional work although it may be used there as a check by reading angles at traverse points.

The general problem.—For the general problem, three signals must be located in the field with respect to the survey. The transit, when set up at any point within range can measure the horizontal angles subtended between pairs of these signals, two pairs being sufficient. The bearing of one of the signals is then computed from the known data after which all the necessary elements are known for finding the length of the line connecting the transit point with one of the signals. This ties the transit point into the survey. The problem may be so modified that it can be used to determine the bearing of the line between signal and transit before the topographical field work commences, i.e., there are special cases of the general problem that simplify the process of orienting the instrument.

Modification of general problem.—Two such methods of arranging the signals are shown in Figs. 1 and 2. In Fig. 1 (case I) the flags are set equidistant on a straight line of known bearing and in Fig. 2 (case II) at the corners of a right triangle having equal legs also of known bearing. The transit is set up at any other convenient point and the two inner angles are read. The surveyor then calculates the angle z by the use of one of the following formulas:

$$\text{Case I} \quad \cot z = \frac{1}{2}(\cot \alpha - \cot \beta)$$

$$\text{Case II} \quad \tan z = \frac{1 - \cot \alpha}{1 - \cot \beta}$$

in which α and β are the two observed angles and z, the angle OBC. The bearing of OB is found by applying the angle z to the bearing of BC. The transit may then be oriented and the bearings of field points read on the horizontal circle at once. If the line BC be set on the meridian, the angle z will be the bearing of OB or its supplement.

Rules of sign.—Certain rules of signs must be followed. If an observed angle lies between 90 deg. and 180 deg., its cotangent is negative and equal to cot (180° — the angle). In case I if the expression $\frac{1}{2}(\cot \alpha - \cot \beta)$ is negative then z is greater than 90 deg. In case II the quadrant between courses AB and BC is positive in sign and if the fraction is positive, the line OB or its extension lies within it. If either α or β is read on the backs of the angle, their signs are opposite the normal value. The needle bearings of OA, OB, and OC should be read to give a natural check on the calculated results. The solution will be impossible if the point O lies (case I) on the line ABC or (case II) on the circumference of the circumscribing circle.

To locate the transit position for mapping, the length of OB must be calculated. If the length of the line BC is known, the length of OB can be calculated from the sine formula

$$OB = \frac{BC \sin (z + \beta)}{\sin \beta}$$

For consistent work the datum for elevations should be carried up to the transit by leveling methods and the HI of the instrument read from a turning point or bench mark. However, where the accuracy of the survey allows vertical angles may be read on a fixed target of known or assumed elevation on one of the signals and the HI calculated, using the formula: Difference of elevation = calculated distance × tangent of vertical angle. This error will be 0.3 ft. per 1,000 ft. for each minute of error in reading the vertical angle.

Explanation of general case.—The general case (Fig. 3) in which the signals do not have the relation of length and bearing as in Figs. 1 and 2 can be solved by determining the bearing of the closing line of a five-sided traverse consisting of the two known courses AB and BC, the two courses AB cot α and BC cot β, and the unknown side. The latter is a line whose longitude and latitude differences equal the algebraic sum of the longitude and latitude differences of the four known courses. The bearing of the line OB is at right angles to this closing line.

The explanation and proof of this general case is apparent from a study of Fig. 3.

The circumferences of the two circles are the loci of all points at which the courses AB and BC subtend the angles α and β, respectively; and the intersection at O of the two circles is the only point which can satisfy the given conditions.

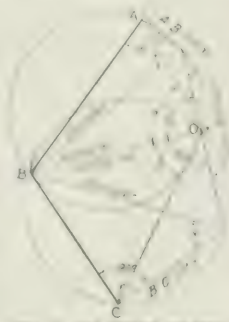


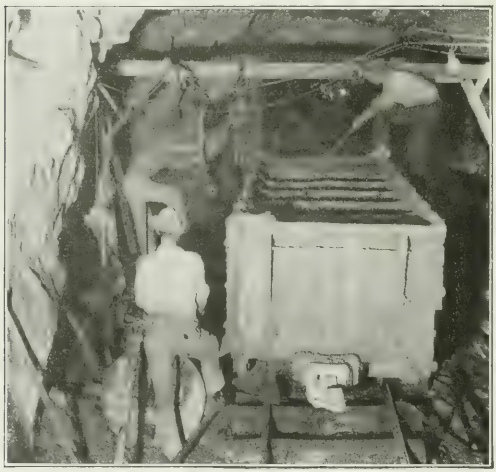
FIG. 3. SOLUTION OF THE GENERAL PROBLEM

Ingenuity is a big asset

in engineering-construction work. The office engineer or construction foreman who possesses it and capitalizes it is a valued employee. A man may have an ingenious idea as to the performance of a certain piece of work, but unless the idea is expressed concretely, put to work as it were, it is valueless. The setting forth of new ways of doing work both in the office and on the job is the function of these pages. If the unique method you have devised is worthy of your employer's consideration, it will be worthy of ours. We will be glad to receive manuscripts specially designated as "Job and Office" possibilities.——*Editor.*

Movable Hopper Saves Time in Loading Concrete Cars

IN DELIVERING CONCRETE to the pneumatic gun used for placing lining in the Kern Canyon tunnel, engineers of the San Joaquin Light & Power Corp., designed a movable hopper which materially speeded up the work by making it unnecessary for the electric locomotive to spot cars accurately at the point where they were loaded. The hopper and the cars were very similar in size and arrangement, both having six 11-cu.ft. compartments. The hopper, however, had only

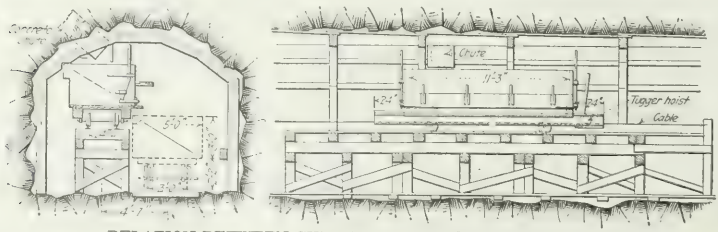


CONCRETE BEING DELIVERED FROM CAR TO GUN
Rear end of gun is seen in lower left foreground

one gate; when this was tripped all compartments discharged simultaneously. The cars were provided with a separate gate on each compartment.

The motive power for the hopper was a small Tugger air hoist mounted on the hopper body and operating a cable wound several times around the drum of the hoist and deadened at both ends of the elevated track on which the hopper moved. A single Tugger served for operation in both directions.

The advantage of this arrangement was that the movable hopper could move along beneath the discharge end of the chute and thus get a uniform loading of all compartments. When the delivery car arrived on the track below, the hopper could be spotted quickly and accurately by an operator who tripped the single door, filling all compartments of the car. The car could then be taken into the tunnel and the 11-cu.ft. batches delivered, one at a time, to the gun.



RELATION BETWEEN CHUTE, HOPPER AND DELIVERY CAR

FROM JOB AND OFFICE

Hints That Cut Costs and Time

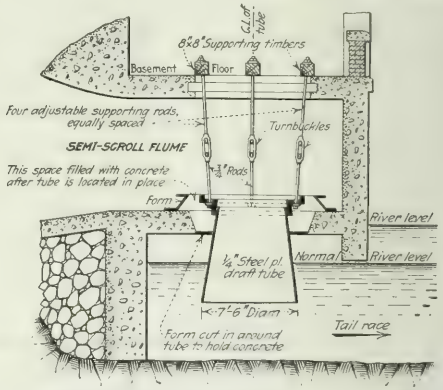
Draft Tubes Hung by Turnbuckle Rods While Concreted in Place

BY HARLAN M. BRYANT
Milton, New Hampshire

DURING the construction of a reinforced-concrete hydro-electric plant, one of the problems that had to be solved was the setting of the draft tubes. Instead of the curved concrete draft tubes used of late, the owners decided to use the older type of plain steel-plate tube riveted to the cast-iron curb ring under the wheel case. It was first planned to cast this piece into the flume bottom when that was poured.

It happened, however, that the manufacturer could not ship the draft tubes until long after the flumes were to be cast. The plans of the flumes were then altered to leave a beveled hole through which the draft tubes could be lowered and concreted in whenever convenient.

The erection men were confronted with an awkward situation in supporting the draft tube while it was being concreted in place; a situation complicated by the fact that the work had to be done when the river was in



METHOD USED FOR SETTING DRAFT TUBES

flood. The water filled the tailrace and even partly entered the flumes, making work from below the flume impossible.

The scheme occurred to the writer of hanging the draft tubes from the floor above. The arrangement shown in the sketch indicates the conditions met, and the solution. After the tube was hung as shown it could be leveled as a transit is leveled, by using the turnbuckles as one would use leveling screws on a transit.

Eight ¾-in. iron rods were cut to suitable lengths and threaded to take the turnbuckles and nuts on the ends. These four adjustable supports were hung from 8-in. x 8-in. timbers laid across the hole so as to come over the quarter points of the draft tube. It was evident that, if instead of

FROM JOB AND OFFICE

For Contractor and Average Engineer

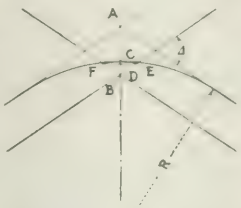
being vertical the rods sloped outward, the tube remained immobile the better. Before the rods were placed the draft tube was lowered into the pit by a crane. The weight was taken off the crane by putting in the rods and taking up the turnbuckles until they carried the load. The chain falls of the crane was then unhooked and moved out of the way. With the turnbuckles the draft tube could be placed to exact grade. It was centered in the pit by shifting the supporting timbers on the floor above.

We had center lines scribed on the concrete floor over the flumes and plumbed down from a straight edge laid out over the hole. When the tube was hanging about in the correct position the forms were dropped in around it and wedged tight. These forms held the tube from swaying with the waves in the tailrace so that it was set quite closely. The hole was then filled with concrete, care being taken to disturb the tube as little as possible. After the concrete was poured but before it set the tube was trued up.

Extreme care was necessary in this last operation as the cast-iron top of the draft tube must be level in order to make the waterwheel and generator shafting line up properly. It was done by laying a straight-edge across the machined part of the curb ring. A machinist's level then showed when the tube was properly trued up.

Solving a Slip-Switch Track Problem

HOW TO DETERMINE the proper curve for a slip-switch connection between two railway tracks intersecting at a flat angle was a problem recently presented by a correspondent. This problem was submitted to W. C. Armstrong, chief engineer of the St. Paul Union Depot Co., St. Paul, Minn., who sent in three solutions, the first of which was worked out by him and the others by G. H. Wilsey, structural engineer for the company. Lack of space permits only the printing of Mr. Armstrong's solution, as follows:



In the diagram let:

R = radius of curve required

g = gage of track

Δ = angle of crossing

D = short diagonal of diamond $A\,B$ $= \dfrac{g}{\cos \frac{1}{2}\Delta}$

E = external secant $A\,C$, $= \sqrt{R^2 \tan^2 \frac{1}{2}\Delta + R^2} - R$

C = chord joining intersection points E and F $= \dfrac{g \cos \frac{1}{2}\Delta}{\sin \Delta}$

M = middle ordinate to the chord $E\,F$ $= R - \sqrt{R^2 - \frac{1}{4}C^2} = R - \sqrt{R^2 - \dfrac{g^2 \cos^2 \frac{1}{2}\Delta}{4 \sin^2 \Delta}}$

Then $E + M = \frac{3}{4}D$

Or $\sqrt{R^2 \tan^2 \frac{1}{2}\Delta + R^2} - R + R - \sqrt{R^2 - \dfrac{g^2 \cos^2 \frac{1}{2}\Delta}{4 \sin^2 \Delta}} = \dfrac{3g}{4 \cos \frac{1}{2}\Delta}$

Which is reduced as follows:

$$R\sqrt{\tan^2 \tfrac{1}{2}\Delta + 1} - \sqrt{R^2 - \frac{g^2 \cos^2 \frac{1}{2}\Delta}{4 \sin^2 \Delta}} = \frac{3g}{4 \cos \frac{1}{2}\Delta}$$

$$\frac{R}{\cos \frac{1}{2}\Delta} - \sqrt{R^2 - \frac{g^2}{8(1 - \cos \Delta)}} = \frac{3g}{4 \cos \frac{1}{2}\Delta}$$

and

$$-\sqrt{R^2 - \frac{g^2}{8(1 - \cos \Delta)}} = \frac{3g - 4R}{4 \cos \frac{1}{2}\Delta}$$

$$R^2 - \frac{g^2}{8(1 - \cos \Delta)} = \frac{9g^2 - 24gR + 16R^2}{16 \cos^2 \frac{1}{2}\Delta}$$

$$\frac{8R^2(1 - \cos \Delta) - g^2}{8(1 - \cos \Delta)} = \frac{9g^2 - 24gR + 16R^2}{8(1 + \cos \Delta)}$$

$$8R^2(1 - \cos^2 \Delta) - g^2(1 + \cos \Delta) = 9g^2(1 - \cos \Delta) - 24gR(1 - \cos \Delta) + 16R^2(1 - \cos \Delta)$$

$$R^2(-8 + 16 \cos \Delta - 8 \cos^2 \Delta) + 24gR(1 - \cos \Delta) - 10g^2 + 8g^2 \cos \Delta = 0$$

$$R^2(4 - 8 \cos \Delta + 4 \cos^2 \Delta) - 12gR(1 - \cos \Delta) + 5g^2 - 4g^2 \cos \Delta = 0$$

$$4R^2(1 - \cos \Delta)^2 - 12gR(1 - \cos \Delta) + g^2(5 - 4 \cos \Delta) = 0$$

$$R^2 - \frac{3gR(1 - \cos \Delta)}{(1 - \cos \Delta)^2} = -\frac{g^2(5 - 4 \cos \Delta)}{4(1 - \cos \Delta)^2}$$

$$R^2 - \frac{3gR}{1 - \cos \Delta} = -\frac{g^2(5 - 4 \cos \Delta)}{4(1 - \cos \Delta)^2}$$

$$R^2 - \frac{3gR}{1 - \cos \Delta} + \frac{9g^2}{4(1 - \cos \Delta)^2} = g^2 \frac{1 + \cos \Delta}{(1 - \cos \Delta)^2}$$

$$R - \frac{3g}{2(1 - \cos \Delta)} = g \frac{\sqrt{1 + \cos \Delta}}{1 - \cos \Delta}$$

$$R = \frac{3g}{2(1 - \cos \Delta)} + g \frac{\sqrt{1 + \cos \Delta}}{(1 - \cos \Delta)}$$

$$R = g \frac{3 + 2\sqrt{1 + \cos \Delta}}{1 - \cos \Delta}$$

For $\Delta = 15$ deg. on standard gage, $R = 802$ ft. $= 7$ deg. 9 min. curve.

Nomographic Chart for Cross-Sectioning

BY C. P. MOWRY

Morford and Mowry Engineering Co., Seattle, Wash.

THE accompanying monographic chart, designed by the writer, gives the volumes of earthwork for varying lengths of stations and sums of end areas, with an accuracy sufficient for most purposes and with a minimum of eye-strain on the part of the user.

The method of use is given below the chart. Results are more easily read from this or any other chart of this type, when employing a transparent strip of celluloid with a hair line scratched upon its lower surface. This method permits of more readily reading results as no part of the scale is hidden and interpolations are more accurately estimated.

The chart may be quickly constructed in the following manner: Draw three parallel lines spaced equidistant and intersected near the left ends by a fourth line, which may be conveniently drawn at right angles to the other three, although this is not essential. Commencing at the intersecting line at the left, lay off the logarithms of the sum of the end areas on the upper line, and upon the lower line the logarithms of length

of station. These are both to be plotted to the same scale, that is, the length of the logarithmic unit must be the same for both. On the original of the accompanying chart, this unit was made 5 in. long, using the scale of 20 ft. to an inch.

A chart properly constructed will give correct solutions of the formula,

$$V = SL/54 = 0.0185\ SL$$

Where,

S = sum of end areas in square feet;

L = length of station or distance between sections in feet;

V = volume in cubic yards.

Upon the middle line lay out the scale of volumes in cubic yards, using a logarithmic unit of half the length of the other two scales. On the original of the chart this unit was made $2\frac{1}{2}$ in. long, using the scale of 40 ft. to an inch. In laying out this scale the position must be so adjusted that log 0.0185, which is the reciprocal of 54, will fall upon the intersecting line passing through the indices of the other two scales.

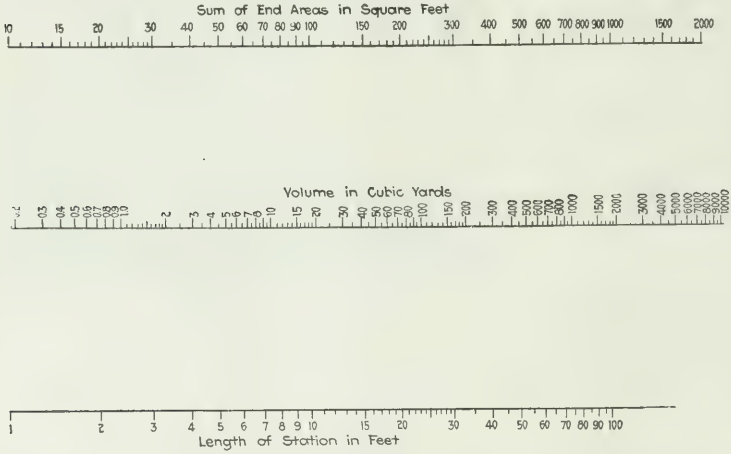


CHART FOR VOLUMES BY METHOD OF AVERAGE END AREAS

Method—Using straight-edge, or transparent celluloid having line scratched thereon, place so that edge or line coincides with "sum of end areas" on upper scale and also with "length of station" on lower scale. Read "Volume" on center scale at intersection with edge or line.

Gravel Trucks Dump From Traveling Turntable

ON GRAVEL-ROAD construction in Iowa in 1921 the speed in unloading trucks was increased by a job-devised turntable mounted on a carriage. Coming from the pit Ford trucks ran up the inclined track (Fig. 1) onto a turntable mounted as shown by Fig. 2, where they were turned through an angle of 180 deg. and then dumped through the platform. When dumped, the trucks already headed in the proper direction shot down the incline on their way back to the pit. The turntable was rotated by power. It took only a few seconds to turn the truck.

Besides acting as a turntable the device directed the spacing of the loads and, by dragging the rear cross-beam of the frame over the dumped piles, cut down their peaks and, in a measure, spread the gravel. All truck-loads were of equal volume. When a load had been dumped the operator of the table stuck the looped rod shown in Fig. 2, into the ground, making a mark. The machine was then run ahead until the pointer, shown under the operator's seat, was directly over the mark. The table was then in position to receive another truck-load.

The machine was made on the job, using two wheels from a Fordson tractor, two Ford truck wheels, a Ford engine and radiator, some I-beams for a frame, and transmission mechanism fashioned of parts readily picked up about a garage and a second-hand dealer's warehouse.

The builder was William Roorda, of Roorda Bros., Cherokee County, Iowa, highway contractors.

FROM JOB AND OFFICE

Hints That Cut Costs and Time

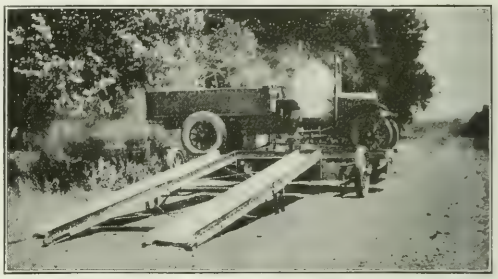


FIG. 1. TRUCK RUNS UP INCLINE TO TURNTABLE

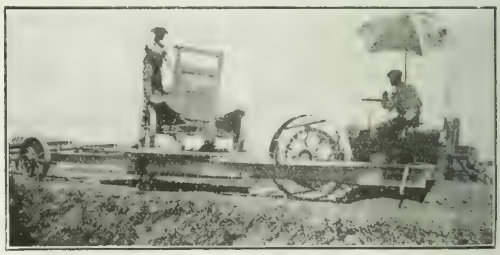


FIG. 2. TRACTION TURNTABLE SPACES LOADS

British Construction Costs Decline

(London Correspondence)

The latest average tenders for the construction of dwellings under the British government scheme show that a house costs £496 as against £888 in October, 1920.

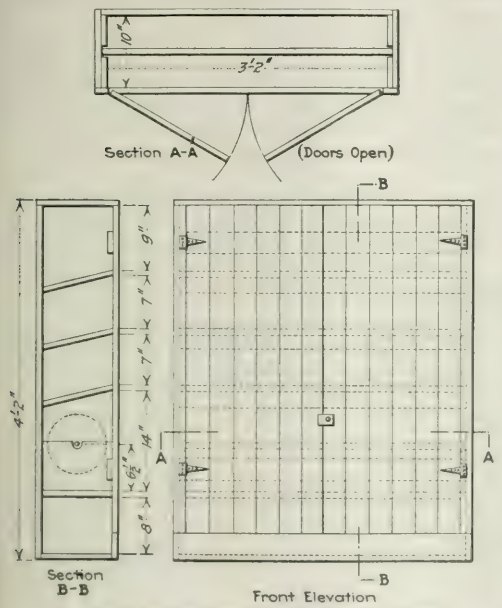
FROM JOB AND OFFICE

For Contractor and Average Engineer

Wood Cabinet for Drafting Supplies

By Arthur M. Shaw
Consulting Engineer, New Orleans, La.

IN THE accompanying sketch is shown a case which I have found convenient for use on construction jobs where it is frequently difficult to obtain a suitable container for drafting supplies such as detail paper,



DETAILS OF DRAFTING SUPPLIES CABINET

tracing cloth, etc. It can be made in a few hours by a carpenter and ordinary dressed lumber can be used. It should be made wide enough for the largest-size sheets of paper employed.

It is not necessary to remove any of the rolls in order to take off the required amount. The loose end is pulled out the required length and the finger is run over the paper on the square edge of the shelf, leaving a mark for cutting. A ten-cent paring knife is suspended by a string on the inside of one of the doors and is used for cutting the paper.

The 50-yd. roll of detail paper is mounted on a roller.

Measuring Tape Marked in the Field

By Kenneth S. Dodd
Liverpool, England

IT WAS recently found necessary to drop anchors in the River Mersey, in England, at certain points which had to be located accurately with reference to the end of a pier. A length of steel wire was used to give the distance from the pier to the position of the anchor. At the shore end, where the wire ran over a pulley, a weight was attached to give a constant tension and dip. The length of wire necessary was measured on shore by hanging the wire between two points the required distance apart, one end being fixed.

The problem was to mark the wire in such a way that it would stand rough usage.

Strips of thin tin-plate were cut out and bent around the wire. They were coated on their inner surfaces with a layer of "Tinol" (a paste which appears to consist of ground-up solder and a flux). The flame of a match supplied sufficient heat to melt the Tinol, and it was found that the strips of tin showed no tendency to loosen even though the wire received rough handling.

Heavy Penstock Part Lowered Down Incline on Cradle

AS described in *Engineering News-Record*, March 23, p. 472, the penstock for the recently-completed Caribou hydro-electric plant in California is for a part of its length a steel pipe on an incline and in a shaft. All material was brought to the site on the upper level approximately 1,500 ft. above the power house, and lowered down the 68 deg. narrow-gage incline built between the upper and lower levels. The accompanying view shows how a 17-ton piece of the penstock was handled. A feature of this lateral pipe is the cast-steel elbow on the top side of the 60-in. pipe, to which is riveted a 42-in. section. The entire piece thus reduces a 60-in. penstock to two 42-in. penstocks.

The piece is shown just entering a 500-ft. shaft into which all penstock lines are built. The piece here shown was lowered in place on a small rigid truck consisting of four 12-in. wheels connected by a frame made of extra heavy wrought-iron pipe. A double set of shackles—one fastened to the truck and one fastened to the penstock—was used to lower the piece into position. A plow-steel cable, 1½ in. diam. connected to a powerful slow-speed hoist was used for the work of lowering.



LOWERING A 17-TON PENSTOCK PART ON A CRADLE

Bascule Door for Airship Hangars Built in France

SINCE the World War commercial aviation has gained considerable impetus among the countries of Europe. The construction of airdromes, therefore, has become somewhat of a problem in its technical details and not the least of these is the provision of doors which will allow maximum utilization of entrance and exit space. There has recently been constructed at the airdrome of Villacoublay near Paris, says a recent issue of *Le Génie Civil*, four hangars measuring 35 m. in length and 30 m. in depth (inside measurement). The height of these hangars is 8½ m. from floor level to the bottom of roof trusses. The conditions, therefore, which confronted the designers of the hangars were:

1. The openings for which doors were to be provided were 35 m. x 8.5 m.; 2. the door frame was not to be placed further than 3 m. from the front of the hangar nor more than 9 m. from the end of the structure; and 3. the mechanism supplied was to permit of the opening and closing of the door within 5 min. with a minimum of personnel.

The door finally constructed and which is illustrated in the accompanying sketch is a circular segmental frame made of sheet iron, 1 mm. in thickness, which incloses completely the hangar front. This segmental frame is stiffened by T-irons following the circular form of the door shell, and by five horizontal girders placed as shown in the figure. They are spaced on 2-m. centers and are slightly longer than the door itself. They are designed to withstand the wind pressure. A system of cross-bracing with small T-beams assures to the segmental frame great rigidity.

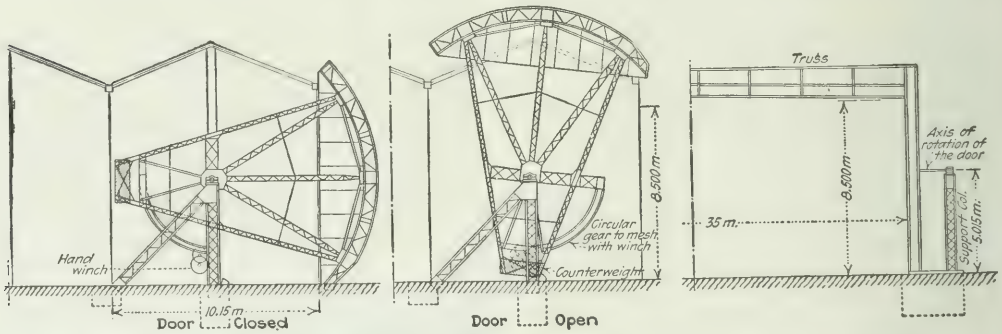
At the ends of the building beyond the door and the column supports of the roof girders are set two frames made of lattice steel girders. The segmental areas forming the door itself are riveted to this frame which is rigidly braced. The ends of these frames are extended beyond the axis of rotation and attached thereto are counterweights which put in equilibrium the entire structure. The counterweight of each frame is inclosed in a metallic box which has a certain amount of lateral and longitudinal motion, and is made slightly larger than need be to hold the counterweight metal. Into this small space are wedged wooden pieces and by their mixture with the cast-iron molds of a very different weight allow the easy displacement of the center of gravity of the door system.

This entire frame is set upon an axis supported by well-braced latticed steel column supports at either end of the hangar. The column supports are strongly buttressed by inclined beams and both beams and columns encased solidly in masonry footings.

The doors are operated by hand winches attached to the column supports, and each is operated in a circular geared frame bolted to the girders. The doors can be operated at either end from within by signals to the operators of the hand winches.

When raised the segmental section just clears the ends of the roof trusses.

The entire contruction is quite light: The roof frames of sheet iron weigh 4½ tons; the beams and stiffeners 7.3 tons. This makes, for a closing surface of 297.5 sq.m., a loading of 40 kg. per square meter. The door and its frame girders weigh 40 tons, of which 22 tons is the counterweight.



END ELEVATIONS AND HALF FRONT ELEVATION OF HANGAR EQUIPPED WITH BASCULE DOOR

Minnesota's Highway Dollar

Graphs showing the source of the average dollar expended for highway work in Minnesota have been included in the 1921 report of the state highway department. One graph shows that the average roads dollar is made up of 63 cents of road- and bridge-tax funds, used on local roads, and 17 cents of motor vehicle taxes, 8 cents of federal-aid and 12 cents of county-reimbursement-bond money—the three trunk-fund sources of revenue. Another pictures how 53 cents of the average trunk dollar went for new construction, 39 cents for maintenance, about 6¾ cents for equipment and less than 1¼ cents for general administration expense. Of the average dollar used for new construction on trunk routes, 40 cents went into permanent grades to make lasting foundations for highway surfacing that future traffic may demand, 17 cents into gravel surfacing, 26½ cents into paving, and the remaining 16½ cents for miscellaneous items. Eighty-two cents of each maintenance dollar was paid for labor. Men and teams got 43 cents of the dollar, against 28 cents paid men and trucks. In addition, laborers took 6 cents of each average dollar. Other items making up the dollar were about 7 cents for gravel, culverts and other materials, about 10 cents for equipment operation and less than 1 cent for unclassified items.

State of Maine To Build Modern Pier in Portland Harbor

CONTRACTS have been awarded for supplying piles, for dredging, for constructing a sea-wall at the shore end and for building the substructure of a new public pier at Portland, Maine. The pier will be located on Commercial St. adjacent to Atlantic Wharf of the Grand Trunk Ry. Terminal and will front directly on the 35-ft. main ship channel. It will be served by the Grand Trunk Ry., and by the belt line of the Portland Terminal Co., which connects all the railroads entering the city.

Present plans contemplate a length of 1,000 ft. and a width of 144 ft. at the outer end, increasing to 236 ft. just beyond the present end of Franklin Wharf, and increasing still further toward the inner end. Eventually the pier will be 320 ft. wide throughout its length. The berth adjoining the pier will be 35 ft. deep at mean low water for a width of 125 ft. and the berth adjoining Atlantic Wharf on the opposite side of the slip will be 125 ft. wide and 30 ft. deep, increasing gradually to 35 ft. at the property line. Berths on the easterly side will accommodate two transatlantic ships and those on the westerly side at the outer end will care for coastwise craft.

As far as the outer end of Franklin Wharf the new pier will consist of a concrete deck on 80 to 90 ft. creosoted piles. Over this portion of the deck will be a steel-frame shed, 90 ft. wide and two stories high at the inner end and one story at the outer. Between the shed and the edge of the pier will be a standard-gage track and a single rail for future installation of a gantry crane. Provision will be made also for cargo hoists of the New York type. On the westerly side of the shed will be several standard-gage tracks, depressed so that car floors will be lever with the shed floor. The tracks and adjoining roadway will be planked or paved to permit trucks to back up over the track to the platform.

At the outer end the easterly side of the pier will have a timber deck with a steel and wood pier shed 60 ft. wide extending from the end of the steel shed to the end of the pier. The standard-gage track will be continued over this section of the pier. The steel columns of the shed are designed for the later installation of gantry cranes.

West of the railroad tracks and outside the limits of the present Franklin Wharf will be built a wharf with a timber deck having a shed similar to that on the easterly side at the outer end. This, being for coastwise liners, will have drop gangways with inclined dock elevators for handling freight to and from coastwise vessels having side-ports.

The pier, as planned, will provide: (1) A berth and pier shed for the largest transatlantic ships that will come to Portland, with grain-handling facilities, freight-handling equipment, and passenger accommodations. (2) Berth and pier shed with freight-handling equipment for smaller transatlantic ships and those plying to Pacific ports. (3) Berth and pier shed for New York and Philadelphia coastwise vessels. (4) Berth for intra-harbor vessels. (5) Existing berth and pier shed on westerly side of Franklin Wharf to be kept for coastwise service.

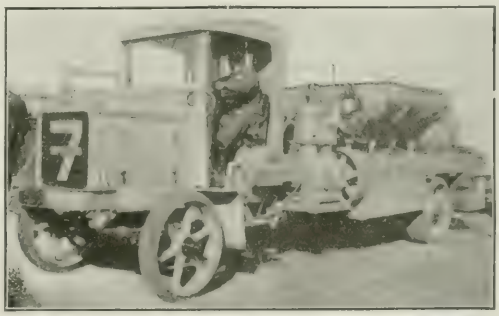
The state legislature has approved a bond issue of $1,150,000 for the construction of the pier. Plans and specifications for the pier sheds, grading, tracks and other facilities are now being prepared, and it is expected that the new pier will be in operation early in 1923.

Henry F. Merrill is chairman of the Directors of the Port, and Fay, Spofford and Thorndike of Boston are consulting engineers.

Many Features Contained in Highway Maintenance Truck

MEANS for carrying through practically every operation required in the repair of any sort of highway are combined in a new highway maintenance motor truck which is being given a trial by the Board of Supervisors of Kern County, Cal.

The truck carries the following main equipment: (1) An air compressor; (2) an air receiver fitted with a safety-valve, gage, 200 ft. of 1-in. hose, and connections; (3) combination material bins with space for 1,000 lb. of cement, 1 cu.yd. sand, and 2 cu.yd. of gravel or rock; (4) a 150-gal. water tank; (5) a concrete mixer; (6) a centrifugal pump; (7) a power-driven



NOVEL HIGHWAY MAINTENANCE TRUCK

nigger-head winch; (8) 50-gal. tank fitted with gas burners for heating road oil; (9) a pressure oil distributor with nozzle and hose; (10) a paint-spray outfit with hose and connections; (11) a pneumatic jack-hammer with a set of chisels, tampers, etc.; (12) a pneumatic post-hole digger and connecting hose; (13) a grading plough and road drag; (14) a wheelbarrow; (15) a 10-ton jack and bracket; (17) 200 ft. of 1-in. manila rope; (17) 25 ft. of tow chain; (18) stencils for miscellaneous lettering; and (19) the following miscellaneous tools and equipment—three shovels, two picks, one large sledge, two crowbars, ten red lanterns, ten "At Work" signs, and ten red flags.

The air compressor is driven by a belt from the forward drive shaft and the concrete mixer by an auxiliary shaft from the transmission. The concrete materials are fed by gravity from all the bins to the mixing apron through hand-operated gates. Water from the tank can be withdrawn either by gravity or pressure. The road plough and drag when in use are attached to an extensible steel boom fitted to the front end of the truck. The truck also contains a draw-bar attachment for hauling trailers.

The multiplicity of uses to which this truck may be put is obvious. It was designed by the Fageol Motors Co., Oakland, Cal.

A Proposed Uniform Law for Land Reclamation by Drainage

An Explanation and Complete Digest of a Suggested General Drainage Law For State Enactment Together With an Abstract of Existing Laws

By Jacob A. Harman
Consulting Engineer, Peoria, Ill.

Land drainage is one of the most important engineering and economic necessities of the future but its necessary development is being retarded by cumbersome laws or by absence of any law which permits co-operative action of those benefited. Mr. Harman, in his extended drainage engineering practice in the Mississippi valley, has devoted many years to the study of drainage laws and has prepared the text of a state law which is intended to promote drainage development and to make it more attractive. This article outlines the current situation as regards drainage laws, states the requirements of an ideal law and gives in extended digest the clause by clause contents of the law. For those who are interested further, "Engineering News-Record" has printed the full text of the proposed law, copies of which may be obtained by addressing this office.—Editor.

A LARGE part of the most fertile agricultural lands in the United States have been brought to their present high state of productivity through the construction of works for protecting the land from overflow, removing the surplus waters, or bringing needed water to the land where rainfall is too small or is not well distributed during the growing season. Individual landowners working independently or in co-operation can operate in a limited manner, but it early became necessary to provide laws for the organization of districts, representing groups of landowners and having taxing powers and the right of eminent domain.

Private corporations organized for the purpose of reclaiming swamp and overflowed lands in the humid regions, and particularly for irrigation in the semi-arid regions of the United States, have operated to a considerable extent, but their experience has been unsatisfactory in so many instances that the organization of drainage districts and of irrigation districts as political subdivisions of the state, with taxing powers, is now generally recognized as the sound and practical method of procedure. The demand for agricultural land in the United States during the past three decades has brought about the development of new systems of laws for reclaiming swamp lands and for irrigation in many states, these laws having procedures fundamentally the same but varying greatly in detail.

I. Development of Drainage and Irrigation Laws

Laws of the Central States—Ohio, Indiana and Illinois were among the first states to enact workable drainage laws for the reclamation of wet land. Other central, western and southern states have followed the principles of local self-government and special taxation. Many of these states have two or more distinct and independent drainage laws, differing in details of procedure and management. In some states, especially Arkansas and Florida, it is not uncommon to establish drainage districts by direct legislation, but most states have general laws under which the owners of land may procure the organization of a drainage district and thereafter control its management by the selection of the administrative officers.

In many states the drainage laws have been enacted within the past ten years. The Missouri law has been used to a greater extent as a model than the older laws of Illinois and Iowa. The Missouri form of law provides for an independent municipal corporation, with officers elected by the land owners. These officials adopt plans, manage the business of the district, and levy and collect taxes, subject to a review by the court of the amount of damages and the equitable distribution of the cost based on benefits to be derived by reason of the improvements.

The drainage laws of Illinois became effective about 35 years ago, following generally the older laws of Ohio and Indiana. The Iowa laws were given their present form about 15 years ago, following the Illinois "Farm Drainage Act" method of taxation, but placing the management in the county administrative officers, instead of creating a local political subdivision under the control of landowners. The Missouri drainage laws were put into present workable form about ten years ago, although under the drainage laws previously in force in that state many drainage districts were organized beginning 20 years ago. The conservancy law of Ohio follows in the main the principles and practices of the Missouri law, but it gives broader power and defines in greater detail the methods of procedure.

A Department of Conservation was authorized by the Indiana legislature in 1919. In February, 1921, the Division of Engineering was added, with a state engineer who is directed to collect data and make computations relative to drainage works, define the natural watershed boundaries and advise courts and other officers relative to the organization plans and methods of construction of drainage districts. In its present form the law requires that the advice be given by the state engineer upon request of a court, or of commissioners or a landowner. The clerk of the court or commission organizing a district must notify the Conservation Department of all the proceedings for the organization of the district.

This law, through the advice and co-operation provided for, probably will have the practical effect of giving the state engineer direct control of drainage plans but apparently fails to give the authority to approve or disapprove plans and to provide for the administrative control over land reclamation works vested in the state engineer of Minnesota and of many far western states. The advisory functions are more fully provided for in the new Indiana laws than in any other that have come to the writer's attention.

Irrigation and Drainage—In the dry or semi-arid

regions, where land reclamation involves irrigation and drainage, a system of laws has been developed to meet the peculiar situation growing out of the necessity of fixing water rights for irrigation purposes and administering the distribution of water. Most areas of land that were accessible to readily available supplies of water were developed by private enterprise. Irrigation became a national question many years ago when the Federal Government established the U. S. Reclamation Service under the Department of the Interior. Public funds are appropriated for the construction of irrigation works and the federal government is to be reimbursed by the sale of public land put under irrigation, and by the collection of water rentals. Drainage of irrigated lands is frequently necessary as a supplement to irrigation.

Ad Valorem and Benefit Taxes—Under laws providing for the organization of districts in Texas and Louisiana, taxes may be levied for flood protection and drainage of land on an ad valorem basis, or on the benefit basis, as the petitioners may desire. Opinion has favored mainly the benefit tax, but a careful study of the working of the ad valorem tax reveals features of merit.

When a tax is levied on a benefit basis in a drainage or levee district the lowest lands, probably remote from highways and so located as to be the last land which can be developed and put into cultivation, will frequently receive the highest tax and may be called upon to pay the interest and annual installment of taxes for from two to five years before the land can be put into cultivation. Furthermore, this land being the lowest, carries the greatest hazard in case of partial failure of the levees to protect from overflow or the ditches to give effective drainage. Under such partial failure, this low land may become the temporary storage reservoir for draining adjacent lands of more favorable elevation.

If a portion of this burden of taxation is placed upon the district on an ad valorem tax basis the lands of greater value and utility will have the greater part of this portion of the tax. Then, when the lands less favorably situated are made available for cultivation, the annual assessment for general, state and county taxes, and consequently for annual drainage taxes, will increase with the value and availability of the land. In that manner such land will pay its due proportion of the "Cost of Reclamation."

II. Basic Provisions of Ideal Drainage Law

Districts as Political Subdivisions—A land reclamation district should be organized and recognized under the law as a political subdivision of the state, and as such should be given the greatest practicable degree of self-government. The state legislature should enact the laws governing the organization of the district and the general conduct of the business. The state judiciary should interpret the laws. The district commissioners, with their appointed officers, should have full control of the administration of the affairs of the district, being authorized to adopt ordinances, rules and regulations and given police powers to enforce their orders by their appointed officers.

The most effective and economical management of land reclamation districts cannot be obtained by placing the management under the officers of the state, or some other political subdivision of the state, because such officers will necessarily consider the interests of the district as subordinate to the state or the other political subdivision for which they are primarily chosen, so that political considerations entirely foreign to the interests of the land reclamation district may frequently influence or control the conduct of such officers in the administration of the district's affairs.

Government May Act in Advisory Capacity—It may be well for the federal or state governments or both, to maintain engineering organizations with advisory powers. The desirable activities may be expressed as follows:

The government should collect and compile engineering, scientific and other useful data and information, and promptly upon verification of accuracy, make them available to the public without waiting for a critical analysis or the promulgation of official conclusions or the local application. By this course much original data of inestimable value now buried in federal and state government files would be accessible to those interested, and would be of much greater use in the advancement of individual and public enterprises.

No Federal Funds for Private Works—Federal or state aid, control and management and even initiative in the construction of works for the drainage of wet lands has been advocated in recent years by many writers and speakers. But it would seem that the experiments in government control of business, industrial and agricultural enterprises which succeeding generations repeat have about reached a stage that should make us see the necessity of decentralizing power and authority and of giving greater latitude for individual and community incentive and support. The reclamation or improvement of privately owned lands by protection from overflow, by drainage, by irrigation or a combination of these functions cannot be a proper enterprise for the expenditure of public funds, and centralized management of local enterprises is contrary to the American principle of local self-government.

Reclamation of government-owned arid lands by the Reclamation Service under federal officers with public funds presents an altogether different question. The general public represented by the government owns the lands which are developed with public funds and the treasury is to be reimbursed by the sale of lands and collection of water rents. The companion proposal that either the federal or state government should loan or guarantee the funds for the improvement of privately owned wet or arid lands is unsound and would lead to abuses on the one hand and to stagnation on the other.

Federal Land Reclamation Districts—On the other hand, there are many cases where the land that should be included in one project or where works for effective and economical reclamation include or involve territory in two or more adjoining states. Federal laws providing for the organization of land reclamation districts by the owners of the lands affected under the jurisdiction of federal courts would provide for such cases.

A federal law for the organization of land reclamation districts embracing land in adjoining states should contain the same provisions as a state reclamation law, except that the petition should be filed in the federal district court and all court proceedings usually incident to the organization and perpetuation of the district should be had in that court. An exception would be the [illegible] for condemnation of property, which should

be under the laws of eminent domain in the state where the property is located.

Such a federal land reclamation district law should become effective in any state upon the approval by the state legislature and enactment of the necessary state laws to authorize the officers of the federal district to exercise the necessary powers of eminent domain, taxation and police.

Local Initiative—In drainage developments the economic law of supply and demand is the only safe guide, and the useful interpretation of the need of reclamation of more lands for agricultural purposes may safely be left to the enterprise of citizens working individually and in voluntary co-operation controlled by the majority in interest in each enterprise. It is essential, however, to provide adequate but easily interpreted laws under which such initiative and co-operation may be made effective and at the same time may protect the property and interest of the minority and of the investor in reclamation securities. The federal and state governments should make scientific studies of the principles necessary for the successful design and maintenance of such projects and should disseminate all the useful information thus gathered.

Reclamation Bonds as Investments—The market for land reclamation bonds could be extended very greatly if the state laws would make such bonds a proper investment for trust funds when approved by a designated state officer, but submission for such approval should be voluntary on the part of the officers of any district issuing bonds.

Right of Taxation—The control of the flow of water in order to prevent floods or to drain or irrigate lands is contrary to the common law principles of riparian rights and of dominant and servient estates. The courts, therefore, are jealous of encroachment on these principles and it has usually been necessary to have a specific constitutional provision for the establishment of land reclamation districts in any state. The rights are statutory and the procedure must be well defined and followed with painstaking care.

With few exceptions, taxation by special assessment proportional to the benefits received has been the basis of raising revenues, and this method of taxation has been a constant cause for controversy regarding the constitutional right and the equity in the application of the tax.

Basis of Management of Districts—Two schools of thought regarding the basis of management and control of land reclamation districts have developed: (1) The reclamation district, whether for drainage, irrigation or flood control, is an independent political subdivision of the state, entirely within the control of the owners of land or of the legal voters within the district, subject only to statutory rights and limitations. (2) The establishment of the district and its management and control are subject to the approval, or under the direct supervision, of a designated state or county official appointed for that purpose, or an ex-officio officer having other duties. Such districts may be organized upon the initiative of the land owners, but often upon the initiative of the state or county officers having control of such work. Some of the states having these features of state control are California, Louisiana, Nebraska, Massachusetts, Minnesota, Montana, Oregon, Utah and Wisconsin.

The tendency in recent years toward centralized government control of public and semi-public functions and regulation of various forms of enterprises, is in opposition to local self-government, which has always been a fundamental feature of the American system. Without undertaking to review the many arguments, it is a fair and safe position to assume that in all governmental functions the central government should be limited in its authority and activity to the safeguarding of persons and property, and that the greatest amount of local self-government compatible therewith shall be sustained. By observing the foregoing principles, the freedom of individual and community will be encouraged.

III. Elements of Uniform Reclamation Law

Progress in drainage and irrigation would be facilitated by adequate laws providing more nearly uniform and more readily followable methods of procedure than now exist. The accompanying summary of a proposed Uniform Law is based upon the initiative of the landowners and provides for local self-government. Provision for approval of plans or the administration of the works by state officers may be made by slight alterations in the text. The phraseology found in irrigation and darinage laws has been liberally used and this will simplify interpretation in the light of the decisions of the courts on present laws.

Outline of Legal Procedure—The proposed uniform law is so arranged as to present the course of proceedings in an orderly and chronological manner, which may be followed easily. A brief outline of the procedure for the organization and management of a land reclamation district, as given below, follows in general the best practice in many states, but includes some features which are new and others which are found in very few state laws. These features are noted more fully later on.

1. Preparation and filing of a petition signed by owners of land requesting organization of a reclamation district.
2. Appointment by the court of a competent engineer to make an investigation and to report in a general way on the feasibility of the project.
3. Notice by publication to all property owners that the petition and engineer's report are on file and setting a day for the hearing.
4. Hearing by the court of landowners petitioning for or against the organization of the district.
5. Finding by the court whether the district should be organized or the petition dismissed.
6. Upon the organization of the district, appointment by the court of commissioners who may be recommended by the landowners.
7. Appointment by the commissioners of an engineer, secretary, treasurer, attorney and other officers.
8. Preparation of a "plan of reclamation" by the engineer for the approval of the commissioners.
9. Preparation of an assessment of benefits and damages by the commissioners.
10. Filing of the "plan of reclamation" and the commissioners' assessment with the court.
11. Notice by publication to all landowners that the "plan of reclamation" and assessment of benefits and damages are on file, and that on a day set the court will consider and determine the amount of damages and ratio of benefits that will result to each tract of land. If "cost of reclamation," including damages, will exceed benefits, plans will be referred back to the commissioners and unless plans are offered which will cost less than benefits, the district will be dissolved.
12. Upon the confirmation of the assessment of benefits and damages the commissioners shall proceed to levy taxes, may borrow money, issue bonds or notes therefor and con-

struct and maintain the works provided for in the "plan of reclamation."

13. The engineer of the district will be the administrative officer in charge of the construction and maintenance of the works.

14. The commissioners upon proper proceedings may modify the "plan of reclamation" and may extend the boundaries of the district and tax any lands either in or outside of district which are benefited.

15. Owners of adjacent and contiguous lands may have their lands annexed to the district and the "plan of reclamation" may be modified so as to reclaim their land under proceedings similar those prescribed for the organization of the district.

IV. Special Features in the Uniform Law

In the author's draft for a uniform reclamation law features that are common, and well established by years of experience in many of the states, are used and an effort has been made to define with accuracy and certainty the steps necessary in the procedure. Of special interest, however, are some features which are new and a few others which are used in one or more states, but are not in common use. These features are explained in the following paragraphs:

A. Preliminary Proceedings and Engineer's Report—Upon the filing of a petition of 10 per cent or more of the landowners asking for the organization of a drainage district, the court will appoint an engineer to make a preliminary survey and report, with approximate estimates of cost, and no notice is required until the engineer's report is on file. (Sections 4 to 6.) This makes available the report of an engineer upon the question of the public necessity for the organization of the district and the feasibility of a plan at the first public hearing. The drainage law of at least one state (Arkansas) now follows a similar proceeding under the general drainage law.

In the majority of states the laws provide for a petition, which must be signed by some number of landowners, ranging from one owner to a majority of the landowners; also, when the petition is filed, for a public hearing upon the necessity for the organization of a district. All landowners may be heard, either for or against, but under this plan no information is available to the court except such as may be offered by the landowners themselves, or such engineers as they may individually employ for the purpose. There is obvious advantage in having at the first public hearing the benefit of the report and testimony of an engineer appointed by the court.

B. Preliminary Expenses—In most of the states where drainage laws have been effective for a number of years no satisfactory provision is made for meeting the preliminary expenses. In some states no provision is made for obtaining money until after the assessment of benefits has been established, and the interested landowners either must furnish money to pay expenses, or obtain the services of some engineer and attorney willing to carry the expense until the district shall have been organized. In other states a bond is required to be filed by the petitioners to cover the expense if the petition be dismissed, and the county board of supervisors, or other administrative officers of the county, are required to advance the money from county funds.

The Missouri law, and the laws of a number of states which have followed that form of procedure, provide for the levying of a preliminary tax of not to exceed 50c. per acre, to be used for the preliminary expenses. If the district is finally dissolved upon the hearing on the assessment of benefits and damages, no other tax is levied. The Mississippi law provides that the commissioners may borrow money on notes or other interest-bearing obligations for preliminary expense, and if the district is not organized they may levy a tax either upon an acre or ad valorem basis upon all the lands included within the petition. In all states, any expense incident to the organization of the district may be paid from the taxes upon the assessment of benefits, when approved.

In the author's draft of a uniform law the Mississippi method has been used, with the added provision that the notes or obligations for preliminary expense shall be drawn for a period of not more than three years, and that taxes shall be levied to meet the maturities of these obligations, whether the assessments of benefits shall have been completed or not (Section 7). This provision is made to meet a condition of delay which often occurs in the organization of a drainage district. Owing to opposition that develops or to the lapse of interest on the part of the petitioners, the final steps for levying taxes upon benefits and raising money are delayed in many cases for a number of years, but no adequate provision is made for the retirement of the obligations incurred, thus working a hardship on those who have furnished the services, and in some cases actually defeating the organization of the district.

C. Method of Taxation—The usual and almost universal method of taxation for land reclamation districts is by special assessment on the lands benefited. In Texas and Louisiana provision is made by separate laws in each state for the raising of funds for reclamation districts, either by general taxation or by special assessment. In some districts in these states the promoters have made use of both methods of taxation, but, so far as observed, there is no reclamation law in any state which provides for the combination of both methods under the same organization and proceeding.

Recognizing that there are some distinct benefits and equities which can be realized by the use of the ad valorem tax in reclamation districts, the uniform law is drawn so that either, or both, methods of taxation may be adopted in accordance with the wishes of the owners of land within the district, subject to the approval of the court having jurisdiction.

D. Number of Commissioners—There are usually three or five commissioners, supervisors or directors in the government board of the district. This number of officers is sufficient to give local representation in a district of any ordinary size. But it occurs occasionally that a district includes lands in a number of counties. In such cases, in order to provide local representation, a larger number of commissioners should be provided for. In the proposed uniform law the normal number of three is required, with one additional commissioner for each county when the district includes lands in more than one county, and the owners of land in each county are given the right to choose or nominate the commissioner who shall represent them (Section 8).

E. Engineer and Attorney as Officers—In most states the law provides for employment of an engineer and an attorney by the commissioners, but in a few states they are treated as officers of the district. This latter plan is embodied in the uniform law, as being both logical and desirable (Section 8).

F. Powers of the Commissioners—The powers of the

commissioners are set out in much more detail than is generally the case in a drainage law or irrigation law. In this respect the uniform law follows very closely to the provisions of the Ohio conservancy act (Section 10).

G. General Taxes Not To Be Increased—Landowners frequently feel that a great injustice is done by the state and county taxing officers who usually raise the assessed valuation of reclaimed land to correspond to the values which are created by the works, notwithstanding the fact that the owners must pay the amount of taxes necessary to create this increase in value. In other words, the owner is taxed to create a value and then is also taxed upon that value before he really acquires the ownership of it. In the uniform law it is provided that no increase of valuation shall be made for general, state and county taxation purposes due to benefits received from the reclamation, except as the reclamation taxes are paid by the owner (Section 15).

H. Abandonment of District Proceedings—It is one of the fundamental provisions of all reclamation laws that at some stage of the proceedings there shall be a finding by the court, or organizing authority, as to the relation between the benefits which will accrue from the carrying out of the "plan of reclamation" and the cost thereof. If the benefits will exceed the cost, the district will be organized, or the proceedings continued looking to organization, as the case may be. But if the benefits are less than the cost, then the proceedings must be dismissed and the district abandoned.

In the author's uniform law it is provided that if the court shall find that the benefits to be received from the "plan of reclamation" submitted by the commissioners would be less than the cost of reclamation, the matter shall be referred back to the commissioners by the court, whereupon the commissioners may revise their "plan of reclamation" and recast the corresponding benefits. It is provided, however, that if no benefits are approved by the court within five years from the time of the first filing of the "plan of reclamation" and assessment of benefits by the commissioners, the court shall then dismiss the proceedings and liquidate the affairs of the district.

I. Simplifying Procedure for Changes in Plans—Under the laws of many of the states even minor changes in plans require cumbersome court proceedings. In the uniform law an effort has been made to provide for minor changes in details of construction, which will not affect the benefits which the "plan of reclamation" will give, without invalidating the assessment or requiring a hearing by the court on such minor changes. Such changes would be made or ordered by the commissioners upon the recommendation of the engineer (Section 14).

J. Progressive Construction and Taxation—In the uniform law provision is made for taxing a portion of the land in a district for a portion of the work which will give special benefits to that land, and thereby make a progressive development and taxation. This obviates the necessity in many instances of organizing subdistricts for local improvements, and distributes the taxation temporarily where the benefits will apply until the "plan of reclamation" is completed and the entire area taxed, as provided in the assessment of benefits (Section 31).

In all of the reclamation laws it is contemplated that a definite "plan of reclamation" shall be made and completed with the least possible delay, and all lands taxed in accordance with the benefits based upon the completed plan. In the larger districts it often requires from three to six years to complete the work, so that the usual method of taxation places the burden upon some lands long before any benefits can be realized, while other lands receive full benefits much earlier.

K. Payments of Deferred Taxes—Under the laws of many states provision is made for the payment of taxes before bonds are issued, thereby relieving the owners of the lands for which taxes have been paid from further taxation for the retirement of such bonds. In Iowa provision is made also for the payment of the entire tax on any tract of land before the maturity of bonds and for calling in the bonds.

In the uniform law provision is made for the payment of deferred taxes, either before or after the bonds have been issued, and providing for retiring the bonds. The rights of the owner of the bonds are protected by providing a premium and advance payment of interest on all bonds that are retired in advance of their maturity (Section 40).

L. Old Districts Coming Under the Uniform Law—A provision in the uniform law makes it necessary for all active existing districts to come under the provision of this law whenever such districts desire to levy additional taxes or extend their works, but this provision safeguards all of the rights and obligations previously acquired by such districts. This method of bringing existing districts under the uniform law is suggested in preference to undertaking to redraft existing drainage laws so as to place all these districts under the provision of the uniform law. It is considered that this method of procedure will be more acceptable to those who may feel that they have vested rights under existing laws (Section 58).

M. Annexation of Outside Lands—Provision is made for annexation of lands by the commissioners when adjacent lands will be benefited by the works necessary to be constructed for the district. The district may also be extended by a petition signed by owners of land within the district, together with the owners of lands adjacent thereto, thus recognizing the community interest between the owners of land within and without the district (Section 20).

N. Tax for Maintenance of Works—Neglect of maintenance of drainage works is due frequently to lack of funds. In the proposed uniform law an annual tax is provided for the maintenance, operation and repair or enlargement of the works of the district (Section 33).

V. Digest of Proposed Law

The following digest of the proposed Uniform Drainage Law gives its principal features in general terms, section by section:

1. Definition of words and phrases used in the law.

2. *Purpose*—The purpose of a land reclamation district is general flood prevention, drainage and irrigation of agricultural lands and the protection, control and distribution of water supplies.

3. *Court*—The court having jurisdiction of the organization of a land reclamation district is defined and its duties are prescribed.

4. *Petition*—Ten per cent, or more, of the owners of any contiguous body of land may petition for the organization of a land reclamation district.

5. *Engineer Appointed*—When a petition is filed, the court is to appoint an engineer to make a preliminary survey, report the boundaries which the district should

have, describe the proposed reclamation works and give an approximate estimate of cost.

6. *Public Hearing*—When the engineer's report is filed, the clerk of the court is to give notice to all persons whose property will be affected, and the court will order a hearing. If it should be found at such hearing that one-third of the owners owning half of the land, or half of the owners owning one-third of the land, have petitioned for the organization of the reclamation district, the court will organize the district without further consideration. Conversely, if objections should be filed signed by one-third of the owners representing a majority of the land, or a majority of the owners representing one-third of the land, then the court will dismiss the petition without further consideration and will levy a tax on all the lands covered by the petition to pay the expenses incurred in connection with the proceedings.

7. *Preliminary Expense*—Money shall be provided for the preliminary expense by note issued by the court, which shall be paid from taxes against the land proposed to be organized into a drainage district, or from the taxes of the district after it has been organized.

8. *Commissioners*—The court shall appoint three commissioners, who may be selected by the owners, and if the district includes lands in more than one county there shall be an additional commissioner for each county so that there may be local representation. The commissioners when first appointed will be for one, two or three years, respectively, and their successors will be appointed by the court upon a petition of a majority of owners of land in such district. When the commissioners are appointed and have qualified, they shall organize, elect a president from their own number, a secretary who may or may not be a commissioner, and a treasurer, who cannot be a commissioner. They shall also elect as officers of the district a district engineer and an attorney, and shall determine the salaries of the respective officers.

9. *Sureties*—Sureties shall be furnished by the officers of the district, and by all contractors.

10. *Commissioners' Authority*—Commissioners are given entire control over the appointment of officers, the preparation of plans and the construction and maintenance of the work; also the authority to levy and collect taxes in accordance with the decree of the court.

11. *Compensation*—The compensation of the commissioners shall be $5 per day for time actually engaged, and they shall be reimbursed for actual and reasonable traveling and living expenses while engaged upon the work.

12. *Liability of Officers for Damages*—The commissioners and other officers of the district shall not be liable to any landowner for any damages which may occur from entering upon the property while in the pursuit of their respective duties.

13. *Liability of Contractors for Damages*—Contractors and their employees shall have the right to pass over the land in the district, and shall not be liable for any damages to any private property when acting within their duties and upon the right-of-way provided by the district, but may be liable for damages to property not controlled by the district.

14. *Plan of Reclamation*—The district engineer shall prepare a "plan of reclamation" for the approval of the board of commissioners. The "plan of reclamation" may be amended or changed. When such change is fundamental, or changes the relation of the benefits to any tract of land, a hearing shall be given before the court for readjustment of the benefits and damages. But modifications of details which do not change the effect of the plan may be made by the commissioners upon the recommendation of the engineer, without submitting the same to the court for approval.

15. *Assessment Roll*—The commissioners shall apportion the benefits and damages and prepare a assessment roll for the approval of the court, and when the assessment of benefits has been confirmed by the court it shall be a basis for taxation for the raising of revenues for the construction and maintenance of the work and for the payment of obligations of the district.

16. *Assessments*—Benefits may be assessed to lands which have not been included in the original assessment when such lands are or will be benefited by the works of the district, or additional benefits may be assessed over the entire district when the amount of such benefits is not sufficient to pay the "cost of reclamation."

17. *Hearing of Objections*—When the "plan of reclamation" and the commissioners' assessment of benefits and damages are filed, notice shall be given to all interested landowners of the date when the court will hear objections to the assessment.

18. *Decision of Court*—The court shall hear all objections that may be made to the assessment and shall call a jury for the determination of damages which cannot be adjusted by the commissioners. The court shall determine if the benefits in the aggregate will equal or exceed the cost of construction, which includes all damages and other expenses and, if so, shall order the confirmation of the assessment. But if the cost will be more than the benefits the court shall refuse to confirm the assessment and refer the matter back to the commissioners for further action. If no assessment is confirmed within a period of five years the court shall dismiss the proceedings and levy a tax to pay all obligations of the district.

19. *Correction of Errors*—Any errors or omissions not in proceedings may be corrected without invalidating the proceedings as to those parties not affected by the errors.

20. *Annexation of Other Lands*—Any body of land contiguous to a land reclamation district may be annexed thereto upon petition of 10 per cent of the owners thereof, and the proceedings for the annexation are similar to those for the organization of a drainage district.

21. *Sub-Districts*—Sub-districts, or an independent district, may be organized in any Land Reclamation district for construction of needed improvements of a local character when not provided for in the existing "plan of reclamation." The organization of the sub-district follows the same general method as the organization of a land reclamation district, except that the officers of the existing district shall be ex-officio officers of the sub-district.

22. *Taxing in More Than One District*—Land may be taxed in more than one district to the extent that benefits are furnished by the "plan of reclamation" of each district.

23. *Consolidation of Districts*—Two or more land reclamation districts may be consolidated when 10 per cent or more of the owners of land in such districts petition therefor, the proceedings to be in all respects similar to those for the organization of a land reclamation district.

24. *Connections with District Works*—Any person owning land may connect the same with the works of any land reclamation district in which such land is located, under the rules and regulations established by the commissioners. If any persons connect works of any kind from lands outside the district with the works of such district, they shall be considered to have voluntarily annexed such land or property to such district, and such land or property shall thereafter be subject to taxation, as if originally included in the district.

25. *Appeals*—Appeals may be made from the decisions of the court on the matter of damages, but no appeal shall be taken from the decision of the court on the matter of benefits. The appeal shall not act as a supersedeas, but the commissioners may proceed by depositing the amount of damages allowed by the lower court and take the property.

26. *Change of Venue*—No change of venue shall be taken, except when the judge of the court in which the petition is filed is disqualified under the provisions of the general statute relating to changes of venue in civil cases. Whenever such disqualification occurs, the judge of such court shall call some other judge to sit in his place.

27. *District as a Corporation*—A land reclamation district shall continue a political sub-division of the state as a municipal corporation, unless dissolved by the court upon the petition of two-thirds of the owners of real property, owning not less than two-thirds of the area of such districts.

28. *Preliminary Taxes*—Preliminary taxes shall be levied

to meet the obligations of the district and preliminary expenses when such obligations mature, without waiting for the collection of taxes from the establishment of benefits. The preliminary obligations of the district may run for a period of not to exceed three years from the date of their issue.

29. *Taxes for Cost of Works*—After the confirmation of the assessment of benefits, the commissioners shall levy taxes for the "cost of reclamation" either as a whole or in installments. The taxes or installments thereof shall draw interest at the rate of 6 per cent per annum, payable annually, until such taxes are paid.

30. *Bonds*—The commissioners may divide the taxes into installments and sell bonds in anticipation of the collection of the taxes to secure the necessary funds to pay the "cost of reclamation."

31. *Pro-rating of Taxes*—When the construction of the work will require such a length of time that some portions of the district may obtain benefits long before other portions will be reached, the taxes may be pro-rated from year to year by the commissioners, with the approval of the court, in relation to the benefits which will result from the work being done. The commissioners may outline a program of progressive construction and taxation to equitably distribute the collection of taxes in relation to the benefits as they may accrue to the lands of the district. When work under the "plan of reclamation" is finally completed the taxes shall be so adjusted that each tract of land shall have been taxed in the ratio of the benefits originally established by the court.

32. *Additional Taxes*—The commissioners may make additional tax levies from time to time to pay the "cost of reclamation" or to meet the obligations of the district. But no property shall be taxed in excess of its benefits or to an amount which would be greater than its ratio of benefits to other lands.

33. *Maintenance Taxes*—The maintenances taxes may be levied from year to year not to exceed 10 per cent of the amount previously expended from the "reclamation funds."

34. *Tax Roll*—The commissioners shall prepare a tax roll each year providing funds for the payment of bonds and other obligations which mature, and the interest thereon, and also for maintenance taxes.

35. *Taxes as Liens*—Taxes levied upon lands and other property become liens and collectable from and after the date that general, state and county taxes are due.

36. *Prepayment of Taxes*—Any person may pay the full amount of his reclamation tax before the bonds are issued and thereafter be exempt from taxation for the payment of such bond issue and the interest thereon.

37. *Tax Collection*—The commissioners shall provide for the collection of taxes by delivering a tax roll to the county collector and require the collector to furnish adequate bonds.

38. *Tax Penalties*—Taxes remaining unpaid on Dec. 31 of any year shall thereafter be delinquent and shall bear a penalty of 2 per cent per month from the date of delinquency and until paid.

39. *Tax on Subdivision*—The collector of taxes may receive the taxes on a portion of a tract which has been subdivided or sold only when the deed of transfer shows the relative amount of tax which is to attach to each portion of the tract so divided and approved by the commissioners.

40. *Deferred Taxes*—Any landowner may pay his deferred taxes in full and have the amount of bond which such taxes represent retired by paying a premium, as provided in the form of the bond.

41. *Delinquent Taxes*—When taxes are delinquent it shall be the duty of the commissioners to institute a suit for their collection by the sale of the property.

42. *Payment by Collector*—Any collector who fails to promptly turn over the taxes collected shall be liable to a penalty of 10 per cent payable to the district.

43. *Fees of Collectors*—The county collector shall retain half of 1 per cent (0.5 per cent) of all taxes collected by him before taxes become delinquent, and 1 per cent of delinquent taxes and penalties collected by him.

44. *Collection of Obligations*—The owner of any warrant, bond or other obligation of the district which is past due shall have the right to bring suite to enforce collection of such obligation.

45. *Bonds for Taxes*—The commissioners may issue and sell bonds in anticipation of the collection of deferred taxes, which bonds, together with other interest bearing obligations of the district, shall not exceed in the aggregate 90 per cent of the total amount of benefits assessed against real property and the ad valorem tax authorized. The commissioners shall set aside a portion of the benefits and ad valorem tax equal to 10 per cent more than the bonds issued as a basis for their retirement. A record of all bonds shall be kept by the secretary.

46. *Bond Values*—Bonds shall be issued in multiples of $100. They shall mature at annual intervals for a period of not more than 25 years, beginning not later than five years after the date of issue. Bonds shall bear interest not exceeding 6 per cent per annum, payable semi-annually.

47. *Record of Bonds*—The treasurer of the district shall keep a record of all bonds.

48. *Sale of Bonds*—The commissioners may sell the bonds by negotiation or by advertising in any market at not less than 95 per cent of the par value and accrued interest. They may pay the cost of lithographing and the necessary legal and brokerage expense for selling the bonds.

49. *Deposit of Funds*—All funds of the district, including moneys received from the sale of bonds, shall be placed in such depositories as the commissioners may designate, and such depositories shall pay into the treasurry of the district interest on the daily balances.

50. *Payments on Bonds*—Principal and interest of the bonds shall be paid at a designated place. Bonds and coupons not paid at maturity shall bear interest after maturity until paid, or funds deposited at the place of payment. Any surplus remaining from taxes collected for the payment of interest and bonds of any one year may be applied by the commissioners to any other legal obligation.

51. *Retirement of Bonds*—Commissioners may retire bonds before maturity by giving notice at the place of payment, and paying into the depository designated for that purpose for the retirement of the designated bonds, a sum equal to the par value, plus the premium prescribed in the face of the bonds as a basis of retirement.

52. *Unpaid Warrants*—When any warrant drawn by the commissioners is presented to the treasurer and not paid for lack of funds, the treasurer shall endorse on the back of the warrant the fact that thereafter such warrant shall draw interest at the rate of 6 per cent per annum until paid, or until there is money in the hands of the treasurer to pay the warrant.

53. *Passage of Bridges*—The equipment used by the commissioners of the district or by any contractor in the construction of the district works may pass through any bridge, grade or railroad or other property crossing the right-of-way of the district, and the district shall reimburse the owner the actual cost of the removal and replacement of the structure. Any owner of such structure who delays the work of the district shall be liable for damages due to the delay.

54. *Bridges*—All railroads and other corporations, private or municipal, or the State or Federal Government, when maintaining bridges or other obstructions crossing a natural or artificial watercourse, must construct and maintain the same to conform to the "plan of reclamation" and must remove any such structure which would interfere with the purpose of the reclamation district. The expense of erecting, changing or maintaining such structure shall be borne by the corporation, or person using the same, except where the "plan of reclamation" required the construction of bridges or other structures in locations where no such bridge or structure is maintained, in which case the court will require the district to pay damages. The owner of any such bridge or structure shall have the right of hearing before the court on the necessity of any changes.

55. *Damages to Works*—All persons or corporations are liable to damages and penalties for injury done to the works of the district.

56. *Water Rates*—The commissioners may establish rates for the use of water which may be provided for or supplied by the district, and the rates so established shall be subject to review by the court having jurisdiction over the district.

57. *Legal Forms*—Forms should be prepared to conform to the usual legal requirements for similar proceedings in the states where the uniform law may be adopted.

58. *Relation to Other Laws and Existing Districts*—No other drainage, irrigation or reclamation law will be repealed, but the enactment of this law provides an alternative system of procedure, complete in itself and independent of other laws.

Graphics Applied to Economic Location of Buildings

How "Cost-Contours" Visualize Changes in Cost Effected by Shifting Power House Site on Side-Hill Location

By Charles P. Dunn
Seattle, Wash.

A GRAPHICAL method for determining the most economical location for a power house is developed by the writer in the following example to illustrate his method of applying graphical principles to the solution of economic problems in engineering design. As will be shown, this method enables the engineer to see clearly the effect on construction cost of shifting the building within the limits of the area under consideration. This in turn makes it easy for him to determine whether net economies may be effected by changes in site looking to convenience of railway access, location of construction plant and material yard or cost of real estate, as the excess cost of construction at a given location over the lowest attainable cost can be taken from the graphs.

Determination of Power House Site.—Let the problem be to determine the most economical location for a power house, 85 x 170 ft., to house four units. Fig. 1 shows a contour map of the site with bedrock contours dotted. It is assumed that the headworks and conduit have already been located and that conditions are such that the length of conduit and penstocks will not be changed appreciably by shifting up or down stream.

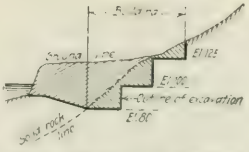


FIG. 2. SECTION AT CENTER LINE A

Consider a series of tentative locations paralleling and overlapping each other and marked 1, 2 and 3 on Fig. 1. The intervals between these tentative locations, which we will call "base" locations, are made equal to one-quarter of the length of the building.

For the purpose of estimating the change in cost that results from change of location, the building is divided

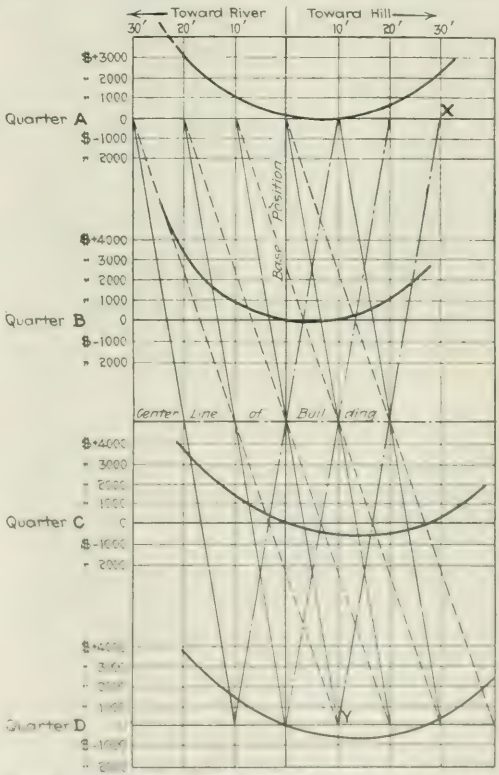


FIG. 3. VARIATION IN COST WITH MOVEMENT TOWARD AND AWAY FROM RIVER

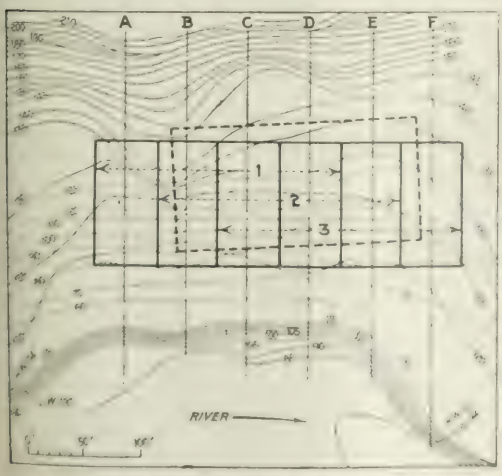


FIG. 1. PLAN OF SITE SHOWING TENTATIVE LOCATIONS

into four units and the lines *A*, *B*, *C*, *D*, *E* and *F* are drawn, each through the center of one quarter of the building. For the building in base position No. 1 we are concerned with units *A*, *B*, *C*, and *D* only.

Cross-sections at *A*, *B*, *C* and *D* are then drawn as shown in Fig. 2. The lines of excavation and foundation concrete are drawn on these sections in several positions, one in the base position (Fig. 2) and others, not shown, in positions nearer to the river and nearer to the hill. Although excavation for a power station is not uniform throughout its length, reasonable accuracy may be attained by using an average section.

The variation in the cost of each quarter of the building as it is assumed to move along its center line *A*, *B*, *C* or *D* is now computed. Only the differences in cost

are computed, no account being taken of the items that do not vary.

These differences in cost are platted in the curves shown in Fig. 3, each curve representing the variation in cost of one-quarter of the building as it moves toward or away from the river. For example: the cost of that quarter of the building centered on line *A* is increased by $3,000 if it be moved from the base position 20 ft. toward the river. The lines *A*, *B*, *C*, and *D* at value $0 in Fig. 3 are spaced equidistant (as they are in the

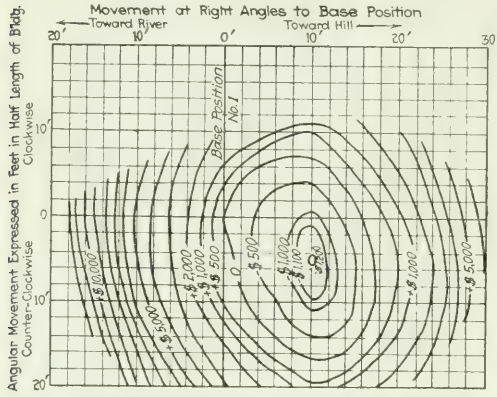


FIG. 4. CONTOURS SHOWING VARIATION IN COST WITH RESPECT TO BASE POSITION No. 1

plan), and the center line of the building is drawn midway between *B* and *C*.

It is clear that the most economical site for the building with respect to base position No. 1 and with no movement up or down stream would be defined by a straight line intersecting the lines *A*, *B*, *C* and *D* in Fig. 3 at points opposite to the minimum points of the curves, but as a line so determined would rarely be straight, it is evident that a compromise must be made. The most economical compromise may be determined graphically.

Each of the vertical and sloping lines in Fig. 3 represents an assumed position of the building. The line *XY*, for example, represents the building moved bodily 20 ft. from the base position toward the hill and turned clockwise about its center through an angle of 10 ft. in half the length of the building. Turning the building at an angle to the base position introduces a small error the amount of which depends on the amount of angular movement, and after a preliminary approximation the engineer may judge whether a second determination is necessary.

The cost of the building in this position is estimated as follows:

For ¼ bldg. on line *A*, $2300 more than in base position
" " " " " *B*, 1800 more than in base position
" " " " " *C*, 600 more than in base position
" " " " " *D*, 600 more than in base position

The algebraic sum of the above gives a cost for the whole building on the axis *XY* $2,900 greater than that estimated for the original base position No. 1. This establishes one point on the "dollar-contour" map (Fig. 4). Each line across the curves on Fig. 3 supplies the data for a similar point on Fig. 4 and enough of these points are computed to determine the contour of minimum cost.

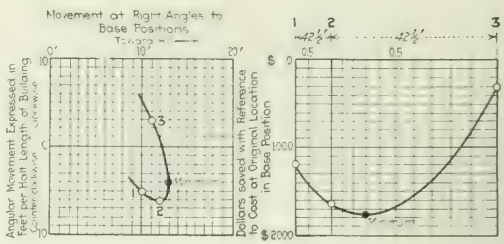


FIG. 5. CURVE OF MINIMUM COST AS BASE POSITION IS VARIED

FIG. 6. PROFILE OF CURVE SHOWN IN FIG. 5

So far we have considered only the variants of position No. 1, moving to and from the river at varying angles but with no movement up or down stream. A similar study of positions No. 2 and No. 3 completes this phase of the investigation. Sections *B*, *C*, *D* and *E* are used for position No. 2 and sections *C*, *D*, *E* and *F* for position No. 3.

Adjustment and Use of Cost-Contour Map.—To reduce all costs to the same datum, the dollar contours for position No. 2 are corrected by the amount the quarter building at *E* costs less than the quarter building at *A* in the base position ($250), and like corrections are made to the contours for position No. 3 by the amount the one-half building *E* plus *F* in base position costs more than the one-half building *A* plus *B* in base position ($1,430).

The minimum points on No. 2 and No. 3 contour maps (not shown) show $1,650 and $320 respectively lower cost than in the base positions. The three minimum points obtained at the base locations No. 1, No. 2 and No. 3 are now transferred to Fig. 5, and a curve passed through them. The profile of this curve is drawn in Fig. 6. The actual distances between base positions No. 1 and No. 2, and between No. 2 and No. 3 are identical (42½ ft.) but since these distances are distorted in Fig. 5, a correspondingly distorted horizontal scale must be used in Fig. 6.

The profile in Fig. 6 shows the most economical location to be three-tenths of the distance from base position No. 2 toward No. 3, which, when transferred to the curve on Fig. 5 gives a location 13 ft. from No. 2 toward No. 3, 13 ft. toward the hill from the line of base positions, and turned counter-clockwise about the center through an angle of four feet in half the length, at which position the cost will be $1,760 less than in the original base position No. 1. This final location is shown dotted in Fig. 1.

Every engineer is familiar with the advantages of graphical methods in the solution of purely technical problems. Many, however, have overlooked the value of such methods as here applied to the economic problems involved in the design of engineering structures.

The act of bringing together in a graph the facts and opinions that pertain to a complicated problem gives the engineer a clearer vision of the problem, helps him to eliminate the personal equation and leads him to a solution in which due weight has been given to every pertinent factor. In rare cases the ideas to be considered are so intangible that they cannot be expressed graphically, but in general the value of a man's opinion on an economic subject can be measured by his ability to express it in a graph.

Expansion and Overturning Causes Damage to Concrete Bridge

By Harlan H. Edwards
City Engineer, Danville, Ill.

DECK expansion of a long concrete bridge in Danville, Ill., with inadequate provision for expansion, water trapped behind abutments and poor concrete were the main causes of incipient failure last fall. It is another example of the lightness with which many public officials regard the importance of adequate and competent engineering control of the construction of municipal structures. Investigations made during the progress of the repairs to the structure disclosed conditions which showed that certain engineering features of the structure as originally planned were neglected or changed and that the character of the concrete work was not of the high class that it should have been.

The Mill St. bridge is a nine-span reinforced-concrete arch viaduct, designed for highway use, having the arch rings of the end spans resting on the abutment walls of the approaches. It was built in 1915 at a cost of about $85,000. As early as three years after the completion of the structure, cracks were noticed in the spandrel columns and arch rings of the east end span, which increased in size and number until action this past summer was imperative to prevent failure of the entire span and probably with it the remaining eight spans of the bridge.

This investigaton led to repairs and additional construction, while the conditions found in the later work corroborated the engineer's assumption that failure in the span was largely due to the fact that the expansion of the deck was inadequately provided for, and that this was assisted by a double action of sliding and overturning of the abutment wall. As shown in Fig. 2, a crack had developed between the wingwall of the abutment and the approach wall, measuring 1¼ in. at the top. The movement of the deck at the face of the abutment was 2 in., indicating about ⅞-in. movement due to expansion.

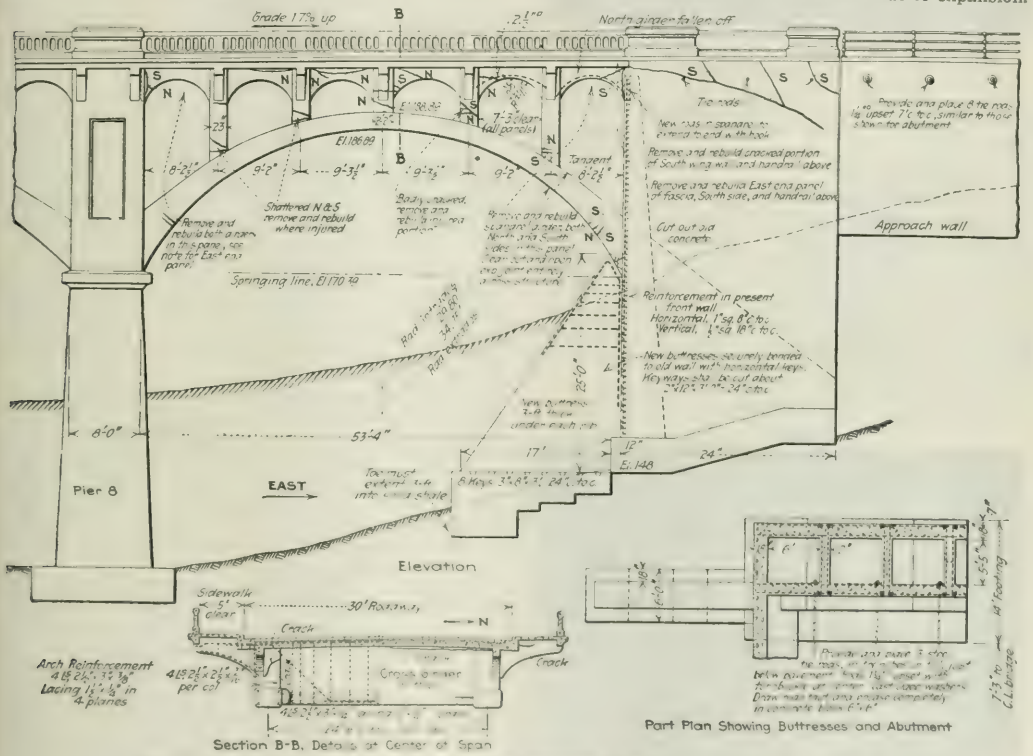


FIG. 1. DETAILS OF DAMAGE TO DANVILLE STREET BRIDGE, AND REPAIR METHODS

The wing walls were of a cellular type, the wells of which had not been filled, thus lightening the wall considerably. No provision for drainage of seepage water from behind the walls had been made, which resulted in a spreading of the walls of about 3½ in. at the ends, since considerable water was found retained. The fact that the abutment walls were ½ in. out of plumb, that the crack of the wingwalls at the approach wall was larger at the top than the bottom, would indicate an overturning movement. The character of the foundation seemed to show that apparently there had been no attempt to bed the bottom of the footing evenly in the shale. Instead, the bed was inclined and part of the footing was founded on coal, 3 ft. thick, immediately above the shale, thus permitting a sliding action.

As shown in Fig. 1, the arch rings were cracked in several places while the crown of the arch was built with a 9-in. greater rise than called for in the design.



FIG. 2. CRACK BETWEEN WINGWALL (ON RIGHT) AND ABUTMENT

The roadway at the curb in the center of the span was humped 1½ in., which probably is the measure of the actual rise of the crown of the arch due to the shortening of the span.

The failure of the spandrel column, as shown in Fig. 2 and more strikingly in Fig. 3, was due to compression, though they were all out of plumb, due to a thrusting of the arch to the west and an expansion movement of the deck to the east. In warm weather all expansion joints were tight, and in the case of the expansion joints of the span in question, there was apparently nothing built but an ordinary construction joint with no attempt at allowing a space for movement as the span elongated with warm weather.

The concrete of all but the rings was noticeably weak



FIG. 3. FAILURE OF SPANDREL COLUMN DUE TO ARCH THRUST

and faulty and most of it had received a generous wash-coat of grout to cover up its defects. Care was not used in depositing the concrete in the forms to prevent honeycomb, while the columns especially were lacking in mortar, due either to a mix lean in sand and cement, or more probably due to separation while chuting into place.

The details of the repairs were carried out under the direction of W. C. Reynolds and supervision of S. G. Gould, of Harrington, Howard and Ash, consulting engineers of Kansas City. The abutment wall was stabilized by the construction of large concrete buttresses as shown on Fig. 2. The shattered portions of the spandrel columns were replaced, supporting the deck on timbers which rested on the arch rings. The broken portions of the roadway and fascia beams and the sheared upper portion of the wing walls were also completely replaced, while seven steel-and-concrete ties were placed across the wing walls and approach walls to arrest further spreading. Future expansion was provided for by opening new expansion joints at each end of the span. Drainage holes were provided in the abutment wall to insure future drainage of this part of the structure. The empty wells of the cellular wing walls of the abutment were completely filled and a new substantial sidewalk laid over them.

New Jersey Water Tax Finances State Board

A TAX of $23,262 was levied against 27 water-supply systems of New Jersey by the Department of Conservation and Development of that state for "excess diversion of water" during 1921. The rate of this levy was $1 per million gallons on all water diverted in excess of a certain free allowance granted by the legislative act of 1907 creating the State Water Supply Commission (one of the predecessors of the Department of Conservation and Development). The free allowance is the amount of water legally diverted in the year 1917 by any water-works system for municipal supply, except that there is no charge on diversions totaling less than 100 gal. per capita.

The 27 water systems on which this tax or license charge was levied supply a total population of 1,801,500. The charge amounts to 1.3c. a year per capita.

The total license charges for 1921 were $5,543 less than for 1920, when some thirty systems diverted more than their free allowance, and $1,288 less than the average charge for the last five years. The department named above attributes the decrease in consumption to "the business depression."

This license charge on excess water diversion finances the water-supply work of the Department of Conservation and Development, which includes investigations of new water-supply projects besides stream gagings and inspection of dams. A total of 21 stream gaging stations are maintained and one will be added this spring. The report on the water-supply situation in the New Jersey metropolitan district by Hazen, Whipple and Fuller, abstracted in *Engineering News-Record*, March 16. p. 430, was paid for from the excess diversion water tax.

Those interested in further particulars of this license charge for excess water diversion may find particulars in a small pamphlet issued by the Department of Conservation and Development, Trenton, N. J., entitled "Laws and Rules Relating to Public Water Supplies and the Erection of Dams."

Across-Road Conduits Built with Pavement

Across-road pipe and wire conduits under new paved roads are required by the New Jersey highway department where a future demand for gas or electric service appears probable. The conduits are located at reasonable intervals generally determined in consultation with local public service corporation officials. They are built when the pavement is built and are then closed off until such time as service requires the street to be crossed, when they are made ready for use.

Flood Conditions and Flood-Protection Problems—II

Final Extracts From Papers Read at Dayton Meeting of American Society of Civil Engineers Outlining Main Elements of Situation in United States and Canada

Mississippi River Control by Levees

By J. A. Ockerson
Consulting Engineer; Member of Mississippi River Commission, St. Louis

The Mississippi drainage basin covers an area of 1,240,050 sq.mi.; the eastern extremity extends into western New York, about south of Buffalo, the western extremity into Montana, west of Butte, the northern into western Canada, 70 miles north of the boundary line, and the southern extremity to the Gulf of Mexico. Besides all or parts of thirty states, this drainage basin includes 20,000 sq.mi. in Canada. It covers 1,822 mi. in longitude and 1,449 mi. in latitude, or 41 per cent of the United States proper.

This great basin is divided into several tributary basins as shown in table, in which is also tabulated the mean annual rainfall in each, for a period of 25 years (U. S. Weather Bureau, 1897).

Name of Basin	Area, Square Miles	Percentage of Whole	Average Annual Rainfall, In.
Ohio	201,700	16	44.2
Upper Mississippi	155,900	13	31.9
Missouri	527,150	43	19.4
Arkansas	186,300	15	29.6
Red	90,000	7	39.1
Central	69,000	6	51.4
Total	1,240,000	100	29.8

The Mississippi River Commission, created in 1879, was charged with developing and executing plans for the improvement of the Mississippi River, to "correct, permanently locate, and deepen the channel and protect the banks of the Mississippi River, improve and give safety and ease to the navigation thereof, prevent destructive floods, promote and facilitate commerce, trade, and the postal service."

Methods of Control — The advocates of flood control for this district were divided into three camps, namely those who favored reservoirs, those who favored outlets, only; and those who regarded the experience of about two centuries with levees for partial flood control as sufficient to justify the use of them for complete control. Others asserted that the floods could not be controlled and that no attempt should be made to curb them, but that mounds should be built for the occupation by the people and their live stock while the lands were flooded. The digging of another river channel from Ohio to the Gulf equal to that of the Mississippi was also urged on Congress.

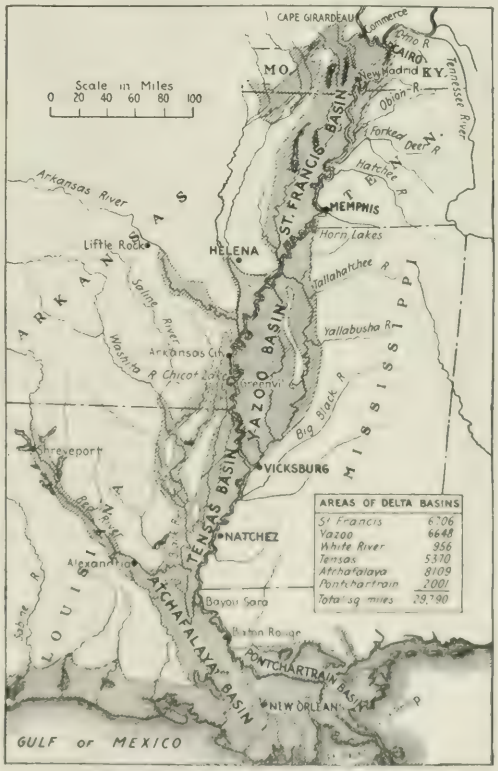
The commission undertook a study of all these plans for flood control and concluded that reservoirs to prevent floods along the lower Mississippi were impracticable, owing to the great number and the size required and to the lack of suitable sites.

The effect of outlets was given careful consideration in the study of the action of existing outlets. There can be no outlets above the mouth of Red River that would relieve the river of flood water without returning it again at a lower point; therefore the major portion of the delta basin would be overflowed before an escape could be reached. Extended observations and many measurements also showed that the reduction of volume by means of secondary channels of an alluvial stream, flowing in a bed of its own formation will reduce the capacity of the main stream and ultimately will result in an increased flood height at and near the point of diversion. Therefore, the conclusion was reached that ultimately all outlets above the Head of the Passes should be closed.

The river at bank-full stage will carry about one-half its maximum discharge, which is about 2,000,000 sec.-ft. at the upper end of the delta. The oscillation of stage between extreme high and low water varies with the locality, up to 60 ft. at Arkansas City and Vicksburg.

Levee Protection — Construction of levees for flood control began at New Orleans in 1717, and by 1828 they had been extended on the left bank to Baton Rouge and on the right bank to the mouth of the Red River. As the river banks became settled, levees were built, and by 1860 all the great delta basins had some measure of flood protection in detached lengths of levee. At that time, the levees averaged about 4 ft. in height, whereas today they average about 18 ft. high.

In 1850 the Federal Government granted to the several states along the Mississippi all the unsold swamp and



FLOOD AREAS OF MISSISSIPPI DELTA

overflowed lands below the Ohio, the purpose being to provide a fund for reclaiming the inundated land, and this gave a decided impetus to the construction of levees. However, even up to 1882, when the Federal Government again came to their relief, through the Mississippi River Commission, flood control by the use of levees did not meet with universal approval owing to the many disastrous failures (712 breaks in the floods of 1881-82-83), although competent engineering boards had repeatedly declared that flood control could only be realized by the use of adequate levees. It was claimed that the construction of levees caused the bed of the river to raise, and consequently they would defeat their own purpose. Extended investigations

established the fact that there has been no progressive elevation of the bed of the river due to levee construction. On the contrary, the latest comparison shows that there is a well-defined tendency toward a cross-section of greater capacity, including a lowering of the bed of the river. Levees were adopted by the commission.

Prior to the construction of levees, the floods of the river covered a width of 60 miles. The floods, laden with sediment, overflowed the channel and deposited the major portion of their load near the river banks, and this in time developed a land slope away from the river of from 3 to 15 ft. per mile. The natural drainage therefore is inland toward the highlands, where it enters tributary streams which in turn empty into the Mississippi at the lower ends of the several basins.

At present, the levees are completed to standard grade and section for about 600 miles. The entire length of the controlling levee line is to a grade that will withstand normal floods, and the practice is to complete the levee to standard grade and section, from the upstream limits of the respective basins, as the work progresses.

Present Standard — The standard levee section adopted has a crown width of 8 ft. at 3 ft. above the highest flood stage, and has side slopes of 1 on 3, supplemented on the land side by banquettes 20 ft. wide for levees from 10 to 13 ft. high, 30 ft. wide for levees 13 to 16 ft. high, and 40 ft. wide for levees more than 16 ft. high, the tops of the banquettes being from 5 to 8 ft. below the tops of the levees. The shrinkage allowance is 15 per cent of the net fill for scraper work, 20 per cent for wagon work, and 25 per cent for dragline and other machine scrapers. The earth is taken from a borrow-pit, usually on the river side of the levee, leaving a berm 40 ft. in width. The pit, beginning at the berm, is 3 ft. deep and from that point outward may be deepened on a slope of 1 on 50 and excavated so as to afford thorough drainage at the back of the pit.

After completion the levees are sodded with Bermuda grass, which affords excellent protection from erosion by rain. Where levees are exposed to wave action, a layer of concrete about 4 in. thick or a board protection is used to break the force of the waves. Severe tropical Gulf storms below New Orleans make necessary substantial protection of the levees from wave action.

The extent of saturation in a levee depends on the character of the soil of which it is built, the length of time it is exposed to the flood, and the depth of water against it. Experiments show that the hydraulic gradient, or the line between the wet and the dry earth in a levee, has a slope of about 1 on 5. To make the levee secure this line should fall well within the base, hence the necessity of reinforcing the levee with a banquette.

In many places, active bank erosion has made it necessary to rebuild the lines of levee several times; particularly is this true of the earlier work in which the levees were placed too near the river bank. The present practice is to locate the levee so that it will be safe from normal bank errosion for at least 20 years.

The remedy for bank erosion is the revetment, which has been developed by the engineers of the Mississippi River Commission. There are three general types, namely, willow mattresses, articulate concrete mats, and solid concrete mats. The articulated concrete-block system was developed by the engineers of the Vicksburg District. The blocks or mat units are 3 in. thick, 11½ in. wide and 3 ft. 11 in. long, reinforced with 12-in. wire mesh. This type has an advantage in that the block units can be prepared in advance, when river conditions are unfavorable for placing the mats. Solid concrete mats, developed in the Memphis District, are reinforced-concrete sheets 50 by 150 ft. by 3 in. thick, sunk in a semi-plastic state from supporting trusses, by pulling the launching barge out from under. It should be stated, however, that this type of mat has not yet been tested to such extent as to develop fully its defects. When these are discovered and remedied, it seems probable that its use will prove economical.

The cost of revetment during the period of high prices incident to the World War, has been about $73 per lin.ft. of bank. Prior to 1918 the cost ran about $34.

Great Flood-Protection Problems in China

By John R. Freeman
Consulting Engineer, Providence, R. I.

The regulation and guiding of certain of China's great rivers in channels better adapted for flood control and for navigation presents some of the most interesting problems of hydraulic engineering that can be found anywhere in the world. The writer had been led through personal observation to believe firmly that the control by human hands of the rivers which cause these great floods is practicable, and that it can be carried forward whenever China's domestic political affairs become straightened out and the inertia of extreme conservatism is overcome.

Floods in China imperil the lives of a greater number of human beings than anywhere else on earth. Until twenty

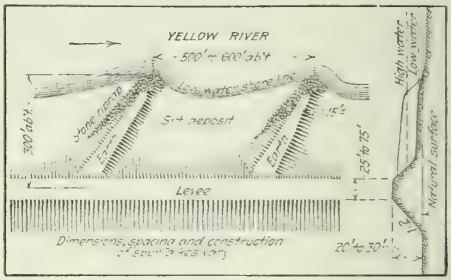


FIG. 1. HOW CHINESE HOLD YELLOW RIVER LEVEES

or thirty years ago the world knew very little about these terrible floods, because means of communication within China were so poor that knowledge of the facts filtered outward slowly and imperfectly. For example, how many know that more than a million people (some say seven millions) perished from one flood so recently as only thirty-five years ago by drowning and by starvation, in an outbreak of the Yellow River about 20 miles above Kai-feng City, which flowed southeasterly over a belt of nearly level country, perhaps 20 or 30 miles in width by 180 miles in length, down into the Huai River.

From his studies of the improvement of the Grand Canal and his studies of the Yellow River the writer has been led to have a profound confidence that great relief can be secured by an expenditure that relatively is not large, and which can be forthwith recovered in increased value of land reclaimed. The necessary structures can be largely built without the aid of steam shovels, industrial railways and the like, by native labor which badly needs employment.

It seems highly probable that the necessary works of river training and dike building, which although extensive are of a simple character, can be so built that present maintenance charges could be lessened. Also it seems highly probable that the value of waste land reclaimed could promptly be made to pay back to the government the entire cost of the river-training works and in addition bring prosperity to an impoverished region, and to other regions bring safety from impending disaster. But all of this is no short or simple task, nor can the works be designed in their best shape until after scientific tests and painstaking observation.

Important Flood Problems—From north to south there are five principal localities where flood relief needs to be studied:

(1) In the flat, level plains of the drainage basin that has its outlet past the great commercial city of Tientsin. This region suffered terribly in August and September, 1917. An area of about 15,000 sq.mi. was submerged, several million people, mostly farmers, driven from their homes, and a property loss of more than $50,000,000 gold incurred.

(2) In the delta of the Yellow River, or Hoang Ho, all along the river's 400-mile course through the delta. During the historic period of 4,200 years this region has been

ravaged by floods time and time again. These overflows come from breaks in the great dikes, and occasionally these cause a wide change in the river's course. The conditions are aggravated by the silt burden brought from the vast and easily-eroded loess deposits of the provinces just upstream from the delta, which make the Yellow River probably the muddiest great river in the world.

(3) The Huai River district in Kiang-su Province, below Wu-hu. About 5,000 sq.mi. of this peculiarly low and level delta region are said to be frequently inundated, with famine often following flood. The land is exceptionally fertile, and under a warm, growing climate normally gives two crops per year; for thousands of years intensive cultivation has been continued in spite of disasters which some-

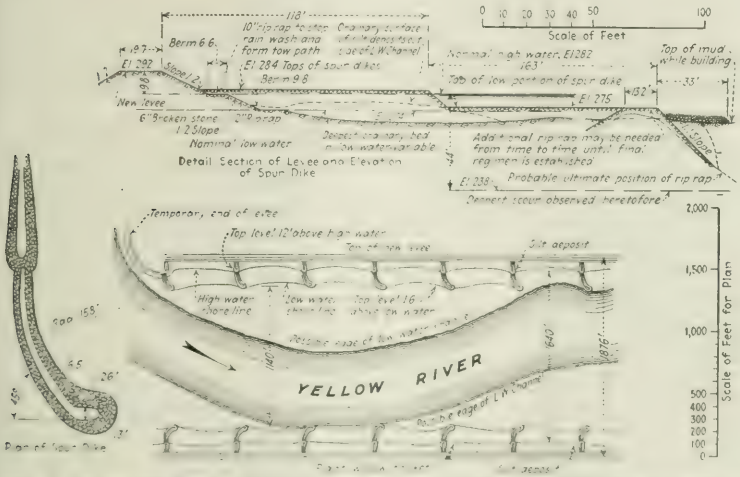


FIG. 2. PROPOSED INNER LEVEE AND SPUR DIKE SYSTEM (TENTATIVE SKETCH)

times have brought death to thousands and at other times have merely destroyed the second of the two yearly crops.

(4) Along the Yang-tze River below Ichang. Here is the Grand Gorges the river floods are said to rise 80 ft. Below Hankow the flood discharge rises to about 3,000,000 cu.ft. per sec., which is about the same as the greatest flood discharge of the Mississippi at New Orleans. The Yang-tze River, although turbid, brings down less silt than the Yellow River, and its delta therefore grows more slowly and its whole regimen has become well established. The flood problems are mainly those of ordinary dikes and river training and control on a mighty and forbidding scale, because of the depth and volume of the water. The charts show dozens of spots where the swirl of the flood cuts pools more than a hundred feet deep, and it is no light problem to work out shore protection that will protect so deep a bank from the undercutting of such a flood.

(5) The valleys of the North, East and West Rivers in the country around and back from Canton in southwestern China. Near the important city of Wu-chow the great West River is said to rise 50 and even 80 ft. in extreme floods, and at the rate of a foot per hour.

The Chinese have had their hands full with the problems of flood control by dikes during their whole historic period of about four thousand years, and have developed a wonderfully good technique in many matters of dike building and in the repair of dike breaks, although in the science of river training they, and all the rest of us, still have much to learn.

One of the most venerated men of the half-legendary days of thousands of years ago is Yu, their great hydraulic engineer, who regulated the waters so wisely, and whose works and precepts were so faithfully followed afterward, that for over a thousand years there was no trouble, until the period of the "warring states." And the one great fact that the great restless Yellow River was held to its course during 538 years on a silted bed several feet above the level of the ground on either side, within dikes built of soft friable river silt, carefully consolidated by tamping and protected from erosion by impinging currents in many places by groins and revetments of perishable milletstalks, speaks volumes for the skill and resources of these old masters.

The flood volume of the Yellow River is from 200,000 to 300,000 cu.ft. per sec. In 1919 a flood higher than any of the preceding ten years had a peak discharge of 280,000-ft., about the same as the flood volume of the Mississippi above the confluence of the Missouri. The low-water flow is about 10,000 cu.ft. per sec. But, while the discharge from low to high thus increases 35-fold, the mean velocity becomes increased only about 2½ times. The necessary increased area of cross-section is obtained partly by the waters' rising and spreading, but largely also by the river digging its bed deeper and wider.

A Possible Method of River Training—The chief object in the river training now proposed is protection against floods by ultimately forming a thick, flood-proof dike by means of silting up the space between the present inner dike and a new straight dike built to confine the new straight and narrow channel and hold this from meandering so that it will henceforth flow everywhere between new banks protected against undercutting by spur dikes (Fig. 2).

All things considered, the Chinese have done wonderfully well in their river training by methods they have followed for hundreds and perhaps thousands of years; but it should be possible to make great improvements by means of precise scientific observation and slow painstaking study in laboratory and field by modern instruments and methods. The river would be compelled to flow in straight courses, 5, 10 or 20 miles in length, laid out nearly midway between present inner dikes as may best fit existing conditions in different localities. The flood channel at the surface would be made only about ½-mi. in width, the centers of the main dikes being less than ½-mi. apart instead of from 4 to 8 mi. apart, as at present. The space of from 2 to 3 mi. in width thus left between the old inner dike and the new straight dike would ultimately become silted up to nearly the level of ordinary floods, forming the most fertile kind of agricultural land, but presenting the great superiority of having the admission of flood water always controlled until growing crops had been harvested by substantial sluiceways and gates built into the new dikes. After the crop had been harvested the admission of more or less flood water occasionally would add to the fertility, and the maintenance of a deep-seated reserve of moisture in the sub-soil would be aided by saturating this bottom land by these occasional overflows. When this broad terrace of earth between old dike and new dike had become built up to about the level of ordinary floods, it is obvious that if the inner dike became overtopped or undercut by the current under extraordinary conditions, that this barrier of elevated ground about 2 miles in width in front of the old dike would prevent any rapid outrush of water from causing disasters like those of 1887 and 1851 or the countless series of outbreaks that have occurred from time immemorial, all along the course of the river through the delta.

Cleaning Up the Building Labor Situation in Chicago

(An editorial impression)

FOR years Chicago has been noted for serious disturbances in the building industry. There have been a number of protracted strikes shutting down work completely. But Chicago is working out its salvation. A strong organization, known as the Citizens' Committee to Enforce the Landis Award, has been formed and apparently is mastering the situation. The end is not yet, but good results have already been secured and the outlook is promising.

The organization of the committee was the culmination of events following a seven-weeks' strike in the building trades beginning May 1, 1921, which grew out of a demand by the contractors for a reduction in wage from $1.25 to $1 per hour. Finally the opposing parties agreed to submit the matter to arbitration and, at the suggestion of the unions, Judge Kenesaw M. Landis was selected as sole arbitrator.

On Sept. 7, 1921, the arbitrator rendered a decision which set lower rates in practically all of the trades and laid down rules abolishing the restrictions of output practiced by the unions. (For data on this decision see *Engineering News-Record*, Sept. 15, 1921, page 467.)

The contractors accepted the award, but some of the unions lodged protests against it and ultimately decided not to abide by its provisions. The situation, for a time hopeful, again gave promise of becoming chaotic. At this juncture a group of citizens took the matter in hand, realizing that if the Landis award were made a scrap of paper Chicago was doomed for an indefinite time to be at the mercy of the pirates who dominated some of the strong unions. They, therefore, solicited the support of other loyal Chicagoans with the result that there was formed the Citizens' Committee, pledged to a fight to the finish to secure the adoption of the award by the whole building industry of Chicago. It was realized that this was no simple matter, nor one that would be finished in a few months. In fact, it was apparent that if Chicago was to continue to enjoy good working conditions in the building industry, the organization must be permanent. Accordingly the committee announced that it needed contributions totaling $3,000,000, to provide funds not merely for the initial fight but for the permanent establishment, incorporation and conduct of the organization. By the end of March $1,800,000 had been paid into the treasury, with the remaining money pledged, an evidence of the public approval of the committee's object.

Hearty approval has come, too, from other directions. The architects of the city with few exceptions have agreed to give work only to contractors who will work under the award, while many of the bankers will advance building funds only on projects being carried out under Landis award agreements.

The make-up of the committee is a guarantee that the fight will be vigorous and that there will be no compromise. Included in its membership are such prominent Chicagoans as Thomas E. Donnelley, of the Reuben H. Donnelley Corp., printers, chairman; John W. O'Leary, of the Chicago Trust Co., vice-chairman; James A. Patten, the well-known grain merchant; Charles Piez, president of the Link-Belt Co., and John T. Pirie, of the wholesale drygoods firm of Carson, Pirie, Scott & Co.

Platform and Procedure.—As its platform the committee adopted the following declaration:

"1. Employers who continue their operations under the terms of the Landis award will be encouraged and when necessary, protected in their operations.

"2. Unions which accept the terms of the Landis award, both in spirit and fact, will be supported.

"3. The sale and use of material going into building operations must be free from arbitrary restrictions.

"4. Contractors who refuse to operate under the Landis award deserve neither the encouragement nor the support of the public.

"5. In those trades where the unions do not accept the terms of the Landis award, work shall continue by workmen who are willing to work, regardless of their union affiliations. These men will be protected and these trades will be permanently established on the basis of the open shop."

The committee's method of procedure was to open negotiations both with the contractors and with the unions. Contractors were asked to agree to hire only men who would work under the Landis award. The unions were asked to accept the following three planks:

1. To abide by the Landis award and to give up all restrictions as to output or use of materials.
2. To agree not to engage in sympathetic strikes.
3. To work on jobs with non-union men.

On the whole there was greater difficulty with the contractors than with the unions, for many contractors wanted to retain freedom to recruit their forces at inflated wages should the supply of building mechanics be limited. In some trades weeks were required before it was possible to get the first group of contractors to sign up with the committee. To date, however, a goodly group of contractors in every trade has been signed up, so that it is possible to proceed with every kind of building work.

Negotiations with Unions.—In negotiating with the unions the committee took the position that if they agreed to abide by the Landis award, the committee would recognize them as the accepted labor group in their particular trades, thus making those trades "closed shops." If, on the other hand, the unions refused to accept the award, the committee announced its purpose to declare those trades "open shops" and thereafter to have no dealings with those unions, though members of the unions as individuals might be employed on building operations, provided they as individulas agreed to abide by the terms of the award. The committee made it clear that once a union was outlawed and that trade declared an open shop, it would remain so permanently and that under no circumstances would the committee compromise and have any relations with the union in question. Up to the present time twenty-one unions are operating under the award, while ten have been outlawed because they refused to accept the award and those trades are now operating on the open-shop basis. Negotiations with the remaining one of the thirty-two trades are still in progress, their contract with the employers having run until April 1.

Naturally, when a given trade was declared an open shop, difficulty was experienced by the contractors in finding adequate help. The Citizens' Committee therefore began to recruit men at other points, with the result that there are now ample supplies of labor in every one of the outlawed trades. In Chicago itself the

committee is conducting an employment office where all men working in the open-shop trades are obliged to sign up, agreeing to abide by the Landis decision, before they are placed.

Relations between the contractors and the unions which have signed up are those normally existing between these groups, the employers calling upon the unions for forces and settling disputes with them without the intervention of the Citizens' Committee.

To date large economies have been experienced as a result of the abrogation of restrictions. Bids on identical work show large reductions this spring over those of last fall, while contractors report greater efficiency on the part of the workers. A building alteration job, for example, on which the bid was $103,000 last October was actually let in March at $68,000. The owner stated, also, that this was the first time in five years that he had been able to do work without paying any graft.

Naturally, the cost of the work done by the committee—such as the maintenance of the necessary organization for carrying on negotiations, the hiring of scouts, the establishment of an employment office, the provision of guards for protecting buildings where violence is feared, and the carrying of insurance to reimburse contractors and owners against damage due to possible violence—is large. Up to the end of March the committee had spent $350,000, and at that time was carrying insurance against vandalism totaling $32,000,000.

Not the least of the work of the committee has been to get its message before the citizens of Chicago. Naturally, the situation has attracted widespread attention and has secured much newspaper publicity. In addition, however, the committee has put forth various documents for distribution to the public, while members of the committee have for months been doing one-night stands at the meetings of civic bodies in every part of the city.

The Outlook.—Even so, it is fully recognized that the fight is not yet won. However, the fact that work can now go forward in every branch of the building industry, that more contractors are signing up every day, and that the beneficial results in lowered costs are beginning to appear indicates that the committee will be able to carry its work to a successful conclusion. One of the difficulties is that not all of the contractors have yet signed up to work under the award. These men form a group of bolsheviks who may have a serious influence on the situation, by overbidding the Landis wages and tolerating the restrictions should there be a pressing shortage of building mechanics. Every effort is being made to bring these recalcitrant contractors into line and to put the whole building industry of Chicago under the Landis award.

French Railways in 1921

The gross operating receipts of the French railways for the calendar year 1921 exceeded those of 1920 by over 400 million francs, yet there was a larger deficit for 1921 by over 120 million francs than for the year previous. Advances of from 70 to 80 per cent in passenger fares and of 140 per cent in freight rates accounted for the increased gross revenues but these were offset by operating expenses exceeding those of the previous year by over 560 million francs, the figures for expenses being estimated.—*Commerce Reports*

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

In Defense of Professor Melan

Sir—In justice to Professor J. Melan, who has done invaluable pioneer work in developing the theory and construction of various bridge types, I want to correct certain erroneous impressions which may be gathered from your editorial on "Self Supported Arch Reinforcement" in your issue of March 30, p. 513.

In that editorial you make comparison between a type of construction employing small shapes for reinforcement, which you refer to as the Melan type, and another system employing rigid, self-supporting steel reinforcement. The fact of the matter is that the second type, which you praise to the disparagement of the first, is really Melan's system of arch construction as developed and perfected by him.

All authorities agree that the characteristic feature of the Melan system is the rigid, self-supporting reinforcement. In the earliest Melan arches built in this country, about 25 years ago, the reinforcing ribs were built up of smaller structural shapes corresponding to the small dimensions of the spans, but the principal was there.

In my translation of Melan's "Plain and Reinforced Concrete Arches" (Wiley, 1917) I have emphasized this feature of rigid, self-supporting reinforcement throughout. Facing pages 115 and 119 I have inserted photographs of a Melan Arch during construction, to show how the reinforcement remained self-supporting after the centering was carried away by a flood. All of the Melan arches pictured have rigid, self-supporting reinforcement of structural steel.

The use of the rigid reinforcing ribs to support dead-load during erection is also part of Melan's system as developed by him. The American owners of the Melan patents did not take advantage of this principle, but Melan applied it in the design and construction of his arches in Europe. Permit me to quote from my translation of his book which he wrote over 10 years ago. In the chapter on "Proportioning Reinforced-Concrete Arches," page 114, you will find the heading: "*Rigid Reinforcement Carrying Part of the Dead-Load (The Melan System),*" and the text—"If the arch-curve conforms to the correct line of pressure and the live-load is not too great, only small tensile stresses will appear. Furthermore, since the maximum intensity of compression in the steel cannot exceed $n = 15$ times the value for concrete, or about 6,000 to 7,500 lb. per square inch, it is evident that *the full strength of the steel cannot be utilized in the ordinary arches of reinforced concrete.* This waste of strength may be avoided, however, by using self-supporting reinforcement (as in the Melan system) and hanging the forms on these steel reinforcing ribs; a portion of the dead weight of the structure is thus transferred directly to the steel, so that the latter receives a certain initial stress before the concrete is stressed at all."

In the succeeding pages, Melan develops the theory of his system and illustrates it by examples from his designs.

All of the advantageous features which you commend in your editorial are fully covered in Melan's work. He employed the principle of suspending the forms from the rigid reinforcement as far back as 1898.

I hope you will feel, as I do, that credit should be given where credit is due.

D. B. STEINMAN,
Consulting Engineer

New York, April 18

[It is obvious from Mr. Steinman's evidence that the Melan principle included self-supported reinforcement, which in turn could carry the concrete during construction. The editorial doubtless emphasized too much the type of construction actually carried out in the United States under the Melan patents, in which dead load was not carried by the reinforcement.—EDITOR.]

NEWS OF THE WEEK

New York, April 27, 1922

Contractors and Dealers Are Heard in Cement Trial

Uniformity of Price Testified to But Competition Also Indicated in Activity of Salesmen

In the examination of more than a score of contractors and dealers in building materials, operating in various parts of New York, Pennsylvania, and New Jersey, evidence has been adduced during the past week in the criminal trial of cement manufacturers of the Eastern district before Federal Judge Knox in New York that a striking uniformity of price has existed in cement quotations, discount practices, bag charges and bag refund allowances. These details have been dwelt upon in the examination of each of the witnesses called by the government. However, the defense has met such evidence by further bringing out the fact that the uniformity existed long before the formation of the Cement Manufacturers Protective Association in 1916, and by showing on cross-examination that (1) manufacturers have often used dealers in the endeavor to discover quotations from competing firms, (2) that in the establishment of a new uniform price there is usually a two- or three-day lag between the new price as quoted by the firm undercutting or raising and the quotations from other manufacturers to meet the new price and (3) that cement salesmen are most active in calling upon dealers in the endeavor to get business.

Other Witnesses

Other witnesses examined included William M. Kinney, general manager of the Portland Cement Association, and Miss Mary F. Kavanagh, formerly in the employ of the Atlas Portland Cement Co.

The examination of Mr. Kinney had to do with the formation of that association and endeavors to promote the use of cement in structural and highway work. The government in Mr. Kinney's examination introduced further documentary evidence composed largely of correspondence passing between Mr. Kinney and members of the association.

When Miss Kavanagh was called to the stand she was examined largely as to her association with and knowledge of the formation of the Cement Manufacturers' Protective Association, in which the Atlas Company had a leading part. She proved a willing witness for the government, but repeated objection was made by counsel for the defense as to the inclusion in her testimony of irrelevant material which was ordered stricken out by the court. In cross-examination she proved an unwilling witness and had to be admonished often by the court for failing to answer properly and for arguing with counsel. One point in her examination sought by the government was to establish the fact she had been instructed to withdraw "damaging" correspondence from the Atlas files by Mr. Holman, then assistant to the president. Miss Kavanagh testified to the fact verbal instructions were so given. Later evidence proved the fact Mr. Holman was away from the company's offices during the time specified.

During the closing session of one day last week considerable discussion was engaged in over the admissibility of certain evidence.

Mississippi Levees Still Hold Flood

Col. Charles L. Potter, Corps of Engineers, U. S. A., and President of the Mississippi River Commission wired "Engineering News-Record," April 25 that the flood on the Mississippi was being held between the levees. The telegram says:

"Unprecedented flood heights obtain in a portion of the lower Mississippi. Floods at Cairo usually come from a very high Ohio and a moderately high upper Mississippi and upper Mississippi floods generally occur in June after the Ohio has fallen. In April this year heavy rains in the upper valleys caused an excessive flood in the upper Mississippi and a moderate flood in the Ohio occurred in March. Cairo gage recorded about 1 ft. below its record at the crest of the Ohio flood, then fell about 3 ft. and has risen about 3 ft. while the upper Mississippi gages are below record heights down to the Arkansas and White Rivers, which tributaries were in flood at the critical time. The natural spillway at Cypress Creek just below the Arkansas River whereby some 200,000 sec.-ft. formerly left the main river in high floods and returned via Bayou Macon, Black River and Red River has been closed since the last great flood. This with the flooded White and Arkansas has already produced heights beyond all records at Arkansas City, Greenville and Vicksburg and will probably carry on to Red River, there being no return water from the Red and with the Red and Ouachita Rivers falling, the Atchafalaya outlet will be able to furnish great relief. No record heights are expected below Red River. No levee under government control has broken except a small one near the mouth of the river. One private levee not in the main line has broken, flooding a small area. We are putting up a hard fight from the Arkansas to the Red. Congress has provided a million dollars. The levee boards are co-operating magnificently and we are going to win."

Flood at Fort Worth, Texas

Excessive rainfall on the Trinity River above Fort Worth, Texas, (reputed as 9 in. in 12 hours) on April 25 caused a rapid and serious rise in the river with consequent flooding of part of the city. Full reports are not available as this issue goes to press.

Postpone Hearings on Plans for Railroad Consolidation

Hearings on the plan for consolidation of all major railroads of the United States into nineteen great systems were begun April 24 by the Interstate Commerce Commission. As the railroads generally were not ready to proceed it was agreed to adjourn the hearings indefinitely.

First consideration is to be given to the roads in the southeastern section of the country which are to formulate a program for the study of the problem and submit it to the commission for its approval. Objections to the plan proposed for this section have been raised by the Southern States.

Philadelphia Receives Bids on Girard Municipal Piers

Bids for the construction of the superstructure of Pier 3, North, and of the substructure and superstructure of Pier 5, North, of the Girard group of Municipal piers in Philadelphia have been received by the Department of Wharves, Docks and Ferries. This is reported to be the largest single contract yet offered by the city in connection with its Delaware River waterfront development plan.

Five bids were submitted, ranging from that of the Triest Contracting Co at $1,812,218 up to $2,045,000, based on plain-concrete floors; and from $1,845,548 by the same low bidder up to $2,080,000 based on asphalt-block floors.

It is planned to have the Girard group of piers in service in 1923.

Hampton Roads Port Commission Appointed by Governor

Governor E. Lee Trinkle, of Virginia has announced the appointment of the following as members of the Hampton Roads Port Commission, created by the last general assembly to aid in the development of ports and rivers in and around Hampton Roads, Va.: N. I. Maher of Roanoke, Va., president Norfolk & Western R.R.; Henry G. Barbe of Norfolk, Va., president Norfolk Chamber of Commerce; Homer L. Ferguson of Newport News, Va., president Newport News Shipbuilding & Drydock Co.; W. M. Martin of Petersburg, Va., secretary Petersburg Chamber of Commerce; W. E. Carson of Riverton, Va., manufacturer, and John R. Saunders, attorney general of Virginia, ex officio.

Power License Granted To Cover San Joaquin River Project

A license under the Federal Power Act has been granted to the Southern California Edison Co. covering its $13,000,000 project on the San Joaquin River in Fresno and Madera Counties, Cal. The primary power available is 112,000 hp.

The project works include a concrete arch dam 100 ft. high; a tunnel 21 ft. by 21 ft. and 28,000 ft. long. The power house will contain six turbines which will operate with a mean static head of 825 ft. They will be capable of developing 195,000 hp. There will be two parallel 220,000-volt transmission lines, one and one-half miles long, which will connect the power house with the double transmission line to Los Angeles.

Bonds for Activated-Sludge Plant Voted by Pasadena, Cal.

By a majority of 5 to 1 the voters of Pasadena, Cal., on April 11 approved a bond issue of $325,000 for an activated-sludge plant and for increasing the capacity of its outfall sewer. The effluent from the plant will be used on the sewage farm that has been owned and operated by the city for many years. It is expected that South Pasadena and Alhambra, which joined with Pasadena several years ago in investigations for a joint sewage-works, will have sewage-bond elections soon. In 1915, Pasadena voters negatived an ocean-outlet sewer project. The results of the recent Pasadena election were awaited with interest in Los Angeles in view of the controversy in the larger city over a new ocean outfall as against activated-sludge plants.

British Railways Resume Speed

(*London Correspondence*)

Following many complaints, voiced largely through the *Times*, London, as to slow train-speeds in Britain since the war, there has been a general speeding-up, together with a closer adherence to schedules. The South Eastern & Chatham, for example, notwithstanding that it must operate through a very congested section of the environs of London, showed during February an average lateness of trains at the London termini as follows: Cannon St., 0.95 min.; Charing Cross, 0.68 min.; Victoria, 0.78 min.; Holborn, 0.53 min.; Ludgate Hill, 0.10 min.; St. Paul's, 0.20 min. These stations handle both local and main-line traffic and the figures include delays from every cause.

The Great Western Ry. also has speeded up. The average speed on the London-Birmingham run, about 110 miles is, 57 m.p.h. The Bristol-London run of 118 miles is made in 2 hours. The log of one trip of this train follows:

Station	Schedule Time	Actual Time	M P H
Bristol	12 00	12 00	
Badminton	12 25	12 32	33 05
Swindon	12 47	12 52	68 14
Milton	1 05	1 09½	73 62
Reading	1 23½	1 27½	66 13
Slough	1 40	1 42	72 52
Paddington (London)	2 00	2 00	61 50

The Penzance (West of England) train, which leaves Exeter at 1:45 ran to Paddington (173 mi. 53 ch.) in 174 min., the average speed being 59.88 m.p.h. The highest speed on this run was 67.16 m.p.h.

Federation Reports Increased Engineering Employment

Distinct improvement in the unemployment situation in the engineering profession is reported by the Federated American Engineering Societies' Employment Bureau, 29 West 39th Street, New York. During the first quarter of this year 778 available positions were sent to the bureau as against 347 for the same period in 1921, an increase of 124 per cent. The number of men placed showed an increase of 41 per cent, rising from 293 during the first three months of last year to 415 during the quarter just passed. The number of new men registering with the bureau fell from 552 last year to 421 during the first three months of this year, a reduction of 24 per cent in applicants for positions.

Many of the positions available are in what is classed as the junior grades, draftsmen, estimators and similar jobs, but there is an increased number noted in the higher-grade openings which are sent in, indicating that many companies are actively preparing for a return to more normal conditions. The gradually-increasing activity does not appear to be confined to any particular line, but is more or less general.

Transportation Policies Outlined by Agricultural Inquiry

"Transportation requires constructive and helpful governmental and public treatment rather than repressive or restrictive regulation," recently declared Chairman Sydney Anderson of Minnesota, speaking for the Congressional Joint Committee on Agricultural Inquiry. "We are convinced," he continued, "that whatever else may be or can be done by Congress or the government to help all business, including agriculture, to readjust and stabilize itself, transportation is a vital factor and must be dealt with equitably and constructively if the country is to go forward and prosper."

As the fruits of an investigation which has been in progress since August, 1921, the forthcoming report of the commission is expected to present many definite and far-reaching recommendations bearing on the relation of transportation to agriculture and industry. The recommendations directed to Congress, Mr. Anderson states, will be confined to matters wherein Congress has power to legislate and wherein there is need for legislative action.

Electrical Engineers Nominate 1922 Officers

The board of directors of the American Institute of Electrical Engineers at its meeting in New York, March 17 selected by ballot the following list of "Directors' Nominees" for offices falling vacant July 31, 1922: For president, Frank B. Jewett, New York City; for vice-presidents; District 1, G. Faccioli, Pittsfield, Mass.; District 3, W. I. Slichter, New York City; District 5, R. F. Schuchardt, Chicago, Ill.; District 7, H. W. Tobey, St. Louis, Mo.; District 9, H. T. Plumb, Salt Lake City, Utah; for managers, H. M. Hobart, Schenectady, N. Y., Ernest Lunn, Chicago, Ill., G. L. Knight, Brooklyn, N. Y.; for treasurer, George A. Hamilton, Elizabeth, N. J.

California To Vote on State Hydro-electric Ownership

Initiative Measure to be Acted Upon In November Proposes Board With Broad Powers

As an initiative measure there will come before the people of the state of California in the election November, 1922, a constitutional amendment known as the California Water and Power Act, which if approved by the majority of the state, will immediately become a law without the necessity of further legislation. The amendment creates a board which has large powers in the control of water and the distribution of power, and in effect establishes in California state ownership of power similar to that in vogue in Ontario under the Hydro-electric Power Commission.

Powers of the Board

The California Water and Power Board under the act will be composed of five members appointed by the governor, but removable by the legislature by a two-thirds vote of all its members on charges of "dereliction of duty or corruption or incompetency." Provisions are made for the future passage of a law for the removal of members also by recall. This board has almost unlimited power "to do any and all things necessary or convenient for the conservation, development, storage and distribution of water for the generation, transmission and distribution of electric energy" and "to purchase, acquire, produce, manufacture or otherwise provide facilities, materials and supplies raw or finished and any property or thing necessary or convenient for the accomplishment of the purposes of the law, to co-operate and contract with the political subdivisions of the state concerning the use of water and generation of electricity, and to supply or construct for said subdivisions distribution systems."

The board is supreme except for a committee composed of the governor, comptroller, treasurer, chairman of the Board of Control and chairman of the Water and Power Board, which issues and sells bonds but has no discretion as to whether or not bonds shall be issued. Bonds of the state not exceeding the sum of $500,000,000 may be issued and sold by the commission and the full faith and credit of the state is pledged for the payment of the principal of the bonds and the interest thereon.

The board is to establish the rates for service without review by any other state body. The body is finally given the right of proceeding in eminent domain. The determination of the board that the taking of the properties described is necessary is to be conclusive evidence of such nessity.

Sawmill and Village To Be Built by Same Contractor

Contract for the construction of an electrically-operated sawmill at Deneo, Miss., has been awarded Dwight P. Robinson & Co., New York City, by the Deal-Swann Lumber Co. The contract includes building a village of about 50 houses, churches, schools, etc. Additional work at other Mississippi towns is to be done by the same company.

Indicted for Phillipsburg Sewage-Works Extras

Conspiracy Charged Against Engineer and Contractors—Town Commission Declared Inefficient

Indictments for conspiracy to defraud the town of Phillipsburg, N. J., in securing $23,000 for extras on the contract for the Landreth direct-oxidation sewage-works have been returned by the Grand Jury of Warren County against the Municipal Disposal Co. of Philadelphia, H. Jerome Hirst, president, Charles E. Parry, engineer of the company, Korp & Korp, sub-contractors, for parts of the work outside those essential of the Landreth process, and C. E. Tilton, formerly town engineer of Phillipsburg. Mr. Tilton is also indicted for malfeasance in office. Four of the five town commisioners (the fifth having been elected after the contract was completed) are severely censured by the Grand Jury for disregard of state laws in letting contracts and in authorizing contract payments, expending money in excess of appropriations, ignorance of the laws of the state governing municipalities, and lack of business methods, but much of this censure is not based on the sewage-works contract. The Grand Jury reported that it did not find evidence that would warrant the indictment of the commissioners. It placed on the voters the responsibility for electing "incompetent and inefficient public officials."

The indictments and censure are the sequence of an investigation of the conduct of Phillipsburg town affairs, conducted by a former state judge, Frederick W. Gnichtel, of Trenton, acting as commissioner of the State Supreme Court in response to a taxpayers' petition alleging irregularities and mismanagement in the conduct of town affairs. Charles B. Brady, of Phillipsburg, was counsel for the taxpayers.

Results of Investigation

Judge Gnichtel's report, filed in November, 1921, although going into various phases of town mismanagement, dealt largely with the municipal disposal contract. He found that the town commission never rescinded its adoption in 1918 of plans for sewage treatment by Riensch-Wurl screens and chlorination, submitted early in 1917 by the late Robert P. Howell, then town engineer, and George W. Fuller, consulting engineer; that in Feburary, 1919, the commission signed a report by C. E. Tilton, then town engineer, advising that the Landreth direct-oxidation system be substituted for screens and chlorination, but that neither then or subsequently did the commission formally adopt the Landreth process by ordinance or resolution. The commissioner found that late in 1919, the commission awarded a contract to the Municipal Disposal Co. for a direct-oxidation plant for $138,000—$122,000 for its own machinery in place and $25,980 for all other material and work, and that the company sublet all the work, except for its machinery, to Korp & Korp, for cost plus 15 per cent. The commissioner also found that although by statute a bond equal to the contract price should have been put up, one for only $32,000 was accepted, and that at the time of the investigation no one could tell where that bond was.

The conspiracy charges of fraud on $23,000 extras are based on the subcontract. The commissioner reported that although the Municipal Disposal Co. agreed to do the work outside of its machinery for $25,980. It was allowed extras totaling $26,556, "without any official action on the part of the commissioners." The bills for these extras were made out and sworn to by Mr. Tilton, the commissioner states, some of them, at least, on the mere say so of the sub-contractors. The irregularities cited by the commissioner include a statement to the effect that although Korp & Korp took the subcontract on a 15-per-cent-plus basis, they added a profit on cement before figuring the 15 per cent. The commissioner states that the books of Korp & Korp for the year the work was done were burned early in 1921, but that Korp & Korp claimed this was their usual practice.

Mr. Tilton resigned as town engineer of Phillipsburg shortly after the court commissioner's report was filed.

Bill Provides for Colorado River Control

A bill introduced on April 26 in the Senate by Senator Johnson and in the House by Representative Swing, both of California, authorizes the construction by the federal government of a dam at Boulder Canyon on the Colorado River and the construction of a canal from the river at Laguna Dam to the Imperial Valley. Provision is made to issue permits for water-power generation and distribution, first to political subdivisions and then to private companies under proper federal control. The dam and reservoir are to be used, "first, for river regulation and flood control; second, for irrigation, and third, power." A sum of $70,000,000 is appropriated for the dam.

El Paso and Jaurez Plan Flood and Mosquito Protection

Both the flood menace from the Rio Grande at El Paso and the mosquito-control problem are being investigated by committees of the El Paso Chapter of the American Association of Engineers. In addition, there is an international committee representing El Paso, Tex., and Juarez, Mexico, that has been appointed to recommend a plan for ridding the two cities of the mosquito nuisance. On the internationa committee are J. L. Campbell, chief engineer, El Paso & Southwestern Ry., who is serving as chairman, W. C. Stewart, city engineer of El Paso, E. A. Paredes, city engineer of Juarez, and A. B. Colin, of the International Boundary Commission. The A. A. E. committee on the mosquito nuisance has already recommended the construction of levees along the Rio Grande and the drainage of low lands.

As to Rio Grande floods, since the construction of the Elephant Butte dam above El Paso the river-bed at El Paso has risen 6 to 7 ft. Mosquitoes at El Paso first became a problem in 1921 and that Dr. J. W. Tappan, of the United States Public Health Service, is of the opinion that unless immediate preventive measures are taken the mosquito menace will be much greater this year than last.

Engineering Employment Shows Decided Improvement

Signs of increased employment of engineers continue, according to the employment department of the American Association of Engineers. More positions were received, more men placed and a greatly-reduced number of men were available at the end of March than for the past five months. The number of engineers actually unemployed is small—only a few in the construction field and a smaller number in the industrial field. The unemployed in other fields is negligible.

The demand for architects, architectural engineers, draftsmen, structural draftsmen and designers with building experience far exceeds the supply in the Central West. Salaries for men of this class of work have increased materially. Tracers receive in many cases as high as $40 a week at the start, while good draftsmen command as high as $350 a month. A few positions are open for construction engineers and superintendents but not enough to equal the supply. The following table shows the trend of employment:

	March 1922	Feb. 1922	March 1921
Applicants for employment	1,696	1,968	2,329
Positions received	407	312	652
Men referred	1,868	1,475	3,532
Men placed	216	172	276

The average monthly salary of positions filled during March was $196, or $10 more than the previous month; for the same month last year the average salary was $203. The highest salaried position filled was $7,000; seventeen positions were filled at salaries of $5,000 and over. The lowest salaried position was $100 a month. The greatest demand for engineers at this time exists in the Central West and the East which is showing an improvement in the industrial situation. A healthy demand exists in the West for engineers of certain classes.

Students and undergraduates this season will have little trouble in obtaining employment. The highway and municipal fields will require the services of many of this younger class, and students in mechanical, electrical and chemical engineering will find employment with industrial companies who are now making places in their organizations as a result of improved conditions.

The most important factor in engineering employment is the apparent attainment of a much greater degree of economic adjustment and stability than previously recorded. The situation, as seen by A. A. E. officials, is far more promising than any that has prevailed for some time.

San Antonio Plans Auditorium

Plans are being drawn for a municipal auditorium by San Antonio, Tex., to be erected in Madison Square. These plans will call for a steel and concrete structure with a seating capacity of about 6,000; the sum of $500,000 is available for the purpose. The planning is being done by Ralph H. Cameron, architect, under the general supervision of the city engineer, D. D. Harrigan, who will also have charge of construction. It is anticipated that the work will start about July.

Philadelphia Bridge Caisson Is Launched

The west or Philadelphia pier caisson for the Delaware River suspension bridge was launched successfully on April 24 at the yard of the New York Shipbuilding Co., Camden. The structure was christened in accordance with regular shipbuilding practice, being given the name "Keystone State."

As launched, the caisson, whose ground-plan dimensions are 70 x 143 ft., was 52 ft. high above cutting edge, or something more than 40 ft. above the roof of the working chamber. It had all reinforcing and all air locks installed, and part of the shafting. A false bottom was placed under it for launching, to check the impact of the water on the transverse partitions in the working chamber. This bottom floated away as soon as the caisson was fully in the water, and the structure settled to 11½ ft. draft. It will be pulled over to the wet dock, the remaining installation made, and 14 ft. of additional cofferdam built on top of it. With this work completed, early next week, it will be towed over to the pier site ready for sinking. It is to be sunk by filling with concrete, which operation will consume probably several days before the structure rests on the river bottom. The bridge commission last week approved contract forms for the first section of the anchorages. This section includes the concrete core and all the anchorage steel for the structures on both sides of the river. Bids are to be asked shortly.

New England Health Institute Will Hear 76 Addresses

Seventy-six addresses by as many speakers will be delivered before the New England Public Health Institute, at Hartford, Conn., May 1-6. There will be twelve separate courses, including those on health administration, preventable diseases, sanitation, and industrial hygiene. The Institute is under the auspices of the United States Public Health Service, the health boards and departments of the six New England states, and the medical schools at Harvard and Yale. The topics of most likely interest to engineers with the corresponding speakers and the days on which the addresses will be made are:

Tuesday, May 2—Protection of Water Supplies, Sol Pincus, sanitary engineer, U. S. Public Health Service; Pollution of Streams, James A. Newlands, Connecticut Public Health Council; Chlorination of Public Water Supplies, Caleb M. Saville, engineer and manager, Hartford water-works. *Wednesday* — The Health Department and the Community, Prof. C.-E. A. Winslow, Yale Medical School. *Thursday*—Rural Health Work, Dr. L. L. Lunsden, U. S. Public Health Service; Sanitation of Public Bathing Places, S. DeM. Gage, chemist and sanitary engineer, Rhode Island State Board of Health. *Friday*—The United States Public Health Service, Dr. H. A. McLaughlin, assistant surgeon-general; Garbage Treatment and Disposal, M. N. Baker, associate editor, *Engineering News-Record*; International Health Problems, Prof. Winslow.

A reception and dinner will be given to the faculty, as the 76 speakers are called, on Thursday evening, May 4, at which Dr. McLaughlin and others will speak.

Indiana Flood-Prevention Work To Be Active

A large amount of flood-prevention work is likely to go on in Indiana during the coming two years, according to local reports. Work in many counties has been held up since the 1913 floods because of mounting prices. Now it is to be pushed ahead of much other public construction. In the floods of the past two weeks almost every city in the state on a stream subject to flood has been damaged, except Indianapolis, where millions of dollars were spent five years ago in flood-prevention work and retaining walls.

Illinois Central Plans to Spend $50,000,000 in Chicago

Issuance of $50,000 preferred stock by the Illinois Central R. R. to be used for electrification and other major improvement of the company's property in Chicago was approved at the stockholders' annual meeting on April 19. President Charles H. Markham expects that work will begin within a year.

Rival Tickets for Directorate of Road Builders' Association

Rival tickets for the incoming directorate of the American Road Builders' Association, to be chosen by letter ballot closing May 12, are supported in letters which have been mailed to the membership under dates of April 18 and 21. Special importance attaches to the choice of directors this year inasmuch as they are empowered, under the revised constitution, to elect the new president, treasurer, and secretary of the association.

Col. H. L. Bowlby, over his signature as president of the association and on its official stationery, has sent out a communication in the interests of the following candidates: H. K. Bishop, U. S. Bureau of Public Roads; C. P. Fortney, State Road Commission of West Virginia; W. R. Neel, state highway engineer of Georgia; George C. Diehl, engineer, Erie County, N. Y.; Francis P. Smith, consulting chemist and paving engineer, New York; M. F. Bramley, president, Cleveland Trinidad Paving Co.; Frank Terrace, Washington State Good Roads Association.

Opposed to the foregoing ticket is one which has the support of the Highway Contractors' Association of New Jersey in a communication signed by Albert V. Barrett, its executive secretary. This letter urges the election of T. J. Wasser, state highway engineer of New Jersey, a president of the association; James MacDonald as treasurer, and Charles M. Upham, state highway engineer of North Carolina, as secretary. Recipients of the letter are urged to vote for the following directors: Col. R. Keith Compton, chairman, Paving Commission, Baltimore, Md.; E. J. McKenna, editor *Engineering News-Record*, New York; H. K. Bishop, U. S. Bureau of Public Roads, Washington; W. Tom Winn, Georgia State Automobile Association; Joseph F. Hehn, Standard Oil Co. of Louisiana, R. J. Wig[illegible] consulting highway engineer, Jefferson City, Mo.; R. H. Stalnaker, assistant state highway engineer, Sacramento, Cal.

Sacramento Filtration-Job Controversy Ends

Board of Three Awards Contractor $25,000 With Equal Division of Arbitration Cost

Decision was rendered on March 27 by an arbitration board of three engineers selected to review the controversy between the city of Sacramento and the Coast Construction Co. over the construction of the new Sacramento water-supply system contract for the construction of which was canceled by the city. The points at issue were (1) the right of the city to suspend the work on Jan. 2; (2) to cancel the contract; (3) the amount of fee due in settlement. The main features of the contract were published in *Engineering News-Record*, Jan. 13, 1921, p. 77.

The contract was for the construction of a portion of the new filtration project to supply the city with water from the Sacramento River and was dated Dec. 31, 1920. The fee for supervision was to be $82,109 and the estimated actual cost, including overhead, was $807,294. The penalty provided was 50 per cent of over-run above this estimate, not exceeding $41,055. The bonus provision applicable with under-runs below the estimate was similar.

Pay Withheld and Work Stopped

On Oct. 31, 1921, the city engineer withheld the payment of a fee on the ground that the cost of the work was exceeding the estimate on which penalty was based. On Jan. 2, 1922, the resident engineer suspended work under the contract. The contractor then asked for arbitration, as provided in the contract. The contract was cancelled by the City Council on Jan. 26 during the arbitration proceedings and the contractor also submitted this action to arbitration.

At the hearing before the arbitration board the contractor presented claims amounting to $127,703. The city claimed the sum of $23,579 as due in settlement of the $41,055 penalty provided in the contract, claiming that the estimate of contract work had been over-run about $211,000.

The arbitration board awarded, in full settlement of all claims, the payment of $25,000 by the city to the contractor with an equal division of the cost of the arbitration, and held that the city had the right to suspend the work and cancel the contract.

The members of the board were J. B. Lippincott, consulting engineer, Los Angeles, for the city of Sacramento; A. J. Cleary, consulting engineer, San Francisco, for the contractor; and G. A. Elliott, chief engineer, Spring Valley Water Co., selected by the two first named.

East Jersey Water Co. Ruled Out on Rate Application

The East Jersey Water Co. has been ruled out of the application filed by itself and associated companies for increase of water rates in Paterson, Passaic, and other New Jersey communities. The State Public Utilities Commission holds that the East Jersey Water Co. is not a public utility but is a holding company, and that the water rates must be fixed separately for each of the associated companies in the municipalities that they supply.

Federation Officers Confer With President Harding

The work of the Federated American Engineering Societies was discussed April 11 when Mortimer E. Cooley, the president of the Federation, and L. W. Wallace, its executive secretary, conferred with President Harding. The President showed keen interest in the organization and recalled the part which Secretary Hoover took in its formation.

Dean Cooley told the President that the federated societies would concentrate attention in the immediate future on reforestation, elimination of waste in American agriculture and industry, and on the reorganization of the federal government. The President's attention also was called to a list of the activities which have concerned the federation since its founding seventeen months ago. These were handed to the president in typewritten form. Quite to the surprise of Dean Cooley and Mr. Wallace the President proceeded to analyze them on the spot. The list is as follows:

Investigation of industrial waste; participation in the settlement of jurisdictional disputes among unions of the construction industry; study of the relative merits of the eight-hour and twelve-hour shifts in continuous-process industries; actively supported Patent Office Relief Bill, topographic survey bills, business-cycle bill, railway transportation bills, and legislation providing a commissioned status for sanitary engineers of the U. S. Public Health Service; study of the Muscle Shoals and Great Lakes-St. Lawrence waterway projects; participation in the unemployment conference's investigation of business cycles; participation in the activities looking to the reorganization of the Federal Government's executive departments, including the bill providing for a Department of Public Welfare, and particularly proposals looking to the establishment of a Department of Public Works; participation in numerous conferences called by the Department of Commerce.

Business Engineering Conference to Be Held in Pittsburgh

Country-wide interest in the second public conference on commercial engineering to be held May 1 and 2 at Carnegie Institute of Technology, Pittsburgh, is reflected by the large number of delegates already appointed. Dr. Glen Levin Swiggett, of the U. S. Bureau of Education, in Washington, chairman of a national committee appointed by the U. S. Commissioner of Education to investigate business training of engineers and engineering training for students of business, announces that "the primary purpose of the Pittsburgh conference is to promote plans for better co-ordination of the major operations in industry and commerce. Internationally known business men and engineers have been invited to address the conference on major topics relating to the co-ordination of college training with the industrial demand, to civic and social training of the engineer and business man, and to the training of the engineer for management of over-seas engineering projects."

The committee is composed of prominent deans of schools of engineering and of commerce in our larger universities, and of engineers and business men who are nationally known for their interest in the reduction of the costs of production, distribution, transportation, etc., through better training in schools and colleges of the personnel of industry and commerce.

Prominent educators, engineers and business executives are announced as speakers and group chairmen at both sessions of each day. Included among these are: Dugald C. Jackson, professor of electrical engineering, Massachusetts Institute of Technology; Henry Rand Hatfield, dean of the faculties, University of California; P. F. Walker, dean, school of engineering, University of Kansas; R. L. Sackett, dean, school of engineering, Pennsylvania State College; C. R. Dooley, director, personnel and training, Standard Oil Co., New York City; W. E. Mott, director, college of science and engineering, Carnegie Institute of Technology; C. R. Mann, chairman of operations and training division, War Department, General Staff, Washington, D. C. Arthur Morgan, president, Antioch College; Dexter Kimball, dean, school of engineering, Cornell University; F. B. Jewett, vice-president, Western Electric Co., New York City; Samuel Insull, president, Commonwealth Edison Co., Chicago; F. M. Feiker, vice-president, McGraw-Hill Co., Inc., New York City; L. W. Wallace, executive secretary, Federated American Engineering Societies, Washington, D. C.; and Eugene Meyer, Jr., director, War Finance Corporation, Washington, D. C.

Bonds for Street Widening Voted at Milwaukee

A bond issue of $2,500,000 has been authorized by the voters of Milwaukee, Wis., for widening Cedar and Biddle Streets from Sixth St. to Juneau Park on Lake Michigan to a probable width of 160 ft. This is in addition to $1,600,000 bonds voted in 1920 for the same general purpose, of which amount $600,000 was for a bridge across the Milwaukee River to unite the two streets which are to be widened. These streets are the main approach to the civic center site which has been approved by popular vote. The cost of the improvement will be met by excess condemnation.

A small adverse vote on a proposed five-mill annual tax levy for city planning purposes, to yield about $400,000 a year, was cast at the first of the two elections noted above. It is expected to bring it to vote again as soon as possible.

Would Have Engineers Conduct Coal Investigation

That engineers should comprise the personnel of a commission which may be authorized by Congress to investigate the coal situation suggested by Nelson P. Gaskill, chairman of the Federal Trade Commission, in testimony before the House Committee on Labor. Mr. Gaskill opposed coal operators or miners sitting on such a body on the ground that they were interested parties. "A body of engineers and disinterested men with power to employ necessary advisors, accountants, freight experts and transportation men," he said, "would be best equipped to get the information and recommend conclusions."

Traffic Problems To Be Discussed

The program of the annual meeting of the National Highway Traffic Association, which is to be held May 12 at the Automobile Club of America, New York City, has been announced by President Arthur H. Blanchard. Among the subjects listed for discussion are traffic safety, regulations governing speeds, weights and dimensions of motor trucks and trailers, license fees and highway franchises.

The national chairmen who have been asked to make reports at this conference are: Elmer Thompson, secretary, Automobile Club of America, on uniform highway signs; Herschel C. Smith, assistant professor of highway engineering, University of Michigan, on traffic capacity and widths of highways outside of municipalities; H. Eltinge Breed, consulting engineer, New York City, on the status of the construction of highway curves and recommended practices to increase traffic safety; F. W. Fenn, secretary, national motor truck committee, National Automobile Chamber of Commerce, on highway transport franchises; Tom Snyder, secretary, National Association of Commercial Haulers, on highway transport clearing houses; George H. Pride, president, Heavy Haulage Co., New York City, on regulations governing speeds, weights and dimensions of motor trucks and trailers; and, Henry G. Shirley, roads and sanitary engineer, Baltimore County Roads and Sewerage Department, on license fees and motor vehicle taxation.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

NATIONAL FIRE PROTECTION ASSOCIATION, Boston, Mass.; Annual Meeting, Atlantic City, May 9-11.

NATIONAL HIGHWAY TRAFFIC ASSOCIATION, New York City; Annual Meeting, New York City, May 12.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, Philadelphia, May 15-19.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Annual Convention, Salt Lake City, Utah, June 5-7.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Annual Convention, Portsmouth, N. H., June 21-22.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, University of Pittsburgh; Annual Convention, University of Illinois, June 20-23.

The Lincoln (Nebraska) Chapter, A. A. E. will hold its next meeting on May 15. A. C. Everham, western contract manager of the Raymond Concrete Pile Co., will give an illustrated talk on the Raymond methods and J. G. Aldrich of Woods Bros. Construction Co. will show moving pictures of the Bignell pile.

The Florida Engineering Society will hold its annual meeting at Daytona, Fla., May 15 and 16. Reservations may be made through the secretary, J. R. Benton, Gainesville, Fla.

Personal Notes

FREDERICK J. PARKER, formerly secretary of the Arthur McMullen Co., announces the severance of that connection and the formation of the general contracting organizations of the Parker-Sawyer Co., railroad and general construction and of the Engineering Construction Corp., highway contractors both of Philadelphia, Pa.

H. A. DUNLAP and JOHN J. WARD have formed the firm of Dunlap and Ward, building contractors, St. Louis, Mo. Mr. Ward was formerly president of the T. J. Ward Construction Co., both of St. Louis.

JAMES N. GLADDING, city manager of Albuquerque, N. M., and his brother, RAYMOND D. GLADDING, have organized the firm of Gladding & Gladding, consulting engineers, with offices in Albuquerque, N. M. and El Paso, Texas. James Gladding will continue to act as city manager until June 5.

C. R. WRIGHT, port engineer of the Port of Hoquaim, Wash., has resigned. His successor has not yet been named.

HARRY S. LEYDEN, chief inspector of highway construction of Fresno County, Cal., has been appointed county superintendent of highway construction and maintenance. His appointment is effective July 1.

G. W. BEAR, general bridge inspector for the Southern Pacific Co., has been appointed engineer of bridges with jurisdiction over all bridges, tunnels, wharves and ferry slips on the Pacific System.

J. J. HEDRICK, JR., county engineer of Hillsborough County with headquarters at Tampa, Fla., has resigned to enter the contracting field. ALLAN PIMM, his assistant, has been appointed county engineer.

WEBSTER L. BENHAM, under the name of the Benham Engineering Co., has taken all the contracts of Benham & Mullergren, Kansas City, Mo. A. L. MULLERGREN has retired from the firm to engage in private practice in Kansas City.

LESTER J. KALEY, for four years superintendent of buildings, Binghamton, N. Y., has resigned to devote his time to private practice as a member of the firm of Vosbury & Kaley. D. W. JONES, who was at one time inspector of public works for Binghamton, succeeds him.

L. A. DOAN, until recently assistant engineer of bridge construction, Indiana State Highway Commission, has been appointed assistant district engineer in charge of bridges for the upper peninsula of Michigan.

WILLIAM L. MCCREDIE, recently field engineer for the Columbia River Basin Survey, has been appointed assistant engineer for the joint management of the Puget Sound Electric Ry. and the Tacoma Ry. and Power Co.

WILLARD E. FREELAND, who was an associate editor of *Iron Age* for four years and recently superintendent of sales production for the Winchester Repeating Arms Co., has accepted a professorship at Massachusetts Institute of Technology.

N. S. KLINK, formerly engineer with C. T. Main, Boston, Mass., has opened his own office in Boston for the practice of architecture and general engineering.

FRED EMERSON, assistant city engineer, Lockport, N. Y., has been appointed city engineer of Batavia, N. Y.

GORDON L. SHANKS, who spent the past year in Mexico on construction work for the Foundation Co., has been appointed municipal engineer for Rockwood municipality near Winnipeg, Manitoba.

THE HIRAM PHILLIPS ENGINEERING CO., St. Louis, Mo., successor to W. R. Heagler & Sons, Paragould, Ark., and Hiram Phillips, St. Louis, Mo., will specialize in drainage, flood protection, irrigation, sewerage and water supply.

Obituary

LAWRENCE BATES JENCKES, of Crompton-Knowles Loom Works, Worcester, Mass., died recently at his home in Worcester. He was a graduate of Yale Sheffield Scientific School and at one time city engineer of Stamford, Conn.

GEORGE R. DAVIS, engineer in charge of the Pacific division of the U. S. Geological Survey, died recently in San Francisco. He had been connected with the Geological Survey for 25 years.

ROBERT BRISBANE, senior construction superintendent for the J. G. White Engineering Corp., died April 16 in New York City. He had recently completed the station of the Radio Corp. of America at Bolenas, Cal.

GEORGE D. BROOKE, formerly superintendent of equipment and machinery of the Iowa Central and Minneapolis & St. Paul railways, died recently at his home in Minneapolis, Minn. Before retiring from active engineering practice he served in the Panama Canal Zone as assistant, first to chief engineer J. F. Wallace, and subsequently to chief engineer J. F. Stevens, and General Goethtals. Among his other duties he was in direct charge of field and shop work necessary for the maintenance of motive power and machinery.

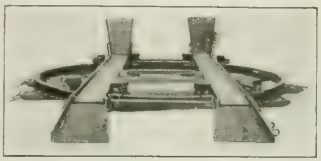
JOHN EICHLEAY, JR., founder and president of the John Eichleay Jr. Co., died April 15 at his home in Pittsburgh, Pa. The firm specialized in structural-steel erection, shoring work and foundations.

Equipment and Materials

Roadbuilders' Portable Turntable

A [illegible] for use in the center [illegible] of a circular track [illegible] wheel screw for moving purposes. On the circular track is mounted the carriage which consists of a [illegible] with hinged approach [illegible] runways are rigidly fastened together and near the end of each runway is attached a pair of flanged rollers or wheels, one roller on each side of the runway. The rollers are properly aligned to correspond with the circular track.

The extreme height that the track must rise above grade to mount the



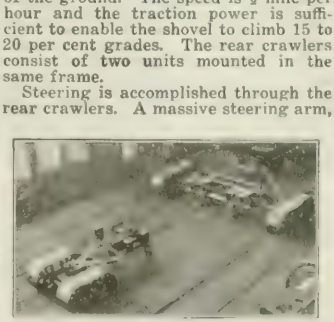
turntable is 10 in. and with the easy approaches provided at the ends of the runways the driving on or over the turntable is accomplished without difficulty.

The best results according to the makers, the Western Structural Co., Moline, Ill., are obtained when the turntable is moved 500 or 600 ft. at a time. The table is moved by a chain hitch to a passing truck which drags it to its position.

Crawler Tractors for Railroad-Type Shovels

Railroad-type shovels of all kinds and sizes may now be equipped with caterpillar-type traction. The Bucyrus Co., South Milwaukee, Wis., makes a mounting of two forward driving crawlers replacing the jack arm and two rear crawlers mounted under the rear end of the shovel. The front crawlers are so designed that they can swivel and adjust themselves to unevenness of the ground. The speed is ½ mile per hour and the traction power is sufficient to enable the shovel to climb 15 to 20 per cent grades. The rear crawlers consist of two units mounted in the same frame.

Steering is accomplished through the rear crawlers. A massive steering arm,



integral with the pintle of the rear trucks, carries a heavy gear segment which engages a pinion on a vertical shaft. It is driven by an independent center valve, reverse-type engine, suspended below the car frame. Steering in curves of large diameter may be accomplished by merely swinging the boom.

Advantages claimed for this mounting are as follows: Time is saved, as only 10 sec. are required for an ordinary move; no rails are to be laid nor jacks to be released and reset. Since the shovel can be moved quickly it does not have to face blasting, and in emergencies, such as slides, can be moved out of danger. It saves two to four pitmen and in soft ground requires blocking only under the crawlers.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Rapid Fire Survey of Business Conditions

Democratic finance must develop a new idea. "We have only one string in our bow, Taxation, and for my part I think it is insufficient," said Lord Milner, some six years ago in the board room of the Rhodes Trust, London. Elaborating upon the idea of creative economics in government he cited the tax-earning power of the Assouan Dam and the Suez Canal. A well known critic recently wrote: "Finance ministers instead of being tax collectors will have to study creative economics and become makers of wealth . . . turn themselves into springs instead of cisterns."

Ingot production per working day in the last four months has shown remarkable increase. Figures for the thirty companies reporting to the American Iron and Steel Institute are as follows:

	Daily Output, Gross Tons	Increase Over Previous Month Tons	Per Cent
December	54,884		
January	61,326	5,442	9.9
February	72,709	11,383	18.6
March	87,806	15,097	20.8

Steel common crossed par for the first time in two years. A million shares have been changing hands each day. On Apr. 21, 1920, the high was 102⅜; in 1921 quotations declined to 70¼, the lowest since 1915, and this week ranged from 99¼ on Saturday, Apr. 22 to 98 on Monday, Apr. 24.

Employees in 113 iron and steel establishment reporting to the Department of Labor numbered 120,663 in March, against 134,421 a year ago, and the payrolls were $5,341,971 and $8,185,422, respectively. Per capita earnings increased 4.3 per cent over the preceding month.

Cost-of-living changes in twenty-eight cities, according to the Bureau of Labor Statistics:

City	Per Cent of Decrease from — June 1920 to March 1922	Dec. 1921 to March 1922
Baltimore	21.7	3.1
Boston	23.5	5.3
Buffalo	23.3	3.9
Chicago	23.1	4.2
Cincinnati	24.0	3.0
Cleveland	23.3	5.8
Denver	21.2	4.8
Detroit	26.0	4.3
Houston	21.2	3.7
Indianapolis	23.2	3.4
Jacksonville	22.4	4.1
Kansas City, Mo	23.6	5.9
Los Angeles	14.5	2.3
Memphis	18.6	3.2
Minneapolis	18.4	3.1
Mobile	24.7	4.8
New Orleans	15.5	2.3
New York	22.5	4.6
Norfolk	22.9	4.4
Pittsburgh	21.3	4.4
Portland, Me	22.6	5.0
Portland, Ore	24.0	3.8
Richmond	21.5	4.6
St. Louis	23.0	3.2
Savannah	25.1	5.6
Scranton	20.5	4.7
Seattle	20.5	2.4
Washington	22.1	3.8

Wholesale prices changed only one point in March, from 151 to 152, according to the Bureau of Labor Statistics index.

Meat for export averaged 14¾c. per lb. in 1921, against 23.84c. in 1920, 30.38c. in 1919, and 11.73c. in 1913.

Building index number of the Bureau remains at 202, against 208 one year ago. A revised index number, including structural steel and other important building materials, and with prices weighted by 1919 instead of 1909 census data, are as follows: March, 1921, 173; February, 1922, 156; March, 1922, 155.

500 truckloads of money of the highest denominations, 10,000 to 50,000 rubles notes, are reported to have been sent out of Moscow in 1921. Four printing works employing 20,000 men operated day and night.

Russia is fast reaching a sound economic basis as a result of removing the Soviet ban on capitalism, according to former Governor James P. Goodrich of Indiana, who has just returned from that country. Quantities of gold are now circulating, although trade is mostly carried on with the depreciated paper roubles — 1,000,000 for a gold ruble. In trade Germany ranks first, England second, Sweden third, and the United States fourth.

An Economic Institute to supply business data to individuals, companies and Government officials has been established by the Carnegie Corporation of New York, and $1,600,000 set aside to finance the project for ten years.

Business done in week ended Apr. 19, as measured by total debits to individual accounts reported by 165 clearing house associations, amounted to $8,797,263,000, compared with $8,414,492,000 for the preceding week. Improvement in New York over last year is 26 per cent, due principally to increased activity of the stock market.

Lumber demand increased 2½ per cent during week ending Apr. 15. Production 15 per cent and shipments 5 per cent below normal according to reports of National Lumber Manufacturers' Association from 377 mills.

Cement Production in March totaled 6,685,000 bbl., against 4,278,000 in February; stocks, 13,824,000 bbl., compared with 14,142,000 bbl. in February.

March cargoes, import and export, show increase of 23 per cent over previous month. Increase in exports of 575,000 tons; imports 1,157,000 tons. American ships carried 35 per cent of both the import and export trade in dry cargo and 77 per cent of the total tanker trade.

Car Surplus, Shortage and Freight Loadings

Reports of the Car Service Division of the American Railway Association show 714,268 cars loaded with revenue freight for the week ending Saturday April 8, 1922, a reduction from the previous week of 112,743 cars. Compared with the corresponding week in 1921, however, this is an increase of 19,387, but on the other hand, for the same period in 1920 it is 87,291 cars less.

The period covered by this report includes the first full week of the coal miners' strike, and the loss in revenue freight loaded is of course, largely due to the decline in coal loading, 115,496 cars fewer being loaded than in the week ending April 1. Coke also decreased 2,053 cars.

That the strike of the miners and the consequent curtailment of bituminous and anthracite production did not adversely affect general business during the first week, notwithstanding some reports to the contrary, would seem to be disclosed by the report of revenue freight loaded other than coal and coke for that week. Merchandise l.c.l. and miscellaneous combined, show a gain of 6,041 cars over the preceding week. Forest products increased 664 cars, and ore 2,448 cars. Live stock loading was 911 cars less than in in previous week. Grain and grain products is the only commodity other than coal which shows a marked falling off. The loading of this commodity has been steadily decreasing for a number of weeks past. The loading for week ending April 8 was 3,436 cars less than the previous week.

Serviceable surplus cars totaled 259,605 for the week ending April 8, or 52,859 cars more than for the week ending April 1. Of these, 92,393 were box cars, 122,359 were gondolas, balance miscellaneous. Compared with the previous week box cars increased 3,902 and gondolas 49,793.

SURPLUS AND SHORTAGE STATEMENT—APRIL 1 TO 8, 1922

Districts	—Flat Cars— Surplus	Shortage	—All Box Cars— Surplus	Shortage	—All Coal Cars— Surplus	Shortage	—Total All Cars— Surplus	Shortage
Eastern	1,620		17,381		46,684		69,700	
Allegheny	912		14,323		41,054		58,040	
Pocahontas	227		632		5,960		7,885	
Southern	3,045	37	7,256	154	7,928	64	22,090	263
Northwestern	1,195		23,033		2,552		32,649	
Central Western	1,617		20,871	25	15,896	50	54,331	75
Southwestern	814	3	8,897	6	2,283		14,910	11
Total	9,430	40	92,393	185	122,359	114	259,605	349
Canadian Roads	4,165		25,815		1,350		39,225	
Grand Total	13,595	40	118,208	185	123,709	114	298,830	349
March 31, 1922	15,680	27	110,676	255	73,841	77	243,236	423

Cement Output Steady for First Quarter

Statistics prepared by the United States Geological Survey show cement production for the first quarter of 1922, at 15,254,000 bbl. as against 15,240,000 bbl. for the same period in 1921. Shipments totaled 13,218,000 bbl. as compared with 12,091,000 bbl. for the first three months of 1921. Although the production rate, for the first three months of 1922, is practically the same as that for the first quarter of last year, increased shipments over last year indicate growing demand. Stocks on hand at the end of March, 1922, aggregated 13,824,000 bbl. as compared with 12,000,000 bbl. on Mar. 31, 1921.

Department of Commerce reports show imports of hydraulic cement in March amounting to 1,597 bbl., valued at $4,308. The total for 1921 was 122,317 bbl., worth $388,828. March imports were from Mexico, 902 bbl.; France, 322 bbl.; Japan, 253 bbl.; other countries, 120 bbl. Total exports of hydraulic cement in 1921 were 1,181,014 bbl. valued at $4,276,986.

Bids Wanted on Big Jobs

Among this week's announcements on contracts let in Construction News, pp. 195 to 209, are the following large projects: Part of 14th St.-Eastern Rapid Transit R. R., Brooklyn, N. Y., to Joslin Constr. Co., Inc., 354 West 24th St., New York City, $1,149,196; a high school at Brooklyn, N. Y., to G. Colon Co., 81 East 125th St., New York City, $1,266,621; a science hall and office building at Washington, D. C., to T. T. Wills, 286 5th Ave., New York City, $2,000,000; a store building at Richmond, Va., to J. T. Wilson, Mutual Bldg., Richmond, $1,000,000; a hotel at Charleston, S. C., to J. W. Cowper, Oliver Bldg., Pittsburgh, Pa., $1,000,000; a 16 mi. pipe line from Swan Lake to Volunteer Park, Seattle, Wash., to Grant, Smith & Co., Henry Bldg., Seattle, $1,468,603.

Big Highway Program Under Way in Texas

Texas has over 2,000 miles on state highways under construction according to the reports received by the U. S. Bureau of Public Roads. This includes 146 miles of concrete and brick pavements, 425 miles of bituminous pavements, 1,190 miles of gravel and macadam roads and the remainder sand-clay, shell and earth roads. This large program is estimated to cost about $28,700,000 of which amounts $13,300,000 is to be paid by the state and federal governments, leaving about $15,400,000 to be paid by the counties and road districts.

New work to be undertaken this year will amount to about 1,350 miles estimated to cost $17,265,000. This work will be financed 25 per cent by the state and 25 per cent by the federal government, and 50 per cent by counties and road districts. All federal-aid funds apportioned to Texas have been definitely allotted to projects, according to J. D. Faultleroy, state highway engineer.

Last year 1,078.5 miles of state roads were completed at a cost of $10,637,521.47 but this year's work is expected to exceed these amounts by at least 50 per cent.

Indicates Senate Views on Tariff Now Before It

Initial discussion of the tariff bill in the Senate reveals that there is practical unanimity of opinion in that body that the ad valorem rates in the bill should be based on a valuation made in the country of origin. Sentiment in the Senate seems to be as strongly opposed to American valuation as that of the House is in favor of it. Approximately 60 per cent of the commodities covered by the dutiable list take ad valorem rates. The remainder of the articles on the dutiable list are covered by specific rates. Every effort was made by the Finance Committee to apply specific rates wherever possible but the difficulty is that in many cases specific rates are impracticable.

In the bill which the Finance Committee has reported, Senator McCumber believes there is no rate so low that it will compel the American producer to surrender the American market to the foreign producer, if he exercises proper economy in the manufacture and marketing of his product. On the other hand, he believes, no rate is so high as to prevent reasonable foreign competition. He expects to see the Tariff Commission become a forum in which any complaints may be lodged as to the unfairness or the injustice of any rate. With the powers given to the President, it will be possible to rectify any injustice that may be worked by reason of rapidly changing conditions. The bill as reframed in the Senate is expected to yield $350,000,000 annually.

Earnings of Well-Known Companies in 1921 and 1920

Annual financial statements of sixty-six well-known American business organizations, as reported to newspapers, show twenty-seven returned deficits in 1921 as compared with ten in 1920.

Appreciable gains in earnings were shown by communication and motor companies. Oil concerns returned largest profits. Among the dye industries, the Allied Chemical & Dye Corp. earned $13,093,889 in 1921 as compared to $29,768,751 in 1920.

Three of five steel firms listed showed heavy losses for the year 1921 while no deficits were registered for these companies in 1920, according to the compilation. Mining enterprises returned small amounts, two showed heavy drops in both years. Most railroads in the list remain with deficits.

Following are net earnings or losses of the companies:

Company	Net Earnings or Losses (Deficits shown in italics) — Total		Per Share. Com.	
	1921	1920	1921	1920
Ajax Rubber Co.	[illegible]	[illegible]		
All America Cables, Inc	3,255,794	22,130,500	14 71	18 39
Allied Chemical & Dye Corp	13,093,889	29,768,751	2 28	6 33
Allis Chalmers Co.	2,215,468	3,564,249	4 07	9 26
Amalgamated Leather Co	[illegible]	[illegible]		
American Bosch Magneto Co	[illegible]	1,595,962		
American District Telephone Co.	979,984	545,043	9 83	5 46
American Glue Co.	496,110	830,445	8 87	15 35
American Public Service Co	2,665,304	2,088,065		
American Radiator Co.	3,178,776			
American Smelting & Refining Co	9,481,471	15,747,715		
Associated Oil Co.	8,157,952	8,807,718	20 52	22 15
Atchison, Topeka & Santa Fe Ry	39,331,661	37,634,751	14 69	13 98
Atlantic Lobos Oil Co.	681,000	1,061,915		
Atlantic Refining Co.	[illegible]	10,513,694		
Boston & Maine R R	[illegible]	[illegible]		
California Petroleum Corp	2,418,448		9 29	
Calumet & Arizona Mining Co	[illegible]	[illegible]		
Calumet & Hecla Mining Co.	[illegible]	3,823,743		
Chicago Great Western R R	592,601	1,548,378		
Chicago & Western Indiana R R	640,142	516,411	12 80	10 33
Fairbanks Morse Co.	[illegible]	2,778,735		
General Electric Co	28,155,667	26,420,616		
Goodyear Tire & Rubber Co.	4,620,043			
Harbison Walker Refractories Co.	1,751,444	2,869,996	5 75	8 79
Hupp Motor Car Co.	890,278		1 59	
Inspiration Consolidated Copper Mining Co	[illegible]	2,294,276		
International Harvester Co.	4,149,900	16,655,300		
Keystone Telephone Co. of New Jersey		80,281		
Lackawanna Steel Co.	1,465,222			
Louisville & Nashville R R.	[illegible]			
Maxwell Motor Co. Inc.	[illegible]			
Mexican Petroleum Co.	1,713,657	1,938,979	7 01	7 75
Miami Copper Co.	[illegible]	1,394,251		
Nashville Chattanooga & St. Louis R R	[illegible]	[illegible]		
Nevada Consolidated Copper Co.	9,123,489	11,577,096	7 50	9 52
Northern States Power Co.	12,963,222	11,798,778		
Otis Elevator Co.	2,100,546	2,880,277	12 02	26 25
Packard Truck & Motor Co.	[illegible]	1,063,306		
Pennsylvania R R.	[illegible]	[illegible]		
Phelps Dodge Corp.	[illegible]	3,766,888		
Pittsburgh Coal Co.	[illegible]	4,183,626		4 93
Pittsburgh Consolidated Coal Co.	4,160,844	426,799	2 11	
Reading Co.	5,780,239	4,663,155	2 95	1 46
Republic Iron & Steel Co.	1,353,452	4,971,129		
Russell Motor Car Co.	[illegible]	[illegible]		
Southern Pacific Co.	[illegible]	1,893,279		14 24
Southern Railway Co.	464,652	5,489,501		
Studebaker Corporation of America	114,719	575,075		
Texas Co.	15,927,781	15,325,802		
Union Pacific R R Co.	[illegible]	[illegible]	8 45	
United Fruit Co.	2,672,550	2,041,449	10 38	102 17
United States Rubber Co.	17,144,461	14,856,326	51 00	62 00
United States Steel Corporation	[illegible]	[illegible]		
Utah Copper Co.	81,670	440,101	1 08	4 53
Virginia Iron Coal & Coke Co.	[illegible]	[illegible]		
Western Electric Co.	[illegible]	519,144		
Western Maryland R R Co.	1,001,623		1 35	24 08
Western Pacific R R Co.	2,212,642	2,403,876	1 88	1 81
Westinghouse Electric & Mfg. Co.	[illegible]	4,015,217		
Wilson & Co.	*92,708,829	*177,174,126		
Woolworth F. W. Co.	[illegible]			
Worthington Pump & Machinery Corp.	[illegible]			
Yellow Cab Co.	[illegible]	662,116		
Youngstown Sheet & Tube Co.	[illegible]	9,[illegible],176		

* Before deducting interest, sinking fund and depreciation.

German Business Fears Result of Rise in Mark Exchange

A news dispatch to the *New York Times* reports that with the improvement of mark exchange, the approximation of domestic prices to those in the world markets and an increasingly acute money shortage, the Berlin Boerse is suffering a "panic of economic pessimism." Many stocks have tumbled from 50 to 150 points.

Domestic prices have increased so materially that the German advantage in world markets has been whittled to almost nothing, and her export trade and export industries are in for a hard time. With the rise of the mark, domestic purchasing power has shrunk and a period of business stagnation has set in. Crop forecasts, moreover, are unfavorable and a money and credit shortage have increased the general nervousness to panicky pitch.

To Move Hotel Building Across Street

A contract has been awarded to John Eichleay, Jr., Pittsburgh, for the removal of the Hotel Truax building, Syracuse, N. Y. from its present site to a site directly across the street recently purchased by the hotel corporation. The Hotel Truax building is a three-story brick with stores on the ground floor, and is about 150 ft. by 80 ft.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted. Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section. The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of April 6; the next, on May 4.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$2.48	$3.35	$4.00	$2.38	$2.66	$3.30	$3.10	$3.25	$3.75
Structural rivets, 100 lb	3.35	3.90	5.50	3.00	3.90	4.45	4.50	3.75	6.50
Reinforcing bars, ¾ in. and larger, 100 lb	2.38	3.25	3.50	2.28	2.56	3.47½	—2.55	3.25	2.75
Steel pipe, black, 2½ to 6 in. lap, discount	61%	61.15%	45%	59½%	61.9–5%	44%	58.8%	53%	30.00
Cast-iron pipe, 6in. and over, ton	47.30	42.00	48.30	43.10	48.00	52.00	+50.00	51.00	55.00
Concreting Material:									
Cement without bags, bbl	2.40	2.39	2.25	1.97	2.24	2.90	2.73	2.94	2.50
Gravel, ¾ in., cu.yd	1.75	1.85	2.25	2.00	1.50	2.50	2.25	1.50	1.50
Sand, cu.yd	1.00	1.15	2.25	2.00	1.00	1.10	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd	1.75	1.90	2.73	1.60	2.25	3.50	2.25	3.00	2.00
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	48.00	36.00	33.50	41.00	+39.00	34.75	28.00	20.00	47.00
Lime, finishing, hydrated, ton	15.80@16.80	18.00	25.00	18.00	29.00	24.00	22.00	27.00	21.00
Lime common, lump, per bbl	2.75@3.18	1.25	2.50	1.40	1.40	2.70	1.75	+2.80	11.00
Common brick, delivered, 1,000	19.90	9.00	11.15	11.00	15.00	12.00	15.00	14.00	16.00
Hollow building tile, 4x12x12, block	Not used	.07975	.115	.0821	.0752	.08	....	.12	.095
Hollow partition tile 4x12x12, block	.11120	.0625	.115	.0657	....	.10	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal	+.89	+.96	1.09	.90	+1.02	1.05	.94	.86	1.05
Common Labor:									
Common labor, union, hour	.75	.35	.....	.80	.....	.50@.55	.56¼	.50@.60	.....
Common labor, non-union, hour	.....	.20	.25	.72½	.40@.50	.35@.40	.47½@.50	.50	.20@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft lengths or over.

New York quotations are delivered except tiles, which are "on trucks." Common lump lime per 280-lb. net, both lump and hydrated quoted f.o.b. cars New York. Sand gravel and crushed stone are quoted alongside dock. Cement and steel pipe delivered to contractors on job. Gravel ready mixed $2 per cu.yd.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed store quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to contractors in yards at San Francisco. Lumber price is for No. 1 fir, common.

Seattle quotes on Douglas fir instead of pine. Common lump lime per 180-lb. net. Hollow building tile delivered.

Montreal quotes on fir instead of pine. Sand, stone, gravel and lump lime per ton. Lime and tile are delivered; cement, sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 98.78 cents). Bag charge is 80c. per bbl. Discount or 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net.

Changes Since Last Week

Firmness in finished steel products is the outstanding feature of this week's market. Structural shapes and reinforcing bars quoted at $1.60 per 100 lb., Pittsburgh, by several large producers. Orders where specifications are especially attractive to makers and buyers are not particular as to deliveries, represent the only quotations remaining at $1.50.

Increasing fuel costs, due to the present coal strike, are causing firmer pig iron prices in all districts. Cast-iron pipe prices also firmer. San Francisco quotes 6-in. pipe at $50 as against $48 per ton.

Long leaf yellow pine, base sizes, quoted in Minneapolis at $39 as compared with $38 per M. ft. b. m., one week ago. Lumber prices elsewhere showing downward tendency.

Common lump lime quoted at $2.80 as against $2.75 per bbl. (180-lb. net) in Seattle. Raw linseed oil quoted at an advance of 5c. in New York and Minneapolis and 3c. per gal. (5 bbl. lots) in Atlanta.

The Cleveland market quotes delivered prices on the following materials: crushed stone, $3.25 per ton; common brick, $14 @ $16 per 1,000; hollow tile 8 x 12 x 12, $143, and 8 x 5 x 12, $50 per 1,000.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. McGRAW, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN *Editor*

Volume 88 — NEW YORK, MAY 4, 1922 — Number 18

Tulane In No Trouble

FROM a source whose accuracy has hitherto been unquestioned there was published in the issue of April 20, p. 666, a brief note stating that there was danger that the engineering and medical colleges of Tulane University might have to close for lack of funds. The statement appears now to have been unduly pessimistic for President Dinwiddie writes that both colleges are in excellent condition, that their funds, while modest, have been largely increased in the past two years and that there is not the slightest intention of closing either school. Tulane has so admirably carried forward the cause of technical education in the South that all engineers will be glad to know that it is not now in trouble.

The Colorado River Problem

FEW rivers have the potentialities of the Colorado. Flow and fall are both great and the surrounding country needs the power and the irrigation water that storage would develop. Furthermore in the lower river there is a serious flood menace, not to urban communities for towns there are scarce, but to one of the richest farm countries in the world. In few rivers likewise is the question of jurisdiction so complicated, for not only does the Colorado flow through seven states with conflicting demands as to relative priority of irrigation, flood prevention and power, but its outlet and much of its flood menace are in Mexico. Finally both utilities company and municipality have filed claims for power development on the river under provisions of the Federal Water Power Act. In the West most engineers know how great is the problem Mr. Hoover's commission is now trying to solve, but elsewhere there are probably many who have not appreciated that there is here one of the most ambitious, far-flung engineering schemes now in immediate prospect. To them the Reclamation Service report abstracted on another page is recommended as an admirable statement of the Colorado River situation as it is today.

Boosting the Barge Canal

ONE thing creditable to the St. Lawrence waterway will be admitted even by the New Yorkers who are so violently opposed to it. It has aroused the business men of New York and the state officials to the necessity of advertising the Barge Canal. That admirable waterway has been officially completed for some years but the growth of traffic along it has been disappointingly slow. The war, with its Government interference, and the post-war depression have together played havoc with predictions of tonnage carried so that the increase in use, while definite, has been very small. Now the various business organizations, alive to the Western propaganda for the international waterway, have decided that the state must show what its canal can do and that the people of New York, 90 per cent of whom live within 10 miles of the canal, must be educated to use it. Whether or not the Barge Canal is a successful substitute for a proposed deep waterway to the Lakes, it certainly has hitherto unused possibilities as a local carrier. In the interest of economic transportation it is to be hoped that these possibilities be quickly made real.

Fall Road Contracts a Failure

FALL contracts for highway construction, undertaken widely in response to the call by Secretary Hoover last September to relieve unemployment by encouraging winter work, appear to have shown almost none of the results anticipated by their advocates. In one or two states, of which Minnesota is the most striking example as noted in our issue of Feb. 9, 1922, p. 234, some construction of gravel roads has been carried out and in a few states a few contractors have accumulated stocks of aggregates for their summer operations, but, generally, there has been no greater amount of road construction during the past cold season than during any previous winter of the last few years. Even the promise that construction would be begun earlier in the spring, which there was some reason to hope might be realized, appears to have failed. Recent visits to half a dozen road-building states of the East have disclosed few contractors at work or even far advanced in getting their equipment onto the ground. The situation has been throughout the winter, and is now, about the same as if the usual procedure of calling for bids in March and April had not been varied. This outcome is unfortunate because it will tend to discourage effort in developing a really promising means of advancing the great road-building program of the country and of economizing in construction. It is an example of a useful idea too precipitately put into action. The way for so great a revolution in contracting habits and construction methods was not made clear before progress was attempted.

Motor-Vehicle Statistics for 1921

THE detailed figures on motor-vehicle registration in the United States for 1921, which the U. S. Bureau of Public Roads has just issued as a supplement to its preliminary announcement of a few weeks ago, offer an interesting field for analysis by the highway engineer. While the total of 10,465,995 vehicles for 1921 shows an increase of about 1,250,000 over the 1920 figures (see *Engineering News-Record*, April 21, 1921, p. 683), the *rate* of increase has fallen off. The total registration in 1921 was about 13.6 per cent greater than that of the previous year, as compared with a 22-per cent increase for 1920 as against 1919. The same relationship, however, does not hold for the commercial-vehicle classification, where a 22.7 per cent increase is shown by the year 1921 as compared with 1920 (last year there were recorded 1,033,151 commercial vehicles, including motor trucks, buses, and taxicabs) as against 841,690 in 1920, a gain of 191,461. This 22.7-per cent increase in commercial vehicle regis-

tration compares with a 12.7-per cent increase in passenger cars during the same period. In other words, the gain in commercial vehicles is progressing at a rate about twice as fast as that of passenger automobiles. This means, of course, that highways throughout the country are being subjected progressively not only to a numerical increase in total vehicular traffic but also to an increase of heavy loadings. Registration fees last year brought in $122,479,000 as against $102,034,000 during the previous year, a gain of $20,445,000, or about 20 per cent. The yield from registration and license revenues in 1921 averaged $11.70 per vehicle as against $11.08 per vehicle the previous year. In this computation for 1921 is not included almost $5,000,000 of revenue received from gasoline taxes in twelve states. Among the states, New York is the leader in total registration with 812,031 vehicles, made up of 630,791 passenger cars, 148,553 trucks and commercial cars, and 32,687 taxicabs and buses. In general, the statistics indicate forcibly the need for continuing policies of highway improvement and maintenance and an adequate and regular supply of funds for this purpose.

Using Old Canal Beds

A BYPRODUCT of the Barge Canal is the subway now being built in Rochester and described on another page. Only a few cities have abandoned canal beds but those who have are fortunate in being able to put to use for modern transportation facilities the abandoned facilities of an earlier day. Cincinnati some years ago started to do just this thing with a part of the bed of the Miami and Erie canal and now the abandonment of many sections of the old Erie canal offers similar opportunity to the large cities of the upper tier of New York State. Syracuse and Utica may be expected to follow Rochester, if not in subways at least in providing interurban entrances, boulevards in centers of congestion, or through-line sub-grade routes.

Funds Needed for Roads

MASSACHUSETTS is not alone among the states in facing a problem of financing highway improvements such as John N. Cole, commissioner of public works, outlined recently in the Boston *Transcript*. Looking ahead for ten years Commissioner Cole sees a need for raising $100,000,000 to be expended on 10,000 miles of road ultimately to form the state highway system, which at present includes 1,700 miles of improved road. A number of years ago Massachusetts discarded the principle of issuing long-term securities for highway improvements so that new funds must be supplied either from an annual appropriation added to the existing state tax or from increased vehicle fees. In the belief that the state, at present, cannot stand the burden of an increased state tax, the Department of Public Works has recommended to the legislature a higher scale of motor-vehicle fees. Many legislators, faced with the necessity of providing increased funds for roadbuilding, are turning toward the motor-vehicle operator with demands to carry the burden. This practice, followed blindly, is apt to result in great abuses. In the case of the Bay State, however, a comparison of the existing scale of vehicle fees with those in other states and with the schedule recommended in the proposed uniform vehicle law by the representatives of the motor-vehicle interests, indicates the justice of seeking increased funds from this source. The small car in Massachusetts today pays only $10 and the larger passenger cars, $15, while the rates for motor trucks from 1 to 5 tons capacity range from $10 to $50. These rates are decidedly low, particularly when compared with the range, in the uniform vehicle law, of from $20 for a 1-ton truck to $80 for a 5-ton truck. In other words, Massachusetts, at present, is failing to receive from the motor-vehicle interests a considerable portion of the revenue which those very interests have conceded to be equitable. This journal has never been an advocate of making unreasonable demands upon motor users for highway development. It has maintained, however, that the scale of fees should be at least as high as those recommended in the uniform law. The facts in the case under consideration indicate a clear-cut case for increased revenue from the road users.

The Impending Catastrophe

DESPITE the depths of frightfulness plumbed during the war we have, it appears, to suffer even more grievous affliction. Submarines and poison gas are but mild irritants alongside the dose now brewing for the chastisement of the American people in general and of someone in particular—whom, we have not yet been able to make out. The trades unions are planning to boycott baseball. Last June Judge Landis was arbitrator in a wage controversy between the building workers and contractors of Chicago. His award was accepted by the contractors and twenty-two of the unions. Ten unions rejected it. The errant ten would now have the controversy reopened and have asked the presidents of the two major leagues to release Judge Landis long enough to do some more arbitrating. Failing this, the president of the Chicago Building Trades Council warns us, baseball is to be "spurlos versenkt." This really is going too far. The obdurate Judge should be made to see the light. He must be made to see it. In the name of humanity, page Babe Ruth!

American Construction Council—An Opportunity

EVER since the war there has been felt the need for some body that would draw together, for furtherance of their mutual interests and of the welfare of the public, all the groups that make up the construction industry. There have been various attempts to accomplish this result, but they have failed to win the wide support needed for a successful national movement. Now, however, there is put before the construction industry a plan that offers equal representation to all groups, that does not disturb group or association autonomy, that merely unites them for the furtherance of their mutual interests and that starts from the solid basis of squaring its every action with the public interest. The American Construction Council is the body—laid out according to that plan.

Its chance for success is excellent. In fact, it must succeed, for if it fail after sincere men have unavailingly tried their hands at other plans, then will be a discouragement that will be insurmountable in years and that will leave this tremendous industry a prey to the inefficiency against which even a long suffering public is reacting. But the times are propitious for launching an all-embracing movement. All who have been active in the previous attempts are parties to this

new effort. These workers include officers of the National Federation of Construction Industries, of the Building Congress movement, which has borne such excellent fruit at New York, Seattle and Portland, Ore., and of various groups, such as those at Philadelphia and Rochester, N. Y., which have worked on less elaborate plans. Furthermore, all the major interests, except labor and public utilities construction departments were ably represented at Cleveland, and both of the absent interests have given such hearty informal approval of the plan that there is no doubt of their adherence. Finally, the building-trade disclosures in various parts of the country, and the pressure for home building bring a demand from the public that the industry pull itself together and eliminate abuses and inefficiencies which are retarding the home-building movement.

The plan formulated at Cleveland appears to us a good one. It makes for a truly representative association. It prevents the dominance of any one group. It functions only where there are mutual interests; it deprives no group of its own distinctive work, but takes over only the common tasks. That these tasks are many need not be emphasized here. These columns have often pointed them out.

Engineers are now called upon to discharge an important civic duty by joining the new council and whole-heartedly supporting its efforts. The Federated American Engineering Societies will doubtless join, but this organized support must be supplemented by widespread and hearty approval by individuals, by the sacrifice of time in committee work and, for those who can do so, by financial support through the taking of sustaining memberships. There is here not merely a civic responsibility, but a civic opportunity. It is in the latter light, particularly, that we hope engineers will view it.

Lost Time Menaces Highway Progress

HIGHWAY contracting has little to be proud of in the manner in which it utilizes the brief season when, in the northern states, it can build concrete roads. Astonishing figures are given in this issue of the small average progress. It is less than 300 ft. a working day. The moderate proportion of time worked is even more astounding. In 114 calendar days there were only 96 working days. Work was actually performed on only 74 days and only 55 full days were worked, calling every day a full day if the lost time was less than three-quarters of an hour. Truly, lost time appears to be the distinguishing characteristic of concrete road construction as this operation is disclosed by the remarkable figures from Iowa.

It is not faulty technique of construction which makes progress slow, but pure waste of possible working time. In Iowa in 1921 work was performed on only two-thirds of the calendar days of the working season. Eliminating Sundays and holidays from the computation, only eight of ten working days were utilized in actual construction. Of the two idle days in every ten working days, one and one-half days were wasted because of rain, snow or mud. In comparison, all that a contractor can do to eliminate delays in moving equipment or from break-downs, and to keep the supply of materials constant, is a small matter. His only possible chance materially to cut down time lost is to devise means for reducing the hazard of bad weather.

No actual information is available how to reduce the hazards of rain, snow and mud in road construction. Even speculation appears to have been largely denied the subject. In concrete building, the hazard of cold weather has in recent years been met very effectively by housing and heating. Is the same safeguard not possible in road construction? Certainly the question is worth attention. Housing is not so impossible a task if one thinks of it. Canvas-covered frames are now universally employed to shield the green slab from the sun and rain. This is virtually a housing device. What is to prevent it from being extended to cover the finished grade? Is it not possible to contemplate the housing of even the grading operations. Shelter-tenting a half mile of road grade is not a stupendous task.

Besides sheltering the work from bad weather, there is the less remote possibility of devising wet-weather methods and equipment. There is not now a concrete road-construction method all of the units of which are designed to operate independently of the moisture conditions of the road grade. Perhaps the method which most nearly approaches the requirement is industrial railway haulage of wet batches. Improvement of industrial railway to make its operation independent of wet grade is a possibility. Safe modifications of the required condition of the subgrade, with respect to wetness, for receiving concrete, are other possibilities. The enumeration could presumably be continued, but the purpose here is to indicate the advantages of developing wet-weather methods rather than to specify in which way development is practicable.

In Iowa last year 15 per cent of the calendar days' period of work were lost because of wet weather. As last year's road builders will recall, there was no excess of rainy weather. The season in fact was rather exceptional for its weather favorable to construction. A season not remarkably bad would raise the proportion of rainy days to 20 or 25 per cent. This is the broad margin of waste which may be narrowed down by wet-weather construction methods. Could it be trimmed even a quarter, more time would be saved than if all delays due to faults of equipment and operation were completely eliminated. Obviously this is a gain worth seeking.

Whatever it may be practicable to accomplish in reducing wet-weather delays, there is an indictment of construction engineering in the broad assertion that if there had been no delays, a season's roadbuilding in Iowa could have been done in two and a half months. Iowa contractors are no more dilatory, probably, than those of other states and its conditions affecting the progress of road work are not greatly different, so that its experience is probably reasonably representative of general practice. Let us put the facts bluntly: There is no concrete roadbuilding for six months from October to May and the six months from April to November are occupied in doing two and a half months' work. What can roadbuilding say of itself as a business or as a technical accomplishment in the face of such a statement?

It was stated in *Engineering News-Record*, Dec. 8, 1921, p. 925, that contracting was failing to develop the technique of road construction and in the succeeding issue of Feb. 2, 1922, p. 177 that highway engineering was registering a similar failure. Can they deny the criticism, with the figures quoted in this issue, confronting them?

What is a Day's Work Laying Concrete Pavement?

Construction Progress on 31 Contracts by 19 Contractors Using 29 Outfits in 17 Counties in Iowa in 1921 Gives Answer—Shows How Small a Part of the Year Actual Work Is Done

By H. K. Davis
Chief Inspector, Iowa Highway Commission, Ames, Iowa

WHAT is a day's work for a concrete crew on highway paving work? Figures recently compiled in the office of the Iowa Highway Commission indicate that the custom has been to overestimate the capacity of a concrete gang; to make no adequate allowance for lost time, and finally, to over-rate the importance of large individual runs.

Average Conditions Represented—In 1921 a road-building program considerably larger than any previous year's output in Iowa, was put under contract and completed. The mileages of types other than one-course concrete were too small to give comparative figures of any particular value. Of this type, however, there were built 151.18 miles, some three times the amount built in any previous year. This furnished an opportunity to secure information regarding plant and organization efficiency by recording the daily progress made by the various contractors. Other reasons besides the increased mileage justified the data collected on 1921 performances as a basis for estimates.

1. The season was average in respect to weather conditions. Spring opened somewhat early and some concrete was laid by a few outfits, but any time thus gained was lost soon after by a late spring snowstorm, with continued bad weather. One or two outfits also operated later into the fall than is usually possible, but here again the equivalent of the time thus made available had already been lost by an early autumn snow. During the season a normal amount of rain fell, distributed in about the usual manner throughout the summer.

2. The season was normal in respect to labor supply. The few labor problems which arose, were occasioned by wages or working conditions and not by the amount of labor available.

3. The season was normal in respect to shipping facilities. Very few of the delays on account of materials could be charged to shortage of cars or other inadequate railway service.

4. A supply of concrete materials adequate to the needs of the work either existed or was developed for practically every job. A small number of outfits were at times held up for material, but this was unusual, there being no more trouble than in any normal year.

5. The paving laid was well distributed over the entire state and was therefore fairly representative of all conditions liable to be encountered in Iowa. A line drawn on a map around all the different paving jobs would include three-fourths of the area of the state.

6. The work done was well distributed as to size of individual jobs. The following statement shows that no great quantity of the work was bunched in any one locality nor went to one contractor: During 1921 work was carried on, on 31 contracts, by 19 contractors using 29 outfits on 35 separate sections of road under 26 road projects in 17 different counties. The term "outfit" is here used to include all loading, mixing and hauling equipment and their crews, which were operated as a single construction unit.

Method of Recording Results—The figures here summarized were compiled from daily inspection reports sent to the central office of the state highway commission by the inspectors on the jobs. These reports covered the day's run in considerable detail, locating it exactly by stations, and giving the usual information about cement content, subgrade, weather, and reasons for delays. They were sent in for each working day regardless of whether work was done. They did not show exact hours worked, therefore, the smallest unit of time was the day or fractional part thereof. Delays of 45 min. or under were not considered, they being too small to change the results materially. These daily runs for each job were checked carefully against the stationing and the length known to have been laid.

IF THERE *had been no delays the whole season's work could have been done in 2½ months.*

OF 35 *per cent lost time only 1.09 per cent was lost because of machinery breakdowns.*

IN 96 *working days, work was done on only 74 days and only 55 full days were worked.*

THE *record that an outfit can make once in a season is a poor criterion by which to judge the efficiency of the outfit.*

A tabulation was made by heading a column for each construction outfit, with a brief description of the work and the equipment used, following, in the body of the table, with the run in linear feet for each day until the job was completed. Runs by different contractors on any given date show opposite to each other on a single line. Reasons for failure to work on any day, or causes for delays were inserted in the same space as the daily runs, using a set of abbreviations in accordance with an attached legend.

General Inferences from the Records—Inspection of the table thus prepared discloses some interesting information. For example the effect of a state-wide or regional rain shows up immediately on the progress made throughout the state or region, on that date. Interesting comparisons appear between industrial railway and truck haul outfits, when the rains have not been too heavy. Also, nothing could be better than this comparison side by side to show the difference in the ability of the outfits to produce results consistently. *When two outfits work side by side, and conditions are similar and the weather is the same, and one outfit fails to work more than half the time while the other produces steady results day after day, the natural conclusion is that the difference lies in the management.*

The earliest outfit to begin work, laid concrete on April 8. The last concrete laid was on Nov. 16. Between these two dates there elapsed 223 calendar days, which, for this year, constituted the length of the construction season on paving. This is believed to be longer than could be depended on as a usual thing in this state.

The two longest-drawn-out jobs in the state were under way for 195 and 193 days, respectively. Neither of these outfits would have required this length of time to complete its work, however, had it not been for long delays due to weather, materials, etc. Several outfits, on the contrary, finished their undertakings in from 30 to 50 days. In some instances this would not have been possible except for the fact that the 30 or the 50 days happened to come between extended spells of bad weather. The effect of weather therefore is considered to balance up fairly well in the final averages.

Another factor is introduced by these short jobs that tends to modify the final averages in an unfavorable manner. This is that such a job does not constitute a season's work for the outfit. In some cases it is known that the outfit actually did other paving, perhaps on city streets. No data are at hand on their performance on any such outside work and it therefore cannot be considered by the highway commission. The record of the outfit as a consequence shows up poorly so far as the season's accomplishment goes, and brings down the average performance for the year for all the outfits. However, what is true of these outfits in an extreme degree is true in smaller degree of the majority of those on the state work during the year. Those outfits which are credited with doing a respectable season's work could in many instances have finished from one to three miles more of pavement if the work had been there to do. This is shown by the fact that the average completion date of all the outfits working was somewhere around Sept. 25, after which date there were several weeks of favorable working weather.

Any attempt, therefore, to regard the season's average performance per outfit as here shown, as the maximum possible output for such an outfit would be a mistake. At most it can only be regarded as what actually was done. And, since the conditions that caused it are not apt to change, it may safely be regarded as what probably would happen again in a normal season. The conditions mentioned are that in Iowa the length of road that can be included in any one contract is much more likely to be governed by the finances of the county paying for it than by the economical length of run for an outfit for the season.

Total and Average Performances—The data when tabulated were summarized (see accompanying table) to show total feet laid in the season, calendar days elapsed, actual days worked, total days delay due to various causes, etc. Averages were figured from these totals for each contractor and for the state as a whole. In spite of some small lengths of pavement held over from contracts let the previous year, and several current year contracts of from one to three miles only, the average length of pavement laid was 27,525 ft., or in the neighborhood of 5 miles. Several outfits laid from 40,000 to 50,000 ft. or from 8 to 10 miles. One outfit closed the season with 61,585 lin.ft. or 11.65 miles to its credit. This was a pavement of more than usual difficulty, having a 20 ft. width, integral curbs, monolithic street inlets, and many intersections and farm entrance returns. Figures in the tabulation are given in linear feet measured on the center line, since for the purpose in view this unit serves as well as any other. It was reported by the man in the field because of the considerable amount of work necessary to reduce stationing to square yards when the design included many widened curves, intersections, etc. For comparative purposes these would introduce but small variations, since they will average very nearly the same per mile of road. The width of all roads also was uniformly 18 ft., except in a very few instances where it was 20 ft. This fact furnishes an easy conversion factor for approximate calculations, 1 lin.ft. being the equivalent of 2 sq.yd. of pavement in nearly 90 per cent of the cases.

The average length of time used per outfit to complete the season's work was 114.3 calendar days. This is a decided decrease from the 180 to 200 days usually taken as the length of the working season on concrete paving. When the average feet laid per day is calculated, with calendar days as a basis, a figure of 241 ft. per day for the state results. This shows how small an average should be used in case it is ever desirable to use a calendar day average.

When Sundays and legal holidays are eliminated from the total calendar days a more logical basis of comparison is left. With the possible working days cut to an average of 96.1, the average output per outfit is raised only to 286 ft. per day, or less than 600 sq.yd.

Eliminating all rainy days and other stops leaves an average of 74.1 days per outfit on which concrete was actually laid during the season. Not all of these days were full days since many of them show only short runs when rain or break-downs stopped the work for the remainder of the day. To the highway commission and the contractors of Iowa it was a distinct surprise to find *that all the concrete laid in a season's work could have been concentrated in two and one-half months of steady work if only the causes for delay could have been eliminated.*

The average laid per day worked, also, is a very conservative figure, being 371½ ft. With a favorable season and everything practically normal, this figure would indicate that the assumption sometimes made that an outfit should turn out 800 sq.yd. per working day is at least ample for an average of good, bad and indifferent organizations. Some half dozen one-mixer outfits only were able to exceed this 800 sq.ft. average throughout the 1921 season in Iowa, and these outfits were the ones that were noticeable to even the casual observer for their ample equipment and good management.

The 74.1 average of days on which work was done represents 64.8 per cent of the average 114.3 days time elapsed during which the work was under way. One contractor's superintendent is known to the writer to have stated early in the season that 80 per cent of the time is the best that any one should figure on. The table shows that he came within 1.8 per cent of reaching this limit with one outfit, but to do this he worked many Sundays that others did not. The closest competitor this firm had in this respect worked 73.9 per cent of the time, and very few outfits reached 70 per cent.

Principal Causes of Delays—The remaining 35.2 per cent of the days not worked are classified under various

Contractor Location	Moore-Young Construction Co Watertown, Ia	Moore Young Construction Co Watertown, Ia	Wm. O'Neil & Sons Panhandle, Minn	Koss Construction Co Des Moines	Koss Construction Co Des Moines	Chas. Wetz Sons Des Moines, Ia.	Koss Construction Co Des Moines	Henkle Construction Co Mason City, Ia	Parker Engineering Co Sioux City, Ia	Lonsdorf & Johnson Humboldt, Ia.	Winslow Construction Co Appleton, Wis	Winslow Construction Co Appleton, Wis	Marsh Engineering Co Jefferson
	Benton Co.	Benton Co.	Cerro Gordo Co.	Clinton Co.	Clinton Co.	Des Moines Co.	Dickinson Co.	Cerro Gordo Co.	Hancock Co.	Humboldt Co.	Floyd Co.	Floyd Co.	Greene Co.
Equipment	Central Prep. Plant Foote 21-E paver Auto Car Trucks, Ford Locomotive Crane	Central Mixing Plant Pioneer Spraying tractor Fuel Trucks Byers Crane	General Prep. Plant Industrial Railways Wooden Tunnel Locomotive Crane	Central Prep. Plant Lakewood Derrick Auto Car Trucks Koehring Paver	Central Prep. Plant Jones Work Car Industrial Railway Koehring Paver.	Central Mixing Plant Smith Mixer Steel Stiff Leg Derrick Bell Conveyor Pettibone Auto Car Trucks Federal Trucks	Central Prep. Plant Stiff Leg Derrick Gravel Plant on Cummins Auto Car Trucks Koehring Paver	Central Prep. Plant Rex Derrick Locomotive Crane Wooden Tunnel Industrial Railway Koehring Pavers.	General Mixing Plant Rex Derrick Yuma Trucks and Others	General Prep. Plant Paving Mixer Truck Haul	General Mixing Plant Rex Mixer Truck Haul Gov. Derrick	General Mixing Plant Double 2-Bag Mixers Gov. Derrick Truck Haul	Use 3 different Plants 1 General mixer N Paving mixer East and two Combined in Central mixing plant W Truck Haul on all cases Stiff Leg Derrick
Pavement	Width 16 ft Concrete Sidewalk	Width 16 ft Concrete Sidewalk	Width 16 ft Concrete Sidewalk	Width 16 ft Concrete Sidewalk	Width 16 ft Concrete Sidewalk	Width 16 ft Concrete Sidewalk	Width 16 ft Concrete Sidewalk	Width 16 ft Concrete Sidewalk	Width 16 ft Concrete Sidewalk	Width 16 ft Concrete Sidewalk	Width 16 ft Concrete Sidewalk	Width 16 ft Concrete Sidewalk	Width 16 ft Concrete Sidewalk
Total [illegible]	[illegible]	[illegible]	[illegible]	41 [illegible]	44 42	[illegible]	25 424	45 125	21 [illegible]	3 119	4 747	[illegible]	[illegible]
Calendar days elapsed from [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Average [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Possible working hours in [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Average [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Working hours [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Average hours per day worked	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Percentage [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Sundays and holidays	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Sundays and holidays on which no work was done	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Non-holiday, but because of rain, mud and frost	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
No. of whole days lost because of break-downs	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
No. of whole days lost because of shortage of material	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
No. of whole days lost because of moving equipment	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
No. of whole days lost because of all other causes	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
No. of whole days lost because of rain, mud, snow	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Percent of all calendar days lost because of Sundays and holidays	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Percent of all calendar days lost because of rain, snow and mud	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Percent of all calendar days lost because of break-downs	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Percent of all calendar days lost because of shortage of material	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Percent of all calendar days lost because of moving equipment	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Percent of all calendar days lost because of all other causes	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Percent of all calendar days lost because of all causes	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
No. of fractional days lost because of rain, mud and snow	13	5	15	16	8	15	9	11	2	2	0	2	6
No. of fractional days lost because of break-downs	0	1	4	5	6	12	1	2	7	0	0	2	0
No. of fractional days lost because of shortage of material	0	0	0	1	6	11	6	0	0	0	0	0	2
No. of fractional days lost because of moving equipment	4	0	2	2	1	5	1	1	1	0	0	3	0
No. of fractional days lost because of all other causes	3	0	0	6	5	9	0	4	2	0	0	2	2
No. of fractional days lost because of total all causes	20	6	21	32	26	52	17	18	12	2	0	9	10
Percentage of days worked on which delay occurred	19 8	22 1	18 3	30 5	23.8	42 3	21 3	19 2	25 6	12 5	00 0	17 0	15 9

heads according to the causes for the delay. The resulting percentages are as follows:

PER CENT OF ALL CALENDAR DAYS LOST

Sundays and holidays	14.20
Snow, rain and mud	14.70
Break-downs	1.09
Shortages of material	1.14
Moving equipment	2.56
All other causes	1.51
Total	35.20

Attention is called to the large part that Sundays and legal holidays and the weather play in the contractors' plans.

The small percentage of whole days lost on account of break-downs is rather noticeable. This speaks a good word for the reliability of modern paving equipment. It also speaks well for the foresight and push of many of the superintendents in having repair parts on hand and being able to place them quickly, for when the small delays due to various causes are tabulated and classified, break-downs make up a much larger per cent of the whole.

The percentage of days lost on account of shortages of material, bears out the statements made earlier, that the season was as favorable as could be expected as regards material supply and delivery.

The moving and re-erecting of equipment makes up a much larger percentage of all time lost than would have been supposed by most engineers.

"All other causes" for days lost, include shortages of water, shut-downs to prepare subgrade, shut-downs by engineer or inspector, labor shortages, truck shortages, etc. They are each one so small as not to justify separate classification.

The fractional days lost are classified under the same headings as the whole days lost except for Sundays and holidays. The tabulation is as follows:

PERCENTAGE OF FRACTIONAL DAYS LOST

Rain, mud and snow	12.41
Break-downs	5.21
Shortage of material	2.51
Moving equipment	1.58
All other causes	4.55
Total all causes	26.26

The figure of 26.26 represents the percentage of the days worked on which there was some considerable delay due to some cause or other. Subtracting this from the 74.1 days worked leaves 54.7 full-days work on which there was no delay of more than about 45 minutes.

The prevailing tone of the conclusions drawn from the tabulation appears to be pessimistic. The almost universal habit of engineers to give honorable mention only to their livest contractors; of contractors to mention only their best days run, and of equipment concerns to advertise only the job where their equipment proved highly successful, have all created false impressions of the possibilities of construction progress. *The record run that an outfit can make once in a season is a poor criterion by which to judge the efficiency of the outfit.* Yet the public, and to too great an extent the profession itself, have these figures in mind in judging a contractor's progress. Alongside such records the mediocre performance of the steady producer seems unromantic and uninteresting, but the fable of the hare and the tortoise is as true today as it was when first told.

Individual High Records—As evidence that the figures used in this article are not based on the performances of a group of lightweight contracting concerns, some of the individual records are appended. While these in no instance set new marks for the contracting fraternity to shoot at, it is believed that they show that the organizations which laid the Iowa pavements in 1921 were well organized and alive to the necessities of their jobs. This being true the figures here compiled are fairly representative and if not entirely applicable in other states, may at least be considered indicative when proper allowance has been made for the differences in basic conditions.

One outfit ran 1,200 lin.ft. of 18-ft. pavement in 19 successive working hours. Another outfit belonging to the same contractor ran 1,025 ft. in 16 hours. An outfit with two mixers in a battery ran 1,025 ft. in a ten-hour day. Another outfit ran 935 ft. of 20-ft. pavement in a

16-hour day, building curbs, gutters, intakes, and driveway returns, in addition. Runs of 700 to 800 ft. were common, while gangs whose regular daily output was from 500 to 600 ft. per day, when running well, were the rule.

One contractor between June 16 and July 30 inclusive, 45 calendar days, worked every day but the 7 Sundays and legal holidays, or 38 successive working days, laying in that time 20,658 lin.ft. of 18-ft. pavement 7 in. thick at the edges and 8 in. at the center. This was an average of 543½ ft. for every working day for a month and a half. Reduced to cubic yards it equals a daily run of two-hundred thirty-one and one half cubic yards.

Another contractor using two separate outfits, worked both outfits every calendar day for 34 successive days from Sept. 21 to Oct. 24 laying in this time 29,347 lin.ft. of 20-ft. pavement 8 in. thick, with integral curb and gutter. This was a total of 5.56 miles or an average of 432 lin.ft. per calendar day for each outfit. Reduced to cubic yards this made 218 cu.yd. per day per outfit. Not the least interesting features of this run was that a weighted average of the haul shows every ton of this material hauled a trifle over five miles. The bulk of it was hauled over a hill road containing seven adverse 6 per cent grades and many smaller ones. A large share of it was hauled up a single grade 9,000 ft. long, part of which was 6 per cent, and which had a number of curves. Practically all the remainder was hauled up a grade a mile long, with several curves and some 6 per cent grade. To complete his difficulties a move was necessary with one of the outfits. By bringing in an extra mixer the remainder of the equipment was moved 15 miles across country and 29 ft. of pavement was laid on the same day.

These accomplishments are not exceptional but they do show good management on the part of the contractors. Yet in spite of this they were able to run only 371 ft. per day for 74 days during the year.

Four Carloads of Lumber

THE accompanying photograph gives evidence of the size of Douglas fir trees which grow in some of the stands of timber owned by the St. Paul & Tacoma Lumber Co. The butt cut on the first car came from a tree which the report says was 300 ft. high and whose lowest limb was some 200 ft. above the ground. This log was 32 ft. long, 9 ft. in diameter inside the bark at



THE "BIG STICK" SCALES 11,000 FT. B.M.

the butt, 7 ft. at the top, and scaled 11,000 ft. b.m. The entire tree scaled 43,000 ft.

The second car in the picture contains the butt log from another good sized tree and the other cars carry the second and third cuts, respectively, from the larger trees. The photograph was taken in January at the mill of the company in Tacoma, Wash., just before the logs were dumped in the pond.

Stanford Stadium Built of Timber on Earth Fill

Material From Site Cut 23 Ft. to Form 37 Ft. Fill—Shrinkage Nominal Due to Tamping by Animals and Equipment

By E. E. Carpenter
Of Baker and Carpenter, Engineers, San Francisco, Cal.

THE athletic stadium completed last fall for Leland Stanford, Jr., University, Palo Alto, Cal., embodies design and construction features unusual when compared with similar structures recently built. Outstanding among these are: (1) the use of timber in seating structure instead of concrete; (2) the placing of embankment by scrapers to form the support for the seat structure; (3) the speed with which the stadium was built; and (4) the skill and efficiency displayed in the prosecution of the work.

General Description—The stadium consists essentially of an excavated bowl-shaped depression, oval in form, 360 ft. in width and 540 ft. in length at the level of the playing field. The excavated material is placed in an embankment nearly surrounding the depression and the combined slopes of the excavation and the encircling embankment form the support for the seat structure or bleachers. The depth of the excavation is approximately 23 ft. and the height of the embankment 37 ft., both with reference to the elevation of the original ground. A standard four-lap or quarter-mile running track encircles the playing field and extends southward at the east side to form a 220-yd. straight-away.

Grading Methods—Elevating graders drawn by caterpillar tractors were used as the major equipment to excavate the material and load it in dump wagons by which it was hauled and deposited in the fill. Four mules were used with each load, which, on an average, contained $1\frac{1}{2}$ cu.yd., excavation measurement. This method of handling proved most satisfactory both for speed and economy and the resulting progress was noteworthy. With three graders working daily rates of progress as high as 3,696 cu.yd. were reached, and weekly rates of 17,000 to 20,000 cu.yd. were maintained. From five to ten 4-horse fresnos were used constantly to trim slopes and work out corners not accessible to the graders, and a steam shovel was put in for a short time to finish the south end of the straight-away and to excavate the drain ditches. For contract purposes all quantities were measured in excavation.

Embankment—While an allowance of about 8 per cent for shrinkage from cut to fill was made in planning the work, it became evident during progress of the work that this allowance was excessive, and minor revisions were made accordingly in the lines and levels of the pit and the embankment to adjust and maintain a proper balance of quantities. The final result shows very closely a balanced condition, the volume of the excavation at completion being practically equal to the volume of the embankments plus the gravel used for road purposes and stocked for future use. The swell of the material from pit to dump wagon averaged about 30 per cent, and the subsequent compacting of an equal amount in placing it in the fill is evidence of the effectiveness of the packing or tamping action of the mules' feet and tires of the heavily loaded wagons.



PLACING EARTH BERM AS SUPPORT FOR SEATING STRUCTURE—STANFORD STADIUM

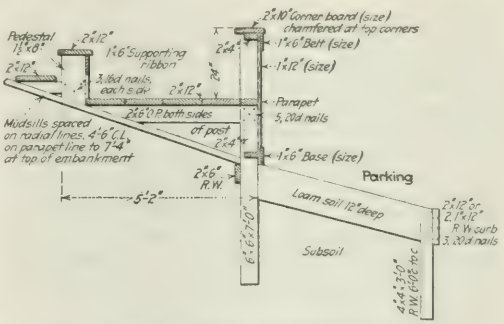
Observations taken during the three months subsequent to the placing of the embankment showed a maximum settlement of less than 1 in., a remarkably small degree of settlement when the fact is considered that approximately 4 in. of ráin fell at the site in November and December.

Soil Investigations—As a preliminary to construction operations, pits were sunk to a depth lower than the finished playing-field level to discover the subsoil conditions and water-table elevation. These pits passed through alternating layers of light clays, sandy silts, and coarse sand and gravel. The water table was found to be well below the level of the finished field, thus removing all possibility of trouble from ground water during construction, and simplifying the problem of the

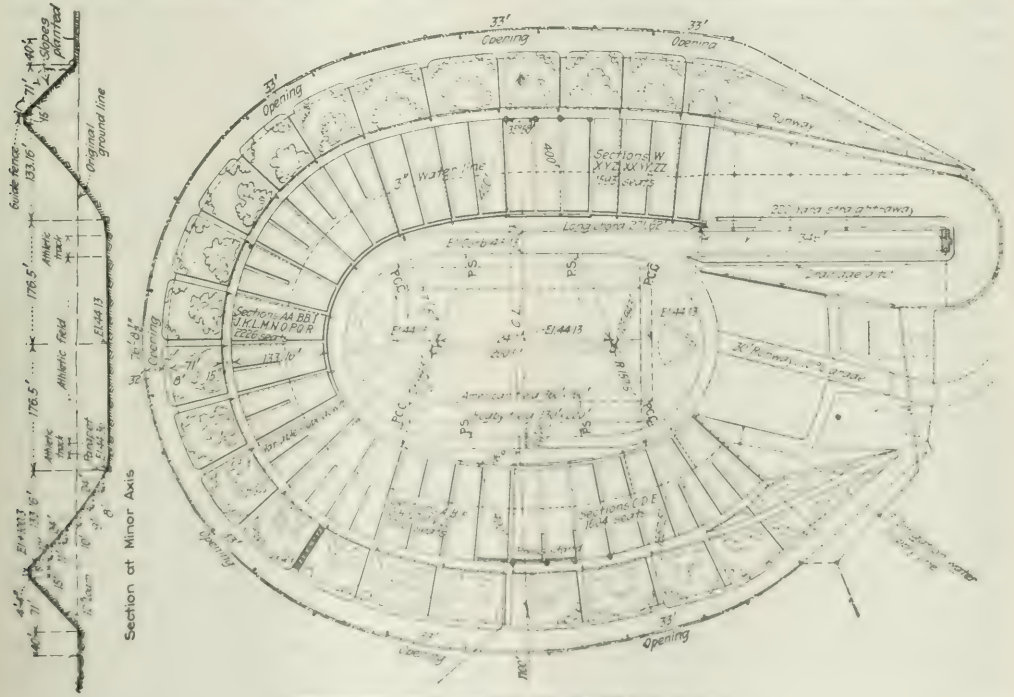
drainage of rainfall and runoff within the bowl. These pits were left open to afford contract bidders an opportunity to inform themselves fully of the nature of the material to be excavated.

Timber Structures—The design of the main timber structure—the bleachers—was developed in a simple form which possesses, nevertheless, the essential requirements of safety, comfort, and economic permanency. More permanent and costly types of construction were fully considered but were rejected as not being required to meet the conditions of use, and as not being justified when investment charges were balanced against maintenance expense.

Inasmuch as the embankment in itself is permanent and non-deteriorating maintenance problems and the annual expense entailed are reduced to the upkeep of a



PLAN, AND SECTION THROUGH SHORT AXIS



CHARACTERISTIC SEATING STRUCTURE DETAILS

very simple seat structure, accessible at all times for inspection and repair.

To illustrate the point of economic permanency, the estimated cost of the bleachers, steps, etc., constructed of concrete was $140,000. The cost of the corresponding structures in timber, as built under the contract was $40,259—a difference of about $100,000 in favor of the timber type. Assuming the life of the timber bleachers, including the redwood mudsills, to be 15 years, and disregarding compound interest, the yearly replacement fund would be about $2,700. Add to this the investment charge at 6 per cent on $40,000, or $2,400, and a total annual charge of $5,100 for replacement and interest is reached. The annual investment charge alone on the cost of the concrete bleachers ($140,000 at 6 per cent) would be $8,400. Without pursuing the comparison further by considering the life or maintenance of the concrete type, nor the fact that a timber seat element is necessary in this type, it is obvious that the timber bleachers are fully warranted on the grounds of economic permanency.

After the bleacher slope of the embankment had been trimmed to very accurate lines, and its gravel surface compacted by a thorough wetting down with hose, 2-in. x 6-in. redwood mudsills were firmly embedded on radial lines spaced from 4 ft. 6 in. at the bottom to 7 ft. 4 in. at the top of the slope. Horizontal checks or headers of 2-ft. x 6-ft. Oregon pine timbers were set in the slope at 12-ft. horizontal intervals on both the inside and outside to prevent erosion or gullying of the slope by rain.

Framing Seating Structure—The pedestals for the bleacher seats and the joists of the footboards were framed and assembled at the mill adjacent to the work

and delivered on the bank in complete units. Similarly, the aisles and steps were framed at the mill and delivered to the job ready to be put in place. Seatboards and foot planks were distributed at convenient points at the top and bottom of the slope and were framed by hand on the pedestals. No. 1 common grade Oregon pine, surfaced four sides, was used throughout the job. The seatboards and the footboards were milled with chamfered or rounded corners to permit interchanging when put in place. Thus a selection of material was possible and the quality of the lumber in the seatboards was correspondingly improved. Curbs for track and roadways were of redwood lumber. Fences of heavy galvanized mesh were installed with redwood posts.

Horticultural Features—The playing field and all slopes of the straight-away and embankment were given a top-soil dressing, which had been stripped previously from the surface of the field. The outside slopes were planted with vetch dotted with selected shrubs and trees which merge the stadium into the natural park-like surrounding landscape. The flat surfaces of the playing field and straight-away are planted with rye-grass turf. With the coming of spring the vetch will probably be replaced by a more permanent type of planting, and the playing field will be seeded with blue grass.

Drainage—While it is realized that a more or less elaborate drainage system will be eventually required for the stadium, no provision for drainage was made in the initial construction. After the run-off and general conditions of drainage have been observed during the first winter season, a permanent system of drains will be designed and installed in conjunction with the installation of the athletic track which was not finished in the initial construction.

Provision has been made for the collecting of drainage water by means of two extensive ditches paralleling and adjacent to the straight-away track and terminating at a sump at the rest house at its southerly end. Pumps of sufficient capacity to handle any waters collected will be incorporated in the drainage plans and installed at a later date.

Cost—The contract for the construction of the stadium was signed May 25, 1921, and work was started June 5, 1921. The contract items were completed on Oct. 31, 1921, on which date a completion notice was issued. The cost of the completed structure was as follows:

Contract items	$163,726.35
Extra work	18,526.48
Gardens and planting	6,387.00
Miscellaneous supplies	5,267.10
Engineering and supervision	16,293.92
Total cost	$210,200.85

The estimated gross receipts from the opening game which was held Nov. 19 when about 60,000 people witnessed the annual University of California - Stanford game, were $213,000, and the net receipts $209,000. The stadium was, therefore, practically paid for at this game.

The design of the stadium was developed by Prof. Charles B. Wing, of the university faculty. The execution of the project was carried out by Baker & Carpenter, San Francisco, as executive engineers for the Board of Athletic Control of Stanford University. The contractors for the construction were Palmer & McBryde, San Francisco, and for the planting, McRorie & McLaren, also of San Francisco.

Analysis of Design Factors for Warehouse Facilities

Unit Values That Insure Adequate Elevator Service, Tailboard Space, Trackage and Shipping Area for Given Floor Space

Abstract of sub-committee report of Committee on Yards and Terminals, American Railway Engineering Association

IN ORDER to insure efficient operation of a warehouse the various service facilities must be properly proportioned to the warehouse floor area. A study of these facilities, or factors of design, i.e. trackage, tailboard space, shipping platform area and elevator service, in fifteen warehouses is presented in Table I.

Elevator Service—Great variation in the amount of warehouse space per elevator may be expected, according to size of warehouse, number of tenants, length of turnover period of goods, and size and speed of elevators.

TABLE I. CHARACTERISTICS OF LARGE WAREHOUSES

No. of Floors	Floor Space, Square Feet; A Shipping Platform (B)	Storage Space Served by Elevators (C)	Total Storage Space (D)	No. of Freight Elev.	No. of Cars	Tailboard Frontage Lin.-ft.	Remarks
8	44,800	3,894,000	3,894,000	72	93	1,824	U. S. Army (E)
8	37,670	1,344,000	1,573,500	24	90	960	U. S. Army (E)
6	19,800	512,000	565,500	7	28	90	U. S. Army (E)
6	F	600,000	600,000	10	F	101	Over L. C. L. Freight house
3	20,860	561,100	561,100	15	32	F	Over L. C. L. Freight house.
7	F	357,100	357,100	7	F	F	R. R. warehouse
8	12,110	282,100	282,100	7	20	216	Priv. warehouse
4	22,700	438,300	438,300	6	24	356	Used by one tenant.
8	F	184,400	184,400	4	F	F	R.R. warehouse
6	F	96,600	96,600	4	F	F	R.R. warehouse
8	7,370	201,800	223,900	4	8	100	Priv. warehouse
8	6,840	230,400	256,300	4	9	100	Priv. warehouse
6	50,400	1,261,400	1,421,000	30	100	1000	Priv. warehouse
5	F	145,100	145,100	8	F	633	Over L. C. L. Freight house
4	5,950	185,700	221,600	5	11	100	Used by one tenant.

A—Floor area used is gross area, no deduction having been made in any case for columns, walls, elevators, checkers' booths, scales, aisles, etc.

B—Shipping platform space is the platform space adjacent to car siding used for shipping purposes.

C—Storage space does not include shipping platform space but does include all other space served by elevators.

D—Total storage space includes all warehouse space except shipping platform space.

E—The U. S. Army warehouses Nos. 1 and 2 are located on seaboard, and are served by both boat and rail.

F—Facilities of these warehouses are used by both freight house and warehouse and, therefore, exact amount used by warehouse is not obtainable.

To reduce the many sizes of elevators to a uniform basis they are listed according to their capacity in number of trucks 3 x 6 ft., which seems to be the size in general use in warehouses. The modern tendency is to install larger elevators, the capacity being 1 to 3 trucks in the older and 3 and 4 trucks in the new warehouses, the four trucks requiring a platform area about 9 x 17 ft. Load capacity has also increased with size, from 5,000 lb. in the older to 10,000 and even 12,000 lb. in the newer warehouses.

Increase in speed has been less rapid, since this materially increases the cost. As most warehouses do not exceed eight floors in height, the question of speed is not so vital as in some other classes of buildings. In arriving at a suggested area of warehouse floor space per elevator, it is assumed that elevators will be of a size sufficient for four trucks, with a capacity of 10,000 lb. and a speed of 150 ft. per minute.

Table II shows the actual area of floor space per elevator and the area recommended by warehouse operating officials. The three classifications assist in observing the effect of length of turnover period of

goods. Thus there is a considerable range in values, particularly between the storage warehouses and those where the turnover is moderately rapid. The latter include the railway warehouses in the list. The army warehouses have been designed for a special kind of service, and their elevators are supplemented by derricks, cranes and whip hoists. Two of them have their elevators arranged in batteries with central control,

TABLE II. RELATION OF ELEVATORS TO WAREHOUSE FLOOR AREA

Floor Area Per Elevator Sq.Ft. Present	Recommended by Operating Officials	Number of Tenants	Size of Elevator in Capacity of 3 ft. x 6 ft. Trucks	Floor Area Per Elevator Sq.Ft. Present	Recommended by Operating Officials	Number of Tenants	Size of Elevator in Capacity of 3 ft. x 6 ft. Trucks
Storage Warehouses with Slow Turnover				Warehouses with Moderately Turnover.			
60,000	.....	Many...	3	37,406	.....	Many...	4
50,450	.....	General storage	2	51,014	39,680	Many...	2
57,600		General storage	2	40,300	.....	Many...	3
				73,050	.....	One.	3
U. S. Army Warehouses.				30,733	.....	Many...	3
54,084	.....	One.....	4	24,150	32,220	Many..	1
56,000	.....	One.....	4	42,046	.....	Many...	3
73,143	56,889	One.....	3	37,140	.....	One.....	2

but although this plan increases the effectiveness of the elevators, it is hardly adapted to general warehouse service. We must be governed by the third classification in the table, from which it appears that 40,000 sq.ft. per elevator is a reasonable allowance. This might be increased to 60,000 sq.ft. where the warehouse is used for storage only. Some building ordinances in limiting the space between fire walls automatically limit the floor area per elevator.

Shipping Platforms—In many warehouses the area of platform adjacent to the railroad siding used exclusively for shipping is made larger than required for shipping purposes in order to provide a small amount of storage space. Under certain conditions this is very desirable. For warehouses with moderately rapid turnover the range of values in ratio between platform area and total storage space is 2.7 to 5.2 per cent, with an average of 3.8 per cent. As the lowest figure is for a warehouse with one tenant it is too low for general use. An allowance of 4 per cent would be ample and should give some storage space on the platform; 3.5 per cent might be considered a reasonable minimum.

Railway Trackage—The amount of trackage required depends upon the extent to which the warehouse is supplied by rail, and whether the shipments are from rail to rail, from rail to team or from rail to boat. The greatest amount is needed when shipments are from rail to rail. The length of turnover period of goods is also a factor. In most warehouses, particularly if more than one tenant is involved, it is only possible to make one setting of cars per day. In other cases, with more than one tenant, two or more settings may be possible. In estimating, sufficient trackage should be provided to enable the warehouse to be operated with one car setting per day. In six warehouses the storage space per car length of siding varies from 14,105 to 20,196 sq.ft. An allowance of 17,600 sq.ft. may be considered reasonable.

Tailboard Frontage—The amount of tailboard space required is dependent upon the extent to which teaming is used in handling goods to and from the warehouse. In two storage warehouses where the turnover of goods is slow, the length of tailboard frontage per car-length of siding is 12.5 and 11.1 ft., with storage space of 2,239 and 2,563 sq.ft. per foot of tailboard frontage. In three warehouses where the turnover is moderately rapid, the frontage per car-length is from 10.8 to 19.8 ft., an average of 15.7 ft.; and the storage space per foot of tailboard frontage is from 861 to 1,306 sq.ft. with an average of 1,030 sq.ft. Taking 1,100 sq.ft. as reasonable in connection with the suggested 17,600 sq.ft. of storage space per car-length, it follows that 16 ft. of tailboard space per car-length should be provided.

Summary of Conclusions—Summarizing the suggested relations between the various factors of design we have the following figures which are suggested for warehouses where the turnover of goods is moderately rapid:

1. One elevator for each 40,000 sq.ft. of warehouse space.
2. Shipping platform area should be 4 per cent of warehouse storage floor area.
3. One car-length of track siding for each 17,600 sq.ft. of warehouse storage area.
4. One foot of tailboard frontage for each 1,100 sq.ft. of warehouse storage area.
5. Tailboard frontage of 16 ft. for each car-length of siding.

Filling of Railway Trestles and Steel Viaducts

Points To Be Noted in Making Investigations and Precautions To Be Observed in Conduct of Filling Operations

Abstract of sub-committee report of Committee on Roadway; American Railway Engineering Association

Before deciding to fill a structure, a thorough study of costs must be made, based on local conditions, in order that preference may be given to structures where the greatest saving in future maintenance may be effected. This applies in greater degree to wooden trestles. Long, low structures, where the water can be carried by comparatively small culverts, will show the greatest saving. In steel structures where operating conditions (such as the use of heavier engines) demand replacement by solid fill, and where commercial dirt and ashes are available in large quantities and at the expense of the haul only, other considerations than future maintenance should govern. This preliminary investigation must develop especially the following:

1. Size of culvert, which will generally govern the type of culvert to be used. Emphasis is laid on providing sufficient area to carry off excessive storm water. The character of foundation will govern the design of the culvert.
2. Character of foundation for the new fill, as this may be such that it would not be economical to fill the structure.
3. Condition of the structure. If a trestle is allowed to deteriorate too far, serious difficulties will be encountered in keeping the structure safe for traffic during the progress of filling.
4. Availability and quality of material for making the fill, as both will affect the first cost, and the latter the future maintenance of the fill. Where commercial dirt is available in large quantities, consideration should be given to its character and the cost of the haul involved.
5. Whether the advantage of widening adjacent cuts from which the filling material may be excavated will justify this method of procedure by improved drainage and increased snow room, as against getting all the material from one place.
6. Elimination of fire hazard by filling wooden trestles should be taken into consideration. If there are any springs in the area to be covered, build concrete boxes over them and pipe the water away. Where rock is available and the fall is sufficient, French drains may be substituted for the

pipe. In marsh land it is frequently advantageous to lay a grillage of small tree trunks, old bridge timbers or sawmill slabs.

Preparing the Structure — Before starting, the trestle must be put in shape to stand the stresses incident to filling. This is very important with trestles over 20 ft. high, because if it is not done and the trestle gets out of surface or line (or both), it is almost impossible to get it back into proper shape. Settlement in the surface of the trestle is generally not a serious difficulty, as long as the line is good. Ordinarily, a foundation which is good enough to support a frame trestle will give very little trouble during filling if a bearing 4 ft. wide is provided the full length of each sill.

Special attention should be given to removing all soft timber from bottom of posts, from sills, and from bottom bracing. In a trestle 20 ft. high these parts should be in condition to run two years without repairs, and three years in a trestle 35 ft. high or over, before the structure should be considered in good enough condition to stand filling. It is better to spend a little money preparing a trestle to stand filling than to take a chance of having to spend much more during the progress of the work.

Steel Structures—In steel viaducts, which are usually of greater heights than wooden structures, precautions must be taken to prevent distortion of the column. This can be accomplished by encasing them in reinforced concrete up to a point within 20 ft. of base of rail. Where there is no danger from fire, satisfactory results have been obtained by the erection of intermediate wooden bents at suitable intervals in order to reduce the load upon the towers. As the filling proceeds, all longitudinal and transverse bracing should be cut loose from the bents as the fill reaches the connection points, for this bracing transfers a great deal of load to the bents, which increases the settlement and has a tendency to work the viaduct out of line. Vertical bracing need only be cut loose at the upper connection points.

Methods of Filling — Two methods in general use for filling bridge openings are: (1) By side or center dump cars (or both); (2) by teams from adjacent cuts and borrow pits. Less general methods are: (3) grab buckets swung from cableways; (4) endless belt conveyors; (5) dumping from cars and leveling by sluicing, and (6) by hydraulic excavation and leveling by sluicing.

Where foundation is good, and in low trestles where it is not good, fills can be made by dumping directly from the structure. Good results may be obtained by using a ditching machine, with two 16-yd. air-dump cars for jobs of 5,000 cu. yd. or less, and by steam shovel and air-dump cars for over 5,000 cu. yd. This dividing line is by no means fixed, as it depends on the haul, the depth of cuts from which material is available, and the relative need for ditching the cuts in the vicinity of the structure. The double benefit derived from the use of a ditcher often justifies a greater total expenditure than would be involved in the use of a steam shovel.

For dumping from trestle, the guard timbers should be removed and planks spiked on ties close to the rails to prevent bunching. With center dumping, alternate ties may also be cut out between the stringers. When dumping large rocks, care should be taken not to damage essential members of the structure. It is sometimes advantageous to instill inverted V-shaped wooden shields, with the apex located under the center line of track. This not only affords protection to members which may otherwise be damaged by heavy filling material from a high drop, but it also approximates to the side dump method which results in less disturbance to the structure. The shields must be removed when the filling has progressed so far that the dirt will not fall free of them.

Where foundation is very bad and appears liable to give trouble due to settlement and where traffic is heavy, temporary trestles may be built on each side of the main trestle, from one-third to half the height of the latter, and located so that material dumped from them will spread to cover the area of the completed fill. Belt conveyors or grab buckets may be employed to advantage for fills of this character. Then by dumping simultaneously from all three trestles, or dumping simultaneously from the main trestle and cableways the settlement may be reduced and kept fairly uniform.

Provision for Settlement—It is often advisable to make a long haul to obtain a better grade of material in order to stabilize the fill and reduce cost of future maintenance. Sufficient material should be deposited to allow for shrinkage of embankment and subsidence of foundation. Fills subject to erosion by rivers may be made more compact and repellent to water action by having the dirt spread by teams in layers over the entire area to be covered.

When filling trestles of over approximately 25 ft., it is good practice to install a small pump, if there is water available at the opening, and run a pipe line underneath the ties through the center of the trestle, having valves at intervals so that the trough formed by dumping on both sides of the trestle (or the central core when center dump cars are used) is kept continually wet. In this way settlement occurs gradually as the filling is deposited, with the result that the filled trestle is not carried so badly out of line and surface. This also gives a solid puddle core to carry the weight of trains.

Immediately after the filling of low trestles, the stringers should be removed, but in high trestles they should not be removed until the fill has settled as far as it will without the load of trains. If a high trestle has become so badly out of line and surface that it cannot be resurfaced and relined, it is better to remove the stringers at once and put the load on the green fill, even if this requires considerable watching and resurfacing of track for some time.

Care should be taken to avoid the formation of a trough which will hold water when removing stringers. This may be done by filling the openings left by stringers with a good grade of clay, and tamping and crowning before applying ballast. On account of cheapness and ease of handling, track should be ballasted on engine ashes until new fill has stopped settling. Where engine ashes or commercial dirt is used for making a fill, great care should be taken that the fill does not catch fire. On a large job of this kind it is always well to have a good sized pump with sufficient fire hose to overcome fire, which may start when least expected.

Hydraulic Filling—In this process, used in hillly country, water from a convenient mountain stream is diverted to supply hydraulic jets or "giants" which excavate material, the water then carrying the material through box flumes to the site. To form the fill, low levees or dikes are built along the lines of the side slope to form a pool in which the material settles while the water drains away. These levees are usually constructed of alternate layers of earth and straw or hay. Tough marsh grass is best suited for this purpose. The material is spaded from the inside and the hay is distributed by a man walking along the dike. The next layer of earth compacts the hay and is quickly puddled by the action of the water. The embankment is constructed usually to within 3 or 4 ft. of its finished elevation, and is then completed by train.

Banks constructed in this manner are remarkably solid. Further, the hay or straw has the advantage of protecting the newly made bank not only during the first year but subsequently, as the seeds germinate and form a sod.

Thames Water Supply Draft and Storage

The amount of water which the Metropolitan Water Board, London, England, is permitted to take from the River Thames is 130 Imp.m.g.d. except at times when the flow of water over the Paddington weir exceeds 200 Imp.m.g.d. Storage reservoir capacity now provided, according to a recent lecture before the Royal Institute of British Architects by H. E. Stilgoe, chief engineer, Metropolitan Water Board, totals 6,600 Imp.m.g. which will be nearly doubled on the completion of the 6,500 Imp.m.g. Littleton reservoir now under construction.

Delaware Practice in Road Structures

By Carlton V. Conner
Formerly Designing Engineer, State Highway Department of Delaware

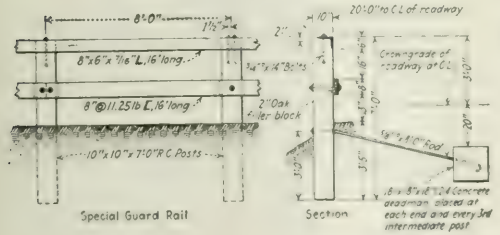
HIGHWAY standards in Delaware require a minimum width of clear roadway at all structures of 32 ft. and a minimum depth of earth fill between the bottom of concrete roadway and the top of slab or arch ring of 6 in. Structures are all designed to carry the concentrations from a 20-ton truck, in addition to the dead-load. The accompanying photographs show the standard types of bridge construction in crossing tidal marshes.

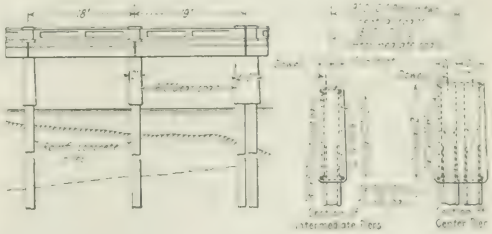
A reinforced-concrete-pile trestle has shown considerable economy over other types of permanent construction, especially in places where mud is encountered to depths of 50 or 60 ft.

A guardrail made up of reinforced concrete posts with concrete "dead-men" and rail of structural steel sections, was designed to be placed along the Philadelphia Pike. On account of the heavy traffic and the fact that this construction is in a residential district, it was necessary to combine strength and suitable appearance.

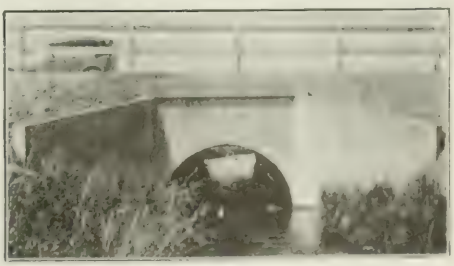
Grading Costs on Federal Aid Roads

A GREAT variation in the conditions under which grading for highways is done in different sections of the United States is reflected in cost data compiled by the Bureau of Public Roads on 1,350 projects of federal-aid road. The figures cover the four-year period 1917-21 and are based on a total of 24,526,415 cu.yd. of earth. For the groups of states the average price per cubic yard is as follows: New England and Middle Atlantic States, $1.33; East North Central, $0.68; West North Central, $0.49; South Atlantic, $0.61; East South Central, $0.41; West South Central, $0.35; Mountain, $0.52, and Pacific States, $0.61. The general average price was $0.56. Probably the most important factor affecting the cost was the amount of grading to be done per mile, the quantity being very small in the groups having the highest prices. In general it is noticed that where mostly old roads are rebuilt the light work and tearing up the old pavement greatly affected the cost. The amount of fine grading or trimming required for the higher types of pavement was also a factor. Labor, character of soil, climate, contract time limits and detour expense affected the cost.













STANDARD BRIDGE TYPES AND DETAILS OF PILE TRESTLE AND OF GUARD RAIL, DELAWARE

Design and Construction of Light-Weight Floor Systems

Practical Details of Long Spans for Light Loads, Comprising Core Construction, Steel Joist and Precast Slab Types With Special Attention to the Core System

By Jacob Fruchtbaum
Buffalo, N. Y.

During the last few years, the greater portion of construction projects consisted of school buildings, hospitals, churches, apartment houses and hotels, in general fireproof buildings, whose floors carry light loads on long spans, and whose design, therefore, is governed by bending moment and not by shear. Since the lower portion of the slab serves little or no purpose in taking compression, it becomes desirable to eliminate most of the concrete below the top two or three inches, leaving just enough of joist below that plane to take care of the shear requirements and convenience in the placing of the steel. This type of construction is generally known as the "hollow floor," "core system" or "ribbed slab" construction.

Structurally, these slabs consist of joists 4 to 6 in. wide, spaced from 16 to 36 in. on centers, with a 2- to 3-in. slab forming the flange of the small T-beams. Any desirable depth of floor can be obtained by varying the depth of the material used to form the joist; the ordinary depth, however, ranges from 4 to 14 in.

Another type of floor used for this class of buildings consists of steel joists spaced from 12 to 24 in. on center and having metal lath fastened to the top and bottom of the joists. On the top lath a 2-in. layer of concrete is placed. The bottom lath is used for plastering, but is omitted where no ceilings are required.

Structural steel may be used in the same manner as steel joists, and as reinforcing steel in the ordinary core type of construction.

Still a third type of light-weight floor consists of precast slabs of either gypsum or concrete. These are sold under a variety of trade marks in both flat and ribbed forms.

Core Construction

Advantages—Core construction is not a cure-all. Its very nature makes it uneconomical for heavy loads or short spans, especially in wall bearing jobs, where dead-load is of minor importance; neither are all types equally economical under all conditions. Thus, we may expect that the shorter the span and the heavier the load, the more suitable will terra cotta with a 16-in. c. to c. spacing prove in comparison with steel-tile construction with a 24-in. spacing (since the ratio of shear to compression is greater). Because of its adaptability for long-span work, core construction renders possible elimination of intermediate beams, thus either giving more head room or reducing the story height. Due to the saving of brick, tile, and expensive stone facing, the latter will generally be of some account in multiple-story buildings. The most important item is, however, the saving in concrete not only in the floor slabs themselves, but, due to the reduced dead-load, in the supporting beams, columns and footings as well. In addition, there will be a considerable saving in material handling charges and formwork. The equipment charges will be the same as for a beam-and-girder job having the same floor area and story height.

With flat ceilings the number of nozzle heads required for a sprinkler system will generally be 20 to 30 per cent lower than for a beam-and-girder floor. This, in addition to the saving in the size of the feeder pipes, will offer a net saving of 10 to 20 per cent of the entire installation.

A better distribution of light, and a greater utilization of daylight is another by-product of the flat ceiling of core construction.

Because of the air space, core construction offers a floor that is more or less effective in deadening sound and preventing condensation. Where a wood floor finish is used, this sound deadening is considerably improved.

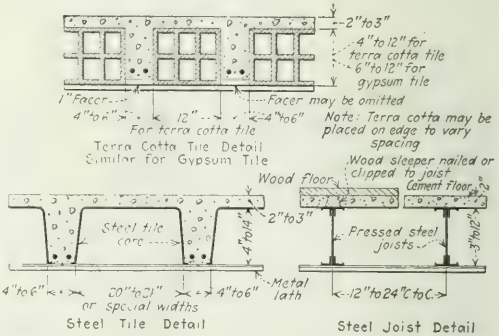


FIG. 1. DETAILS OF TYPICAL LIGHT-WEIGHT FLOORS

With a cement floor finish, some sounding board effect will be found at the joists, as well as at the flanges of T-beams, because of the solid mass of concrete at those points. The best remedy for the above is to use suspended ceilings, since in that case a continuous air space is provided. In addition, suspended ceilings allow replacement and inspection of floor piping at a minimum cost.

Gypsum tile slabs having joist facers possess an additional advantage in that only two-coat plaster work is required. Two-way core slabs were at one time very popular. If properly designed, they are seldom economical, although they reduce the depth of the floor construction. They should not be used except for practically square panels.

Method of Design—Core slabs are designed in the same manner as ordinary T-beams. For purpose of illustration, let us assume the following data:

Span.—Simple, 20 ft. c. to c., 19 ft. in clear
Live-load = 75 lb. per sq.ft.
Wood floor finish = 18 lb. per sq.ft.
Fireproofing = ¾ in.
f_s = 16,000 lb. per sq.in.
f_c = 650 lb. per sq.in.
n = 15

Using steel tile for core fillers, then, the design is as shown in the table at the top of page 731.

Design		Loads
10 + 2*.	$w = 156 \times 2.17 = 338$ lb. per lin. ft. of joists	10 + 2 = 56**
5-in. joists	B.M. $= \frac{338 \times 20^2}{8} = 16{,}900$ ft.-lb. $= 203{,}000$ in.-lb.	L.-L. = 75
26 in. c. to c.	Stress $= \frac{203{,}000}{(10.75 - 1)} = 203{,}000$ in.-lb.	Finish = 18
1 1-in. round straight 1 ⅞-in. round bent	$A_s = \frac{20{,}800}{16{,}000} = 1.30$ sq.in.	Ceiling = $\frac{7}{156}$ lb. per sq.ft.

*10 + 2 indicates a 10-in. core with a minimum concrete topping of 2 in. giving a total slab thickness of 12 in.
**The dead-load will depend upon the type of core used and width of joists. It may be obtained in each case from tables furnished by the manufacturer who supplies the core material.

One 1-in. round and one ⅞-in. round furnish 1.39 sq.in. and will be used.

Neglecting compression in stem, and assuming value of *kd* to remain fixed, the average safe compression per square inch of flange is $\frac{650(3.08)}{4.08} = 491$ lb., since $kd = 0.379(10.75) = 4.08$.

Safe compression on slab $= 491(26)(2) = 25{,}500$, that is, the slab is safe in compression.

In this particular problem, many designers would use two ⅞-in. rounds in every other joist, and one 1-in. round and one ⅞-in. round in the alternate joists, thus giving an average area of 1.30 sq.in. Unless transverse reinforcement is furnished, this is not considered good practice, especially with a wide spacing of joists, or where the difference in steel between adjacent joists is large. This practice also slows up the field work in connection with the placing of stee'

With reference to shear:

$$V = \frac{338 \times 19}{2} = 3{,}210 \text{ lb.}$$

$$v = \frac{3{,}210}{5 \times \frac{7}{8} \times 10.75} = 68 \text{ lb. per sq.in.}$$

where V = total end shear.
and v = maximum unit end shear in lb. per sq.in.

Except for long spans, or where anchorage or continuity steel is needed in the top, no bent bars are required where the shear is less than 40 lb. per square inch. With properly anchored bent bars, such as bars with hooked ends, or those carried a sufficient length past the neutral axis to develop their full strength in

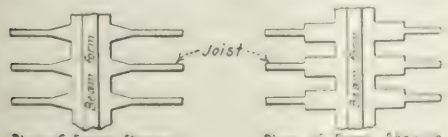


FIG. 2. METHOD FOR INCREASING CONCRETE JOIST AT SUPPORT

tension (40 to 50 diameters), a shear of 60 lb. per square inch may be allowed on the section. Where the shear is greater than can be taken care of by the bent bar and the concrete in the joist, either tapered ends, or a narrower width of tile may be used at the support to increase the concrete joist area. (See Fig. 2.) It is very expensive to place numerous small stirrups, and, rather than resort to them, it will prove more economical to deepen the slab. In simple spans, the bars may be bent so as to take the excess shear. In continuous spans, if the bars are to be of any value in taking tension due to negative movement they must be bent down too far away from the support to be of use in withstanding shear.

To illustrate the methods of figuring compression at the support, assume that the slab in the previous problem is continuous; then

B.M. $= \frac{2}{3}(203{,}000) = 135{,}200$ in.-lb.

$$C = T = \frac{135{,}200}{\frac{7}{8} \times 10.75} = 14{,}370 \text{ lb. (at support).}$$

Safe compression on stem $= 0.413 \times 10.75 \times 5 \times 375 = 8{,}320$ lb.

Stem can take all the compression at a distance*

$$1.05 \times \frac{(14{,}370 - 8{,}320)}{69 \times 5} = 18 \text{ in. from center line of support.}$$

*Negative moment at a distance x from the support $= \frac{wl^2}{12} - \frac{wx^2}{2} - \frac{wlx}{2}$.

That is, the decrease in moment is $\frac{wlx}{2} - \frac{wx^2}{2}$ or decrease in compression,

$$D = \frac{\left(\frac{wlx}{2} - \frac{wx^2}{2}\right)}{jd}$$

Neglecting the second term in the parenthesis, $D = \frac{Vx}{jd} = bvx$ or $x = \frac{D}{bv}$

The omission of the second term will seldom cause an error over 5 per cent so that $x = 1.05\ D/bv$.
The same principle offers a simple method for locating points where compression or tension steel may be stopped.

If the supporting beam has a wide enough flange, no special ends are required, otherwise, a narrow or tapered end tile can be used. Compression steel is figured in the ordinary manner, except that with wide beam flanges it is not always necessary to lap the bars. Thus, with a 15-in. imbedment in flange, and an allowable bond stress of 100 lb., a 1-in. square bar will carry by bond $15 \times 100 \times 4 = 6{,}000$ lb. (This value must not, of course, exceed the allowable stress in compression.)

Width of joist required at center line of support $= 5 \times \frac{14{,}370}{8{,}320} = 8.6$ in.

Bond stress is a negligible item since the shear is low and bent bars are generally provided, leaving very little shear to be taken by the concrete.

Terra cotta and gypsum tile slabs are designed in the same manner.

Methods of Detailing.—The general principles of detailing reinforced concrete apply with equal force to core construction. Some special points will, however, be taken up. In continuous slabs considerable difficulty is experienced in taking care of the compression at the support. Where the slab is supported by concrete beams, the tile is kept back far enough to provide the beam with sufficient compression flange; and, due to the rapid decrease in the negative bending moment, the concrete stress in the joists will generally be satisfac-

tory. But where the slab is supported on structural steel beams or walls, or if the concrete stress at the edge of the beam flange is too high, either a tapered end tile or a narrower width tile may be used at the end of the row. Where these methods are unsatisfactory or insufficient, compression steel is introduced. In many instances it will be more economical to use a deeper tile and a lower stress than that allowed, and thus avoid compression steel, or a large mass of concrete. The methods of taking care of excess shear have been discussed under the subject of design.

Where partitions and concentrations occur, the concrete is generally overstressed. In some designs double joists are used to overcome the difficulty; and while this method may be satisfactory for short spans, or for a close spacing of joists, it will not do for the average case. Assume, for example, that 4-in. joists are spaced

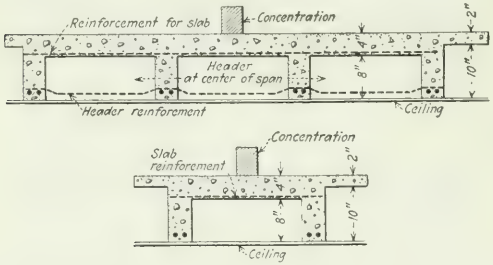


FIG. 3. METHODS OF SUPPORTING CONCENTRATED LOADS

24 in. on center. Doubling the joist width will give an 8-in. joist 28 in. on center. While the load is approximately doubled, the width of the compression flange has only been increased from 24 to 28 in., that is, less than 17 per cent. The best method is to use a shallower tile, that is, if the slab is 10 + 2, use an 8 + 4 for as big a width as is required to develop the compression, and distribute the load over the several joists by reinforcement in the topping or headers. As a final resort compression steel is added. (See Fig. 3.)

Where terra cotta tile or gypsum blocks are used, it is advisable to use a joist facer between the various blocks, so that the entire plastering will be done on a uniform surface. The joist facer serves an additional purpose in securing an even width of joist, but is difficult to place. Where suspended ceilings occur, the facers are omitted.

To obtain the required length of the rows of tile; with steel tile, vary the lap; with gypsum, saw the end blocks, with terra cotta, the length to the nearest 6 in. only can be used.

Where small openings occur in the floor, it is advisable to stop the rows of tile on both sides of the opening and close them with end caps, thus securing a piece of solid slab in which to form the opening. With large openings, or those occurring at joists, headers should be used.

On account of their large bulk, weight, and breakage, terra cotta and gypsum blocks will generally prove expensive, unless the plant where they are made is near by. Gypsum should be waterproofed and stored carefully before being used.

Shrinkage steel (¼ in. round at 12 in. or 18 in. c. to c.) should be used in all slabs, especially those with thin

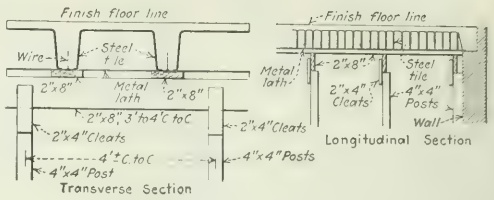


FIG. 4. DETAILS OF FORMWORK

floor finishes or no dead air space on the underside.

Formwork.—The joists are formed by either removable forms of steel or wood, or left-in-place forms of steel, terra cotta or gypsum. Where ceilings are lathed and plastered directly on the underside of the floor slab, left-in-place forms should always be used as, due to difficulties in fastening the metal lath rigidly enough to offer a firm base for plastering, methods utilizing removable forms have proved failures. However, even where suspended ceilings are used or no plastering is done at all, it is seldom advisable to use removable forms due to their large initial cost, rapid depreciation, and expensive storing and moving. In general, even the lightest of removable tiles must be used at least three or four times to prove economical.

Suspended ceilings produce a more sound-proof floor, but are seldom used because of their greater cost and encroachment on head-room. However, many plasterers prefer to work on a suspended ceiling than on metal lath that is directly fastened to the underside of the joist, due to a policy, that is fortunately disappearing, of some contractors not wiring the lath into the concrete joists. Where the plastering is done a long time after the lath is placed and there is any danger of rusting, copper bearing or pure iron lath is often used.

The forms treated thus far dealt with forming the joists. The matter following refers to the material supporting the steel, terra cotta, or gypsum tile, during the process of construction.

With steel and gypsum tile, forms are required under the joists only, and in view of the width of the joists, the 2 by 8 plank has become practically standard for

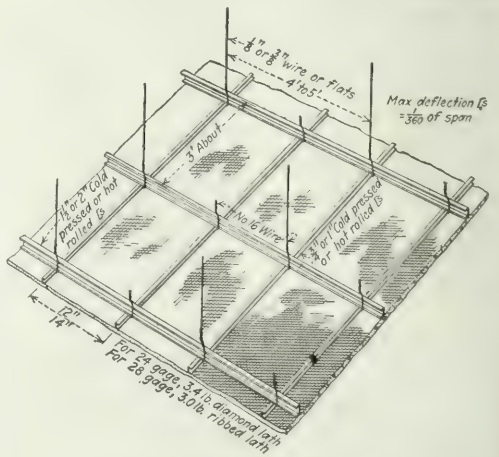


FIG. 5. SUSPENDED CEILING DETAILS

the underside of the joists. To avoid additional sizes, it seems most economical to use the 2 x 8-in. for stringers as well.

Two types of forms are used. In both types a 2 x 8-in. plank is placed under the concrete joist, but while in one type a 2 x 8-in. is run on edge under the horizontal plank forming a continuous T, in the other method the vertical planks are placed on 3 to 4-ft. centers under the horizontal planks and at right angles to them. It is hard to say why the first method survives, as it is considerably more expensive in both material and labor. Some contractors form the floor solid; however, this is an absolute waste, and except for terra cotta tile, should not be used.

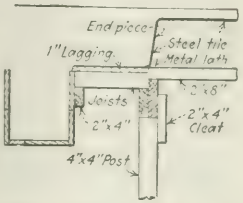


FIG. 6. FORM DETAIL FOR BEAM FLANGES

The load carried by the horizontal plank will be determined by the deflection allowance. Assuming partial continuity, and

w = uniform load in lb. per ft.
l = span in ft.
E = 1,200,000 lb. per sq.in.
I = 3,461 in.⁴ for 2 x 8 in. horizontal plank (1¾ x 7¼ in. dressed)
I = 67.88 in.⁴ for a 2 x 8 in. plank placed on edge.
wl^2 = 10,250 where deflection is limited to 1/360 of the span; and, wl^4 = 38,500 where deflection is limited to ¼ in.

Thus, a 2 x 8-in. horizontal plank will carry 475 lb. per running foot on a 36-in. span, 256 lb. on a 42-in. span and 150 lb. on a 48-in. span where deflection is limited to ¼ in. and 380 lb. per running foot on a 36-in. span, 240 lb. on a 42-in. span and 160 lb. on a 48-in. span, where deflection is limited to $\frac{1}{360}$ of the span.

With a maximum fiber stress in tension or compression of 1,200 lb. per sq.in., and a maximum stress of 200 lb. per sq.in. in shear, we get for a 2 x 8-in. on edge

wl = 5,425 for shear requirements, and
wl^2 = 17,520 for moment requirements (partial continuity assumed)

That is, for spans up to 3 ft. 3 in. shear governs the load, while above that, moment governs. Deflection will not be a deciding factor. Therefore, the safe joist load per running foot is 1,095 lb. on a 4-ft. span, 701 lb. on a 5-ft. span and 487 lb. on a 6-ft. span. Posts and bracing are figured in the ordinary manner.

With terra cotta tile construction, it is advisable to form the entire floor. In view of the close spacing of joists, there is no economy involved in using 2 x 8-in. at 16 and 17 in. on center over using 1-in. roofers solid. The only additional lumber is the slight number of battens required. Besides, a solid floor will make the work slightly more economical than would otherwise be the case.

Construction.— Where several lengths or sizes of material are used to form the core, it has been found more economical to place all material of one size, then of the other, and then of the third. Thus, for example, in a steel tile job, the most economical arrangement of the work would be to place the metal lath first, wire it, place the pieces of one size of tile, then of the other, and finally the end caps. Considerable time is saved and economy obtained in arranging the work as indicated above rather than making up each row separately. The same general principles hold true for terra cotta or gypsum slabs.

The ribs of the metal lath in steel tile construction should be wired into the concrete. The additional cost of this labor is more than offset by the saving in plastering cost. It is advisable to nail the tile down to the forms every 8 or 12 in. to prevent the tile from bulging. Especially is this true of the lighter type of steel tile, where over-runs in concrete as much as 15 per cent may result because of the deformation of the steel tile. With the terra cotta and gypsum tile it is also advisable to wire the spacers into the joists or provide some mechanical arrangement for holding them in place.

In all types of core construction it is very essential that no trucking be done on the cores but that plank runways be provided for that purpose.

Where the concrete topping is to be troweled smooth without putting on any extra finish, special precautions must be taken with steel tile that has a crown, as there is a tendency for the tile to deform due to the floating of the finish. A flat tile stands up better under that action. However, it is advisable, in most cases, to use a ¾-in. cement finish and not try to float the top.

Steel Joists

Advantages—Where dead weight is an important item, as in tall skeleton frame buildings, especially with heavy foundation work, we may expect steel joist construction to prove economical. It furnishes the lightest weight floor made, and, consequently, offers the biggest saving in the supporting beams, columns and footings.

Flat ceilings are obtained with this type of construction, offering advantages similar to those previously discussed under core construction.

Another advantage of steel joist construction is found in the fact that the concrete is not figured to take any structural stress. During cold weather it is thus possible to pour the roof first and do the rest of the work under cover.

Methods of Design and Detailing—There has been considerable discussion lately about the possibility of designing steel joist to compete, in initial cost, with wood construction. Some very radical statements have been made with reference to the above. However, it seems very questionable whether steel joint construction will, in the immediate future, be able to do that, especially so, as wood joists are generally designed for comparatively high stresses. If steel joist construction is to be more economical, it is certain that the deeper

TABLE SHOWING DESIGN OF STEEL JOISTS

10 in. — 8.8 lb. joists @ — 114 ft. [illegible] — 224 lb. per ft.

23½ in. — [illegible]

2 in. topping

$$\text{B.M.} = \frac{224 \times 20}{8} = 11{,}200 \text{ ft. lb.}$$

$$S = \frac{I}{c} = \frac{11{,}200 \times 12}{16{,}000} = 8.4 \text{ in.}^3$$

10 in. — 8.8 lb. I provides 8.4 in.³ and will be used, or we can use a 10 in. — 9.5 lb. joist with a section modulus 7.6 in. spaced at $\frac{23.5\ (7.6)}{8.3} = 21\frac{1}{2}$ in. c. to c.

Load	
Finish	8 lb.
2 in. slab	24
Joists	4
Ceiling	8
L. L.	75
	114 lb.

joists will all be composed of built-up sections, thus strengthening the members in moment and weakening them in shear and consequently producing a better balanced member for the use to which it is put.

Where special loads, such as partitions, occur the spacing of the joists can be decreased or another joist added to make up for the additional section modulus required.

The economical joist to use is that one which will give the least weight of steel per square foot of floor area. A ribbed lath should be used on both top and bottom of the joists to give the desired rigidity. To obtain a satisfactory job, a 24 gage ⅜-in. ribbed lath weighing at least 4.8 lb. should be used on top while on the bottom, for any spacing over 18 in. on center, a 26 gage ⅜-in. ribbed lath weighing at least 3.6 lb. per square yard should be used. For shorter spans, a 28 gage ⅜-in. ribbed lath weighing at least 3 lb. per square yard may be used. This last item, of course, will have to be considered in deciding upon the economical spacing of joists. As a general rule, however, it will prove most economical to use a spacing as near 23½ in. as possible and thus take full advantage of the strength of the lath.

It will be noted that special attention is paid to weight and depth of rib instead of effective cross-sectional area. This is due to the fact that where the material acts as a form, the important item is the depth of the rib and its weight. Its effective cross-sectional area comes into play only after the concrete has set and has begun to act as reinforcement. This is a very important point often overlooked by the people who should know more about it. The weights and types of lath used are standard with nearly all manufacturers.

The use of ribbed lath is practically admitted as a necessity by all engineers. If the rib is to be of value, every rib should be fastened to the steel joist.

The web of the joists and the spacing of spot welds along the flange should be tested for shear in the same manner as they are for built-up structural steel girders, and, for short spans, they may be the governing factors. Some designers use bridging to stiffen the members. As it is absolutely useless in compression and practically useless in tension, its only justification is in its aid to the erector. Some contractors put on the bridging after the floor is all placed with the idea of carrying out the intention of the drawings. It is evident that the bridging in that case has not been used even to fulfill the pretense of its being an aid in construction. Ordinary wire or wood spacing strips will answer the purpose for erection, and, for stiffening after the concrete has set, ribbed lath should be used.

Where the joists rest on walls, anchors should be provided and the joists punched to receive them. Where they rest on structural steel beams or angles, some provision should be made for clipping or bolting them to the supporting members, and sufficient bearing should be provided. Where they frame into structural steel members so that the top joist is at the same level as the top supporting member, coping is resorted to. Where steel joists frame into concrete beams, some continuity is occasionally figured; it is not, however, considered good practice to do so whether anchors are provided or not.

Shrinkage rods (¼ in. rounds 18 in. c. to c.) should be used with all steel joist slabs. The rods are to be placed at right angles to the ribs of the metal lath.

Formwork.—No formwork whatsoever is required with steel joist construction, as the concrete is poured directly on the metal lath. The only precaution is to use a comparatively dry mix of concrete. The elimination of forms is a very important item in buildings that have large story heights such as occur in auditoriums, gymnasiums or other public gathering halls.

It is not economical to use a metal lath that will deflect considerably and thus increase the concrete quantities. Neither is it good policy to use a metal lath with too big a mesh so that the neat cement will run through. It is believed that the recommendations made under methods of design and detailing will prove satisfactory.

Construction—The most economical way to proceed with the work is to lift the joists and place them on their supporting members in bundles and then spread them out to their locations as indicated by marks previously made on the supporting members. Some kind of bracing or wooden strips should be used to keep them in their proper location. Metal lath for the top is placed next (allowing the proper laps), ends wired and then clipped to the joists. A comparatively dry mix of concrete can then be poured. The lath for the underside is applied after the concrete has been poured. It also is clipped to the joists in the same manner. The most economical way of applying the clips will depend upon the type of clip used.

If a wood finish is to be used, wooden strips are placed and nailed down or clipped down before any concrete is poured. No trucking of any kind should be allowed on the metal lath.

Structural Steel—Where structural steel members are used as steel joists, the floors are designed and built in the same manner as indicated under steel joist construction. Where used as reinforcing steel, they are also used to support the forms for the slabs during construction, so that all or nearly all posts and bracing are eliminated. When used as reinforcing steel, they are figured in the same manner as ordinary core slabs, except that shear along the top flange, and steel stress in the extreme fiber should be carefully checked. As a matter of fact, it is a very difficult matter to really figure stresses in this type of floor because of meager analyses and tests at present available.

The use of structural steel has several advantages in that it eliminates most danger due to removing the forms too soon and makes possible the use of a suspended ceiling, giving a continuous air space, at no additional cost. Against that must be offset the uneconomical present methods of figuring it, the greater depth of floor construction that it requires and difficulty in obtaining continuity where desired. With reference to the first objection, it must be admitted that all tests show that the present methods, if sanely applied, are on the side of safety, considerably in excess of the average requirements.

Precast Slabs—The only practical use for these is in roofs and then primarily in industrial buildings. Their great advantage is their light weight, economy in handling, elimination of form work and independence of weather. They are generally reinforced and designed to span four to five feet. To obtain an economical design, the purlins must be so spaced that the minimum number of

special sections will be required. Where ventilators or openings occur in the roof, special sections cannot be avoided. The great difficulty with this type of construction is the fastening of the material to the structural steel supporting members, and, in localities subject to severe winds, it is not unusual to hear of these roofs being seriously disturbed, especially where no openings are provided to relieve the pressure inside of the building. These slabs are cast in durable molds as the amount of duplication is very large. The concrete slabs may be cast by either a wet or dry mix process, the wet mix producing a denser concrete.

Compensation of Engineers in the Employ of Philadelphia

Number of Men Under Various Salaries and Classes Compared with Recommendations of Engineering Council's Committee

By James W. Follin
Staff Engineer, Bureau of Municipal Research of Philadelphia

As a byproduct of a study made by the Civil Service Commission of Philadelphia of the classification of positions in the municipal service, there is certain information available on the compensation of engineers which may be of interest to engineers generally. The information was derived from class sheets used by the classification consultants (Griffenhagen & Associates, Ltd., in a report made in 1920), and which were made available by the Civil Service Commission. A class sheet was prepared for each grade of employment in the proposed classification of the engineering service, and the existing positions with their salaries were listed on these sheets according to the judgment of the classification consultants, with the advice of administrative officials. A compilation of the information obtained from these sheets gives the salary distribution of the entire 319 positions classified under the engineering service, according to the several vocational groups. It makes it possible to determine the percentage of positions which carry compensation within certain ranges, such as, for instance, the salary ranges suggested in connection with its plan for classification of engineering positions by Engineering Council's Committee on Classification and Compensation of Engineers. (See *Engineering News-Record*, Jan. 15, 1920, p. 117.)

Engineering Pay Inadequate—Table I shows us that out of a group of 319 engineers in municipal service in Philadelphia, approximately 50 per cent were receiving in 1920 (no general increases have been made since then, and in 1922 a reduction in the bonus has reduced some compensations) salaries ranging from $1,620 to about $2,700 a year, the range of salaries suggested by Engineering Council's committee for the position of junior assistant engineer. For entrance to this grade no experience was specified by the committee if the applicant possessed a professional degree, and promotion to the next grade of assistant engineer with salaries from $2,700 to $4,140 was made possible after only two years' experience in the junior grade. Only 18 per cent of the entire group of 319 engineers in Philadelphia were receiving in 1920 salaries above $2,700, while 32 per cent were paid less than $1,620.

While it has been recognized that municipalities generally are parsimonious in their payment for technical services, specific information to support this recognized fact has been very scarce. Information on the entire engineering personnel of a large city may be useful to engineering societies. In this connection it should be added that the large number of inspectors which are connected with engineering work (such as highway inspectors, sewer inspectors, etc.), are not included under the engineering service, but under the skilled and semi-skilled trade service, so that the comparatively low salaries paid such employees has not operated to reduce the average compensation of the engineering service.

There may be some disposition to discountenance the use of the salary rates set up by Engineering Council in a time of high prices as a basis for comparing the adequacy of existing salaries, but few would disagree that the information set forth in Table I shows quite clearly that the rates of compensation in the engineering service in Philadelphia are grossly inadequate, and are not conducive either to attracting a high grade of engineer to the municipal service or to holding him there after he has become adjusted to his duties and is of maximum usefulness to the city. The present scarcity of engineering positions on the outside, with the resultant increased demand for municipal positions, is unfortunate for our municipal engineering services because it is most difficult to secure increases from legislators when the positions are being eagerly sought after. However, increased activity on the outside will

TABLE I.—COMPENSATION FOR ENGINEERING SERVICES, CITY OF PHILADELPHIA, PA.

Number of positions at the various rates of pay which were classified under the several vocational groups of the engineering services in the studies on classification of positions made by Griffenhagen and Associates, Ltd., for the Philadelphia Civil Service Commission in 1920.

Vocational Groups	Suggested Salary Range From	Suggested Salary Range To	Salaries Including Bonus, Dollars per Year: 576	720	1,000	1,008	1,080	1,152	1,200	1,320	1,344	1,380	1,440	1,563	1,584	1,620	1,656	1,680	1,728	1,800	1,840	1,892.50	1,935	1,979	2,016	2,085	2,100	2,310	2,420	2,500	2,640	2,790	2,970	3,207	3,300	3,840	4,000	4,140	4,500	4,800	6,000	8,000	10,000	Total Positions
Engineering Aid	$540	$2,580	1	5	5	1	12	11	2	1	8	7	5	1	1	1																												84
Draftsman	960	2,580					4		2				2					1	4	2	7																							44
Assistant	1,500	4,320																									1	1	1		1												5
Civil Engineering	1,500	10,000																		24	6	5	10	14		19	3	1		5	10	1		1	2	5	19	1	2	1	1	146
Electrical Engineering	1,500	7,200																								2																3
Mechanical Engineering	2,400	4,320																		1		1		2		2		1	1													8
Structural Engineering	2,400	8,100																						1		5	1	2	1			2		1		4		2	1			29
Total Positions			1	5	5	1	16	11	2	1	8	7	5	1	1	1		1	4	27	13	6	10	15	1	28	7	4	1	5	14	1	1	1	2	5	23	1	3	4	2	1	319

	Less than $1,200	$1,200 to $1,799	$1,800 to $2,399	$2,400 to $3,000	$4,000 to $10,000
Special Grouping: Number of positions	29	85	134	42	29
Per cent of whole number	9.1	26.6	42	13.2	9.1

	Less than $1,080	$1,080 to $1,620	$1,620 to $2,700	$2,700 to $4,320	$4,320 up
Salary ranges based on Eng. Council's Report: Number of positions	1	11	159	58	29
Per cent of whole number	3.8	34.3	48.8	18.8	9.1

probably result in an exodus of engineers from municipal service with a consequent loss in working efficiency to the municipal organizations. It is unfortunate, with such a good field to choose from, that salaries are not now more nearly adequate so that the qualifications for the positions at present vacant could be raised to the limit and the very best men secured.

It will probably not be very encouraging to the engineer who quite often has accomplishments to his credit somewhat in excess of the average non-professional man (although this point is frequently over-emphasized), or to the teacher of engineering who is directing the careers of the coming generation, to learn that in one of the large groups of engineers in municipal service one out of every two is receiving between $1,620 and $2,700 a year, the equivalent pay of the worker in the skilled trades or of the ordinary salesman. And numbered among the incumbents of such low-paid engineering positions are men with professional degrees and as high as ten years of experience.

Engineering Pay Lags Behind—It is a well-known fact that the increases in pay for engineering and scientific services lagged behind the pay increases of many other groups during the time that the compensation curve was on the up grade to offset the rapidly increasing cost of living. Figures show that the engineer in municipal service in Philadelphia was much worse off than the average city employee—whose condition was bad enough. The purchasing power of the average engineer's salary in November, 1920, was only 62 per cent of the purchasing power of December, 1914, while in December of 1921 the drop in prices had only

TABLE II—MUNICIPAL SALARIES AND LIVING COSTS, CITY OF PHILADELPHIA, 1914, 1920 AND 1921

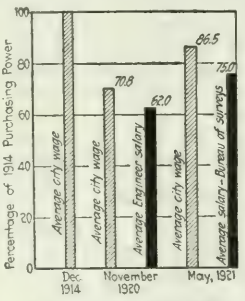
Date	Type of Services	Wage Level*	Cost of Living Level**	Purchasing Power of Average Wage	Increase in Wages* Necessary to Restore 1914 Purchasing Power
Dec., 1914	All city services	100.0	100.0	100.0	
Nov., 1920	All city services	143.6	202.8	70.8	41.2
Nov., 1920	Engineers	125.9	202.8	62.0	61.3
Dec., 1921	All city services	150.8	174.3	86.5	15.7
Dec., 1921	Bureau of Surveys	130.8	174.3	75.0	33.3

* Including the bonus ** From U. S. Bureau of Labor Statistics

raised this value to 75 per cent. The average city employee, on the other hand, was some ten points higher in the scale. These facts are shown by the accompanying diagram. In the table accompanying the chart the actual percentages of increase in wage levels and living costs are given.

The figures show that in December, 1921, an average increase in compensation of one-third was necessary in the Bureau of Surveys (which is typical of the entire engineering service) to restore the 1914 purchasing power. This percentage of needed increase may have been slightly reduced since December by further decreases in the cost of living, but even if the purchasing power of engineering salaries were back on the 1914 basis there would still be room for improvement, since it was more or less generally recognized in 1914 that engineering pay was inadequate.

Classification an Essential to Adequate Pay—Hope to the engineer in the municipal employ in Philadelphia would seem to lie primarily through the adoption of a classification plan, particularly since under such a system the responsibilities of the job rather than the particular personality of the incumbent would be emphasized in placing the position in a grade of employment which would carry certain minimum and maximum rates of pay. The salaries proposed in the classification plan for Philadelphia are generally lower than those in Engineering Council's recommendations, but this fact is of only minor importance since the classification of the existing positions in nearly all cases provided for an increase over the existing rates of pay, and it will probably be easier in the future to raise the maximum compensation, or both the minimum and maximum, if the basic principles of classification are adopted.



LAG IN PHILADELPHIA MUNICIPAL SALARIES

Purchasing power of average city wage and engineering salaries in 1914, 1920 and 1921.

There seems to be but little hope that any classification plan for Philadelphia will be adopted in the near future, although a committee of the city council last summer did give formal recognition to the need of a proper classification about six months after council itself had taken considerable delight in kicking the report around. It is not improbable, however, that some day the demands of employees and the public will be so strenuous that attention will have to be given to the principles of equal pay for equal work, adequate pay for services rendered and opportunities for advancement to those who enter municipal employ. It would appear that national and local engineering societies could be of much assistance to municipal engineers by approving standards of classification and compensation and by carrying on a continuous program of education to secure their adoption.

Lower Truck Weights Sought in California

In explanation of the effort it will make to secure a reduction in the allowable gross weight of motor trucks when the next legislature meets the California Highway Commission has issued a statement from which the following extracts are taken: "At present the [gross weight] limit in California is 30,000 lb., which weight is exceeded by no state in the Union and equaled by only two. The average weight permitted is 22,000 lb. and is the reduced weight most generally in effect today in California counties which have passed ordinances for the better protection of their county systems. A 22,000-lb. limit will permit the free use of any 5-ton truck loaded to capacity and where the chassis and body weight is not excessive will allow from ½ to 1 ton overload beyond rated capacity. . . . The equipment which would be affected by a 22,000-lb. limit is negligible. In the United States the number of trucks manufactured with a rated capacity in excess of 5 tons is only 1 per cent of the total. Even the 5-ton type is only 2 per cent of the total. With 40,000 trucks registered in California, there would be approximately 400 trucks which would not be able to transport capacity loads and stay under a 22,000-lb. gross load limit. Existing equipment could be allowed to operate until worn out under special permits."

Two-Hinged Timber Arch Used As Temporary Railroad Bridge

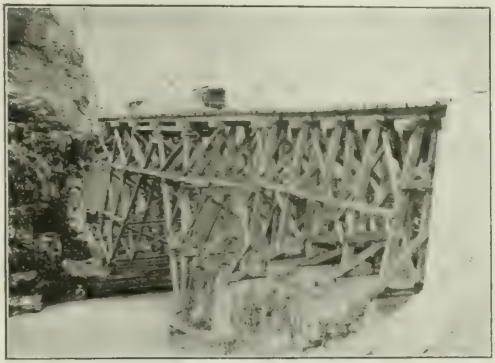
Traffic on California Logging Railroad Carried by Structure Designed as Falsework for Erecting 120-Ft. Girders

By W. J. H. Fogelstrom
Of Fogelstrom & Johnston, Consulting Engineers, San Francisco, Cal.

THE HUTCHINSON LUMBER CO. recently built a 15-mile railroad in northern California to tap a stand of some two billion feet, b.m., of timber in the Feather River basin. The line starts from the Western Pacific R.R., 7 miles east of Oroville, Cal., and follows up the Middle Fork of Feather River about 3¼ miles where a bridge across the south fork of that stream was required. Beyond this point the line rises rapidly on a 5.2 per cent grade into the timbered areas in which later extensions of the road are contemplated. Because the load is expected to be in service for a considerable period of years, a steel bridge was decided upon for the south fork crossing. Local conditions led to the selection of a 120-ft. steel girder bridge.

The most convenient way to get the large steel girders in place, it was decided, would be to build a timber falsework on which track could be laid at grade and over which standard equipment could operate. This would make it possible to handle the girders with a locomotive crane, setting them on concrete piers built entirely independent of the falsework. The falsework was designed and built as a two-hinged timber arch, as described herein. When the falsework was completed the immediate need of the bridge and delay in getting the steel girders erected on account of litigation resulted in the use of the temporary structure for regular railroad traffic. The fact that this has continued for some time and may become permanent attaches interest to the structural features of the bridge.

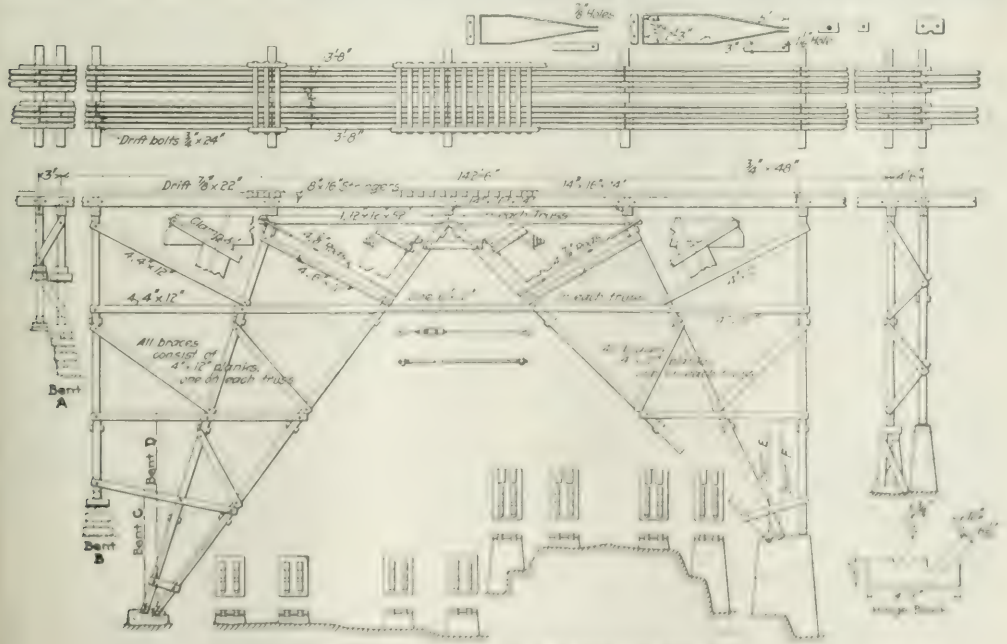
At the point where the south fork crossing is made, the base of rail has a maximum height of 72 ft. above the bottom of the river. A through girder instead of



LOOKING ALONG THE COMPLETED TIMBER TRUSS

a deck girder was chosen because a dam has been projected about one-half mile below the bridge which would back water up to such a level that a deck girder would not be in the clear. The girders are to be supported on concrete piers to be built just back of and above the two footings of the timber structure. Foundations are in solid dock.

On account of the lateness of the season when the bridge work was begun and the probability of high



TWO-HINGED TIMBER ARCH RAILROAD BRIDGE

STRESSES IN MAIN TRUSS MEMBERS (+ TENSION—COMPRESSION)

	B-C	C-D	a-b	b-c	c-d	a-B	B-b	b-C	C-c	c-D	D-d
Dead load	— 3,600	— 5,500	18,500	3,300	— 13,200	— 17,900	— 2,200	— 17,400	— 11,600	— 2,600	— 18,400
Live load	—43,100	—49,700	107,600	40,000	88,300	—155,600	—30,300	—125,900	—106,200	—30,000	—160,600
Live load....	+29,300	+31,400	+ 7,200	+ 29,600	+ 27,700	+ 15,800	+ 25,200	+ 26,600	+49,400	+20,200	+16,600

water, which always carries a mass of floating debris, coming before the falsework could be removed, it was decided to build the temporary structure with ample clearance and to make it strong enough to resist the flood pressures and hence avoid interruption to traffic in case the permanent bridge was not finished before high water. A temporary structure in the form of a two-hinged timber arch, as shown herewith, was selected as best adapted to this purpose.

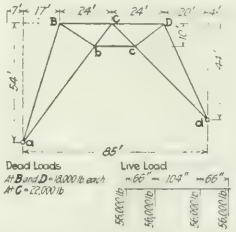
The foundation for the two-hinged arch consists of small concrete piers in which are imbedded the foot- or hinge-blocks which support the inclined bents. The footblocks have rounded grooves made to fit similar curves on the under side of the bent sills. These grooves made it possible to erect the bents in a vertical position and then allow them to swing around the footblock as a hinge until the desired inclination over the stream was reached.

By building the bents so that all outside posts and all track posts, when in their final positions,, form four longitudinal planes, it was possible to get the final alignment of the structure in such form that it made, practically speaking, four two-hinged arch trusses. The stresses given are computed by assuming the structure as a two-hinged arch. The additional braces shown in the detailed drawings were put on to stiffen the structure and tie it together; they were not included in the calculations.

The two steel girders for the permanent bridge weigh about 50 tons each and were shipped complete, each girder loaded on three flat-cars. In addition to the weight of these girders the falsework was designed to carry the live-load stresses caused by a 112-ton crane. This live-load is distributed on eight wheels, with a total wheel base of 19 ft. 8 in. and a truck wheel base of 5 ft. 6 in. This crane, which was the only one available for the erection of the plate girders, naturally causes very eccentric loads in the falsework and is the cause of the great variation of stresses in the same members as shown in the stress table.

The four posts of each bent are placed so that two-thirds of the load will come on the two track posts and one-third on the outside posts. Thus track posts each carry one-third the total load and outside posts one-sixth. All members except *B-b*, *b-c* and *c-D* are 12 x 12-in. Douglas fir; *B-b* and *c-D* are 6 x 12-in. timbers with $\frac{7}{8}$-in. upset round rods; *b-c* consists of 6 x 12-in. timbers with $1\frac{1}{4}$-in. upset round rods.

The critical points are *B*, *C* and *D*. At *B* and *D* the rods *B-b* and *c-D* terminate in $\frac{1}{2}$ x 3-in. strap iron loops or stirrups which hold the top chord, *B-C-D* tight against the post. With this arrangement when tension develops in the top chord the connections will not open. At *C* the posts are bolted with 1-in. bolts to the top chord preventing any pulling apart at that point.

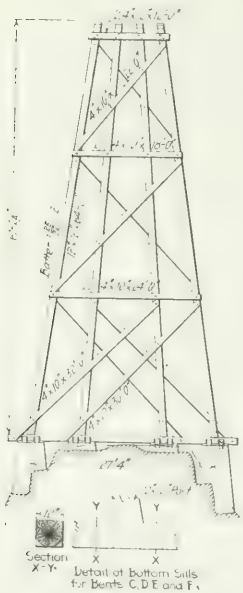


TRUSS MEMBERS FOR WHICH STRESSES WERE CALCULATED

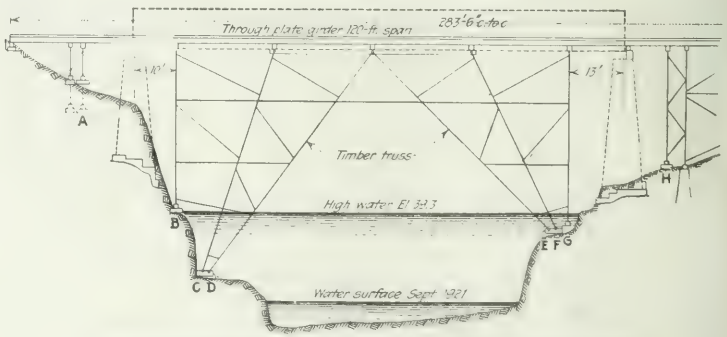
It will be noticed on the detailed drawings that the various bents have different batters. The batters are calculated so as to give all outer posts a batter of $2\frac{1}{2}$ in. per ft. and track posts $1\frac{1}{4}$ in. per ft. These batters are measured in a vertical plane when the bents are in their final position with the principal members forming four longitudinal trusses. All cross bracings are also figured so as to come as nearly as possible in the same horizontal plane.

The design as shown in the drawings was made for a temporary falsework to carry the track across the gorge until the permanent steel structure could be erected. However, with some few changes and strengthening of connections it could be made a more permanent structure to serve the logging traffic regularly in case the steel span is not put in.

S. T. Norris is chief engineer of the Hutchinson Lumber Co.



ELEVATION OF BENT "E"



RELATIVE POSITIONS OF TIMBER AND STEEL STRUCTURES

Indianapolis' Ten Million-Gallon Covered Reservoir

Groundwater Limited Depth—Groined-Arch Floor for Upward Pressure and Flat-Slab Roof for Economy—Built in 120 days

Paper Read Before the Indiana Sanitary and Water Supply Association, March, 1922, by W. C. Mabee, Assistant Chief Engineer, Indianapolis Water Co.

IN January of this year, a 10,000,000-gal. reinforced-concrete reservoir for the Indianapolis Water Co. with a groined-arch floor and a flat-slab roof was completed at a cost of $223,500. Limiting conditions as to depth were imposed by the high ground water causing upward pressure and the upper limit was fixed by the hydraulic gradient of the supply conduit. Careful cost data were kept of the various operations which were carried out by contractors on both the cost-plus and unit basis. Construction of floor columns and roof was carried on continuously from one end to the other from successive set-ups of a large portable mixing plant. No expansion joints were left. At the end-of-the-day joints special provisions for flooding were made to eliminate surface cracking.

The site chosen for the new reservoir was formerly part of the open infiltration gallery at the Riverside pumping station, constructed in 1882 and abandoned as a source of supply in 1907 when the first covered reservoir at this station was built.

The reservoir is divided into three phases by two baffle walls which provide for the uniform circulation of water through all parts of the basin. The baffles are 4-in. brick walls joining columns and extending to the column heads, the walls being reinforced at the middle point of each panel by a 12-in. square brick column. Piping connections are provided so that water may enter or leave the reservoir at three points. One of these connections communicates with an adjoining reservoir of less capacity through a controlling chamber having a drain connection by means of which either reservoir may be emptied and cleaned independently. Another of these connections enters a sump or suction well making practically the entire contents of the reservoir available to the pumps. Pipe connections are 48 in. in diameter.

It was considered advisable and necessary to design the reservoir so that a rise of 10 ft. in the groundwater level would be counterbalanced by the weight of the structure and the superimposed loading of earth upon the roof of the structure without consideration of the weight of the water contained within the reservoir. This excessive upward pressure of groundwater during flood stages, calculated to be exerted at a time when the reservoir might be empty, and the necessity of an equal distribution of downward pressures upon the soil presented a problem in the design of the floor which obviously could be solved best by the employment of the groined-arch type of construction. Further, this type of floor forms intersecting valleys which can be flushed readily when it is necessary to clean the basin.

While a groined-arch roof would have been as satisfactory as the flat-slab type of construction adopted, experience in Indianapolis has shown that contractors as a rule prefer to build along lines with which they are familiar and will for that reason submit lower prices for the flat-slab type of construction than for the groined-arch type, notwithstanding the fact that the groined-arch roof requires practically no steel. The necessity of weighting the structure suggested the use of 27 in. of filling on the cover, assumed to weigh when saturated 250 lb. per sq.ft. This fill also prevents the formation of ice in the reservoir and tends to maintain the roof slab at a reasonably uniform temperature in all seasons, thereby minimizing the distortion of the structure from temperature changes. The total live- and dead-load considered upon the roof slab was 470 lb. per sq.ft. or a superimposed load of 350 lb. The flat slab is designed in accordance with computations based upon the rulings of the American Concrete Institute for four-way reinforcement.

The usual spacing of columns for work of this character varies from 15 to 25 ft. and for the loading under consideration the slab thickness would vary from 7¾ in. for the 15-ft. spacing to 12 in. for the 25-ft. spacing; the column spacing could even be made as little as 10 or 12 ft. on centers. There is no doubt in the writer's mind that the structure with the smaller column spacing can be built for less money, but considering the groundwater problem and the desirability of heavy sections an 18-ft. spacing was adopted. The columns are 24 in. in diameter, reinforced with eight ⅞-in. round bars and ¾-in. tie-bars.



MOUNTED CONCRETE-MIXER PLANT FOR RESERVOIR CONSTRUCTION

The floor, walls and roof of this 254 x 542-ft. reservoir were poured with only eight moves of the large mixing plant. A ½-sack batch mixer was also used for the floor.

Except for corners with a 10-ft. radius, the reservoir is rectangular in plan, 254 x 542 ft., with a net water surface of 136,500 sq.ft. or 3⅛ acres. It stores about 1 mg. per foot of depth and the depth is 10 ft. 8½ in. The cost per million gallons stored, exclusive of piping connections, brick baffle walls and engineering, but including all earth work, was $19,150, equivalent to $1.41½ per square foot of water surface. In percentage this cost was divided as follows:

Excavation, average cut 11 ft.	15.6
Lateral [illegible]	2.1
Levee embankments	2.1
Concrete structure, including [illegible]	[illegible]

The typical labor charges per hour upon which these costs were based were as follows: Common labor, 30c; skilled labor, 35 to 60c.; form builders, 60c.; teams, 75c. All levee work was done by force account for which the company allowed the contractor cost plus 15 per cent.

Excavation.—The dimensions of the excavation were 280 x 570 ft. with a cut varying from zero to 23½ ft., the average being 11 ft. The character of excavation was top soil and hard gravel. The work contemplated filling an abandoned infiltration gallery or reservoir which extended diagonally across the site for the proposed new structure with sand and gravel from the excavation and rolling the

fill with a locomotive crane, the expense of rolling being paid for on force account.

Gravel suitable for concrete was washed, screened and stored in piles upon the old infiltration gallery site at an additional cost of 40c. per cu.yd. The top soil was carefully selected and stored in piles conveniently located for top dressing embankments after completing the structure.

Excavation progressed by months at the following percentage rates: 21, 42, 15, 14, 8.

The equipment consisted of a locomotive crane operating a 1¼-yd. clamshell bucket which was used to fill the old gallery and which was also used to elevate gravel to the washing platform. The larger part of the excavation was handled by teams and wheeled scrapers. The average rate of excavation for the elapsed time was 324 cu.yd. per day and the maximum rate for 30 days was 750 cu.yd. per day. Earth for refill and embankment was included in the contract for concrete work and was handled by wheeled scrapers as follows: 17,985 cu.yd. at 55c. per cu.yd.; 10,150 cu.yd. by force account at 75c. per cu.yd. The total excavation and refill, 80,130 cu.yd., cost the water company an average of 58c. per cu.yd. The average rate of placing embankments for the elapsed time was 230 cu.yd. per day and the maximum rate for any month was 293 cu.yd. per day. R. H. Scott & Co. was the contractor.

Concrete Work—Eleven bids ranging from $6.35 to $15.08 per cu.yd. were received for placing 11,158 cu.yd. of concrete, the water company furnishing all cement and steel to the contractor on board cars at the water company's switch and also delivering gravel to the site, the contractor unloading, hauling and storing cement and steel, furnishing all material for forms, centers and supports; bending settling and securing all reinforcing bars, mixing and placing concrete; fine grading and tamping the reservoir bottom.

The contract was awarded the Mead Construction Co., the lowest bidder, May 26, 1921 and was finished Oct. 24, 1921, the day before the time set in the contract for completion. The average daily progress for the elapsed time, 120 days, was 93 cu.yd. and the maximum day's work was 328 cu.yd. The maximum month was 5,323 cu.yd. In percentage the rate of progress was as follows: June, 2; July, 25; August, 48; September, 21; October, 4.

The water company furnished 15,523 bbl. of cement at a cost of $2.44 per bbl., which the contractor handled for 19c. per bbl. The 464 tons of steel bars cost the water company $2.58 per 100 lb. including the cost of bar spacers. It was placed for $15 a ton. About 5,500 cu.yd. of gravel were purchased at a cost of $1.53 per cu.yd. and 8,443 cu.yd. of gravel were reclaimed from the excavation at a cost of 47½c. per. cu.yd.

Excluding engineering the unit cost per cubic yard of concrete, all of which was a 1:2:4 mix, was: Cement $3.40; steel bars, $2.15; gravel, $1.11; labor (by contract) $6.39; total, $13.05. The labor cost of mixing and placing was $1.7133; fuel, 12; miscellaneous hardware, steel and repairs, 29c. per cu.yd. Hand grading and tamping preparatory to laying the floor cost the contractor $1.50 per 100 sq.ft.

Contractor's superintendence, field-office and bond expense are not included in the unit costs quoted but profits realized by the contractor are included.

Method of Construction—The floor was formed by a series of parabolic groined arches having a rise of 18 in. on a span of 15 ft. 8 in., a minimum thickness of 9 in. and a maximum thickness of 27 in. at the columns. The column base is 28 in. square. In construction, the floor was divided into two parts; the lower 4 in. was laid first as a mat, reinforced with ½-in. bars spaced on 12-in. centers in two directions; this mat served the double purpose of a waterproof membrane and as the foundation for the groined-arch upper floor section.

The roof slab is 9 in. thick and has drop panels at the column heads 6½ ft. square extending 5½ in. below the bottom of the slab. The columns and column heads are circular and were formed by special metal forms rented by the contractor. The cost of setting the 420 column forms was $2.03½ each. The rental of column forms sufficient to form 10 per cent of the columns at once and the purchase of floor screeds distributed over 420 columns amounted to $6.32 each.

The walls are 15 in. thick and rest upon a footing 9 in. thick extending 12 in. outside of the outer wall line, the vertical reinforcement having its anchorage in the floor and roof slabs. The walls at the corners of the reservoir are curved to a radius of 10 ft., this expedient having been found successful in the elimination of contraction cracks at points where such cracks are usually found troublesome. Reinforcement for temperature stresses in the walls consisted of ⅝-in. round deformed bars spaced on 12-in. centers in each face. The form lumber necessary to construct 18 per cent of the wall length and 15 per cent of the roof surface, including supports for 27 per cent of the roof surface distributed over the entire surface formed, amounted to 5c. per sq.ft. The cost of forming labor for the roof surface was 11.5c. per sq.ft. and for the wall 5.7c.

The roof forms consisted of a series of bents or trussed units made from 2 x 8-in. planks doubled, which were spaced on 3½-ft. centers and lagged with 2 x 8-in. planks. These bents were erected upon wedges. At the center point of each panel between columns a 4 x 6-in. prop was left standing for seven days after the centers had been struck. The drop panels around columns were made of wooden units in two sections and were used seven times.

Wall forms were made in unit sections each 4 ft. wide using ⅞-in. tongue-and-groove sheathing placed vertically, reinforced by 2 x 6-in. ribs placed longitudinally and with wood flanges at the sides for bolting the sections together. The 4 x 6-in. horizontal walings, spaced on 24-in. centers, were bolted through the wall at intervals of 30 in. by ⅝-in. round rods held by set-screw clamps. These rods were left in place until after the removal of the forms.

Equipment—The contractor's equipment consisted of one 18-cu.ft. mixer mounted upon a platform forming the base of a tower 74 ft. high and located under a charging hopper or bin holding 45 cu.yd. of gravel. The tower supported one concrete chute 30 ft. long and two counter-balanced chutes, one 40 ft. and one 50 ft. long, giving a working radius of 120 ft. This mixer plant was mounted on rollers for convenience in moving. The chute system was manipulated from a 70-ft. boom attached to the base of the tower and the elevating bucket operated by a single-drum hoisting engine. The hopper was charged by means of a two-drum hoisting engine operating a stiff-leg derrick mounted on rollers and having a 70-ft. boom and ¾-yd. clam-shell bucket. In addition to this outfit the contractor used a ½-sack batch mixer for placing floor concrete.

The larger mixing plant was placed first in the center of one end of the structure and then moved eight times down the center to the opposite end, finishing floor, walls and roof as the derricks moved along. Day-joints were properly bulkheaded and keyways left in all bulkheads, immediately upon the completion of one portion of the roof the margins of the day's work were dammed with a small mortar edging and water about 1½ in. deep was permitted to fill the inclosure. This procedure eliminated surface checks by keeping the fresh concrete saturated and also tended to keep the temperature of the concrete from rising during the hot days of mid-summer. No expansion joints were provided, dependence being placed upon the steel bars, keyways and the density of the concrete mixture to produce a monolithic and waterproof structure. The centers were removed seven days after pouring a section of roof slab. However, one 4 x 6-in. prop was left in the center of each span between columns in two directions. In seven days more these props were removed and in two more weeks, or 30 days from date of depositing the concrete, the earth fill was distributed over the roof in layers 7 to 10 in. deep. The work was done in midsummer when weather conditions for curing the concrete were most favorable.

The work was carried out under the direction of B. J. T. Jeup, chief engineer, Indianapolis Water Co. Leonard Metcalf, Boston, was consulting engineer.

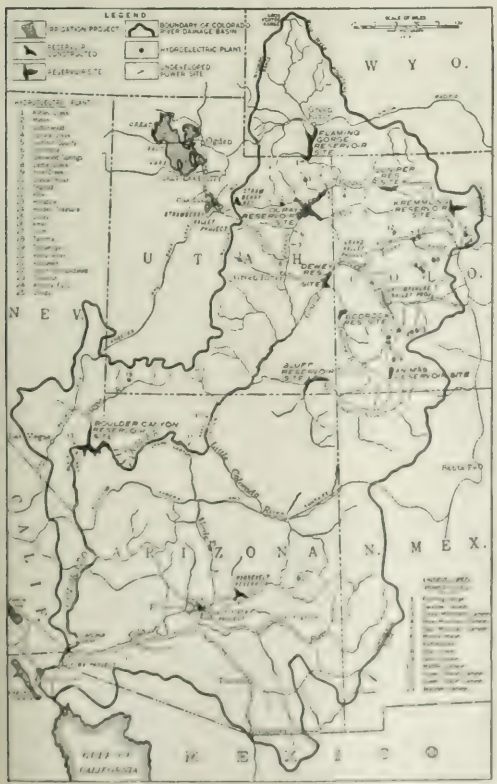
The Colorado River; Its Control and Development

Hydraulics of the River and the Demand for Power, Flood Control and Irrigation Subject of a Federal Report—Recommends Boulder Canyon Dam and All-American Canal in Imperial Valley

Pursuant to the act of Congress approved May 18, 1920, and known as the Kincaid Act, the United States Reclamation Service has been carrying on an extended investigation of the hydraulics of the Colorado River and the problems of its development to satisfy the threefold necessities of irrigation, power and flood control. The final report has just been made by Director Arthur P. Davis, and has been transmitted by the Secretary of the Interior to Congress. The report is only a part of the many data on file with the Reclamation Service, which will be utilized in the current study of the Colorado River problem now being conducted by the Colorado River Commission under the direction of Secretary of Commerce Hoover. The major features of the report, including the hydraulic data, the recommendations as to the Boulder Canyon dam which, if built, will be the highest dam ever attempted, and the solution of the Imperial Valley flood situation recommended by the committee, are included in the following abstract.

THE control of the floods and development of the resources of the Colorado River are peculiarly national problems for several reasons:

1. The Colorado River is international.
2. The stream and many of its tributaries are interstate.
3. It is a navigable river.



MAP OF COLORADO RIVER BASIN SHOWING PROJECTS FOR DEVELOPMENT

4. Its waters may be made to serve large areas of public lands naturally desert in character.

5. Its problems are of such magnitude as to be beyond the reach of other than national solution.

Physiographic Features.—The Colorado River is formed by the junction of the Grand (now called the Colorado) and Green Rivers in southeastern Utah. Its length from the junction of the Green and the Grand to the Gulf of California is about 1,050 miles, thus making, with the continuation of the Green, 1,750 miles in length.

The drainage area of the Colorado River is 244,000 square miles, distributed as shown in the accompanying table, which also shows the water supply from the various branches:

TABLE I AVERAGE DISCHARGES OF THE COLORADO RIVER SYSTEM

	Per cent of total discharge	Discharge in acre-feet	Square miles	Per cent of total square miles	Acre-feet per square mile
Green River	32	5,510,000	44,000	18	125
Upper Colorado (Grand River)	40	6,940,000	26,000	11	267
San Juan River	14	2,700,000	26,000	11	104
Other areas except Gila	8	1,560,000	91,000	37	17
Gila	6	1,070,000	57,000	23	19
Total	100	17,780,000	244,000	100	73

Observations of silt carried have been taken periodically at Yuma just below the mouth of the Gila River for a long series of years and show an average annual amount by volume of 113,000 acre-feet, on the assumption that 85 lb. of dry matter is equivalent to a cubic foot of solid.

The silt content of the Colorado, with the Gila not in flood, has averaged about one-half of 1 per cent and this is fairly representative of the silt conditions at Boulder Canyon reservoir. The discharge at Boulder Canyon is estimated at 17,500,000 acre-feet annually. On this basis the average annual silt discharge is about 88,000 acre-feet per annum.

Irrigation Requirements.—In the valleys of the Lower Colorado, and especially the Imperial Valley, storage is needed for the extension of irrigation and for safety against drouth of the areas already irrigated when the cycle of low years rolls around.

The need is also vital for protection from floods of the Colorado which threaten the levees along the river valley and which are a constant menace to the Imperial Valley, threatening a repetition of the experience of 1906. Both of these problems are urgent and vital.

The records of the Imperial Irrigation system show that for a considerable period in 1915 the waters of the Colorado River were all, or practically all, diverted at the intake of that canal and applied in irrigation of Imperial Valley, with the result that an actual shortage existed there part of the time. The shortage was not severe nor disastrous but at best a value as indicating the actual state of the water supply in relation to use. The shortage would have been still greater had a period as low as that of 1900 and 1904 occurred at that time.

Since 1915 there has been considerable improvement in

the application of water in the Imperial Valley, but recent experience shows that storage is needed to supplement the low-water flow before any large irrigable areas can be added.

Since 1915 Imperial Valley has increased its irrigated area over 60,000 acres in the United States and about 150,000 acres in Mexico. The Imperial Irrigation District contains more than 100,000 acres of irrigable land not yet irrigated and the same valley in Mexico can increase over 40,000 acres and is in a physical position to take the necessary water from the Imperial Canal before it reaches the California line.

The increased irrigation in the basin in 1920 over 1915 is about 300,000 acres and the desired expansion in the Imperial Irrigation District and incontestable or unpreventable expansion in other regions will bring this acreage up to 877,000 acres, or about 400,000 acres more than in 1915, besides the various increases in the Upper Basin.

For full development of all the lands that can be reached by gravity and reasonable pumping lifts on the Lower Colorado River large storage capacity will be required,



BOULDER CANYON ON THE COLORADO RIVER

Here may be built the highest dam ever attempted, at least 500 ft. high and with possibilities of many hundred feet more.

estimated at about 11,000,000 acre-feet if provided by a reservoir below the Grand Canyon in the Colorado. If storage is provided above the Canyon, this must be increased by at least 2,000,000 acre-feet on account of the unavoidable losses due to the impossibility of regulating the flow in exact accordance with the needs of irrigation from a reservoir so far distant, and for other reasons.

Flood Control.—To remove the menace of flood from the Colorado River will require a much larger storage capacity than that above given.

The floods divide themselves naturally into two general classes, those from the Colorado River, which drains large areas in Wyoming, Colorado, New Mexico, Utah, and Arizona, and those from the Gila, which lies mostly in Arizona and partly in New Mexico and Mexico.

A reservoir site of 2,200,000 acre-foot capacity has been investigated near Sentinel, on the Lower Gila, which, if built and maintained, would practically eliminate the menace from the floods of the Gila, but the investigations show such poor conditions for foundation and abutments that the feasibility of this reservoir is subject to doubt.

The control of the Colorado River proper is, however, the main element involved in the flood menace of the lower river, and this has been investigated extensively.

Possible reservoir sites have been found on the Grand and the Green Rivers which, if constructed and operated for the purpose of flood protection, would greatly reduce the volume of the floods, for though the areas intercepted by each are small compared with the total area of the Colorado River Basin they drain mountains with high precipitation that furnish a relatively large volume of water. A reservoir site also exists on the San Juan River, which is the next tributary of importance, but the feasibility of this has not been established.

Of the total area drained by the Colorado River—244,000 square miles—96,000 square miles are drained by the Grand, the Green, and the San Juan, which, though draining less than two-fifths of the total area, furnish approximately 84 per cent of the total water supply. There is still, however, an area of nearly 100,000 square miles below these rivers, exlusive of the Gila, which would be uncontrolled by such reservoirs. These areas, though furnishing a relatively small quantity of water, owing to their aridity, are yet of such extent and declivity that they furnish occasional floods of magnitude from direct precipitation, due to which their control is important from the standpoint of the flood menace.

In the study of this problem, it has been demonstrated that for several reasons it is desirable to have a reservoir below the Grand Canyon of the Colorado, which will intercept most of the drainage of the Colorado River and therefor be a more complete solution of the flood-control problem This method of control is still more vital for other reasons

Upper vs. Lower Reservoirs.—The large areas of very fertile and valuable lands now developed and being rapidly developed require immediate relief by extension of storage for irrigation, and if such storage is constructed in the upper basin, it will of course be operated in conformity with the requirements of irrigation in the lower valley as nearly as this can be predicted, but a large percentage of the water will be lost owing to the great distance and the impossibility of predicting the exact requirements a month or more ahead. In order to provide against embarrassing shortage, it will be necessary to turn out at all times sufficient water to provide for the most extreme conditions that may occur, but which seldom do occur, and this will mean that nearly all the time a large amount of water will be flowing to waste. A large part of this waste can be obviated by an adequate reservoir on the lower river.

In addition to the above waste, any water supply appropriated above for use in the lower valley would not be available for irrigation in the upper valley. The most feasible sites occur at points where this would be an objection to such use, because it would leave in an arid state lands that might otherwise be irrigated in the upper basin. Such a result would be a distinct waste of resources, as investigations show that there is a sufficient quantity of water to furnish an adequate supply to all of the lands in the basin that can be feasibly reached by gravity or reasonable pumping lifts. There will, of course, be local exceptions to this where the areas can be reached only by tributaries in which the local supply is insufficient.

In addition to the above waste, the regulation of waters from the upper river in accordance with irrigations needs in the lower valley would be distinctly out of harmony with the best use of these waters for power in the canyon regions where the power resources predominate.

In the upper and lower regions of the Colorado Basin irrigation interests should and must predominate, although power resources are very important. In the middle or canyon region of the basin, power resources predominate and irrigation interests are small. In general, where irrigation interests are practicable, they should be given preference

over power interests, and this rule requires storage of water in Boulder Canyon, or below, for the use of the lower valleys. The states in the upper basin are therefore vitally interested in seeing that such development takes place before the natural resources are depleted by storage above for use in the lower valleys.

Likewise the states containing the lower valleys are interested in having storage in the lower basin on account of the economies thereby obtained and the greater convenience and ease of control of a reservoir near the point of use. Incidentally, it will have large power resources, which are important in the development of the resources of the Southwest.

Boulder Canyon Dam.—Fortunately, the investigations at Boulder Canyon have shown the feasibility of a high dam at that point, which if built would furnish storage as shown in the accompanying table:

TABLE II—CAPACITY OF BOULDER CANYON RESERVOIR.

(Computed from original plane-table sheets; scale 2 in. equals 1 mile.)

Contour elevations.	Area. Acres.	Capacity. Acre-feet.	Contour elevations.	Area. Acres.	Capacity. Acre-feet.
700	.....	.....	1,100	67,740	10,153,000
750	2,350	58,750	1,150	84,110	13,949,250
800	7,950	316,250	1,200	105,100	18,679,500
850	15,260	846,500	1,250	127,660	24,498,500
900	21,620	1,818,500	1,260	131,000	26,000,000
950	29,160	3,088,000	1,280	142,000	28,600,000
1,000	39,690	4,609,250	1,300	152,000	31,600,000
1,050	53,160	7,130,500			

Note.—The canyon walls extend up to above the 2,000-foot contour, or about 700 feet higher than the last one for which capacity is calculated.

Borings have been prosecuted at the proposed dam site in Boulder Canyon and the cross section of the canyon has been fairly well worked out. A large amount of additional borings is, however, necessary to develop the entire foundation of the proposed dam and this will probably modify its location. Similar information is also necessary for the coffer-dam which must precede the main construction, and must be, for temporary work, of a rather substantial character. Results of the borings indicate the maximum depth to bedrock of about 135 ft. below low-water level. This is regarded as feasible, although the foundation work will of course be difficult and expensive in view of the great volume of the river when in freshet.

Various studies have been made on the basis of the information available and these studies indicate the cost of a dam, with flow line at 1,230 ft., to be about $45,000,000. This would have a storage capacity of about 21,000,000 acre-feet. Increased height of dam to provide greater storage can be provided at an additional cost of about one dollar per acre-foot for the next 10,000,000 acre-feet. A capacity of 31,000,000 acre-feet would require a flow line at about 1,296 ft. above sea level.

These figures include preliminary work and the completion of the dam in shape to serve for storage purposes and upon which to install power plants, but do not include any other cost of power development or transmission.

(A description of alternate methods of constructing the Boulder Canyon dam is included in an article by Arthur P. Davis, which appeared in *Engineering News-Record* of Feb. 2, 1922, p. 184.)

The High-Line Canal.—The construction of a high-line canal connecting Laguna Dam with Imperial Valley was investigated and reported upon by a board representing the State of California, Imperial Irrigation District, and the United States, under date of July 22, 1919, and was published under the title, "Report of the All-American Canal Board. A canal located entirely within the United States from the Colorado River at Laguna Dam into the Imperial Valley, California." Reference is made to that report for the details of such a plant.

Power Development.—The development of power at the Boulder Canyon reservoir is a by-product, which does not in all respects conform to the requirements of irrigation, but can be made to conform thereto with some advantage. The extremely arid and semitropic character of the lands in the Lower Colorado Basin makes it necessary to irrigate throughout the year, and the irrigation requirements therefor conform more nearly to the requirements for power than do those in northern latitudes.

It is estimated that the feasible irrigation projects in the lower basin, which would divert water from the main stream, comprise 2,020,000 acres, of which about 60 per cent is in the United States and 40 per cent in Mexico. The full development of the proposed projects in the upper basin will subtract substantially from the total water supply, but there will still be left ample water to irrigate all the lands of the lower basin if it is conserved and regulated in a storage reservoir of ample capacity. With 1,505,000 acres of land in the lower basin irrigated and with a total storage capacity at Boulder Canyon of 31,400,000 acre-feet, of which the lower 5,000,000 is reserved for silt storage and the upper 5,000,000 is reserved for flood control, it is possible to develop over 700,000 firm horsepower. With the entire 2,020,000 acres of irrigable land developed in the lower basin the possibilities are still 600,000 firm horsepower, and besides this there is a large amount of secondary power which is not constant but will be of considerable value.

All this is on the assumption that the total area of irrigable land in the upper basin is irrigated, namely, about 4,000,000 acres, of which about three-eights is now under ditch. The development of the upper basin will doubtless proceed steadily, but it will be a long time before the full development is reached and the water later to be consumed by future irrigation will be available for power at Boulder Canyon until that development is realized. This will greatly increase the figures shown above for a long time to come and, in the meantime, any regulation of the river above for any purpose will also tend to increase them.

The great value of this power and the wide demand for it, together with its magnitude, indicate that the power privileges of the Boulder Canyon reservoir can be made to bear the entire cost of the dam.

The markets for power are numerous and various in this part of the country consisting in general of the mining interests in Arizona and Nevada, the pumping requirements of the Colorado River valley, and the needs of municipalities of Arizona and southern California for municipal and commercial uses. Possible municipal customers of importance are Prescott, San Diego, Riverside, and Los Angeles.

The last named city has indicated a desire to share in this development. It has already developed considerable power on the Los Angeles aqueduct and owns a system for distributing electric current within the city limits. The demands, present and prospective, are far beyond the capacity of the city to supply with the present facilities and this is considered the most effective and extensive of all the power demands.

It is desirable, of course, to extend to all customers who desire to share in this development the same privileges. The use of the name of the city of Los Angeles is merely typical of such cities as may eventually elect to share in this development. Others may later apply and should have equal privileges.

Comparison of Reservoir Sites.—The demand for a large regulating reservoir on the lower Colorado is urgent and imperative, first for regulating floods and, second, for providing storage water for irrigation, and, third, for power. Without the power the reservoir is not feasible at all as the expense would be too great to be borne by other interests alone.

The reservoir site provided by a dam at Boulder Canyon is the lowest point on the Colorado River where a site of sufficient capacity can be found. Above this site the Grand Canyon occurs and no reservoir of a capacity sufficient to control the entire flow of the river occurs until we reach a point above the Grand Canyon National Park. A site has been proposed above the mouth of the Paria River in Glen Canyon and it had been urged that a reservoir formed here would, for a given height of dam, provide greater storage capacity and would so regulate the floods as to facilitate the construction of other dams farther down. These are

valid arguments as far as they go, but such a reservoir would not answer the present purposes for several reasons. Between the Glen Canyon and Boulder Canyon site about 50,000 sq.mi. of drainage flows into the Colorado, including the Little Colorado, the Virgin, the Paria, the Kanab, and many smaller tributaries. This region furnishes about 10 per cent of the water supply passing Boulder Canyon and most of it is subject to torrential summer rains and to floods at other times, and the Glen Canyon site would not therefore give satisfactory control of the floods, which is the most urgent of the problems presented. A satisfactory solution of this problem could not be accomplished at any point above Boulder Canyon.

Any large reservoir on the Colorado must depend for its financial feasibility upon the availability of an adequate market for not less than one-half million horsepower of electric energy within economical transmission distance. The principal available markets are the Pacific slope of California, irrigation pumping, the mining regions of Arizona, electrification of the Southern Pacific, the Santa Fe, and the Salt Lake Rys., and cities in Nevada, Utah, Colorado, and New Mexico. All of the more important markets above listed are more convenient to Boulder Canyon than to Glen Canyon. This is especially true of the most important markets, the cities and irrigation districts of southern California. To reach these the most feasible route for transmission lines, considering the importance of transportation and their construction and maintenance, is approximately along the railroad routes. [Averaging up these distances, a table shows the difference in favor of Boulder Canyon to be 264 miles.] This advantage in transmission distance is of course decisive. It would be hard to find a power site in the United States more remote from adequate markets than the Glen Canyon site.

As regards silt problems, the Boulder Canyon dam as planned would store the silt for over three centuries if all were caught and held, and for nearly a century before greatly impairing its water storage function.

Recommendations — At the conclusion of the report the following recommendations are made:

1. It is recommended that through suitable legislation the United States undertake the construction with Government funds of a high-line canal from Laguna Dam to the Imperial Valley to be reimbursed by the lands benefited.

2. It is recommended that the public lands that can be reclaimed by such works be reserved for settlement by ex-service men under conditions securing actual settlement and cultivation.

3. It is recommended that through suitable legislation the United States undertake the construction with government funds of a reservoir at or near Boulder Canyon on the lower Colorado River to be reimbursed by the revenues from leasing the power privileges incident thereto.

4. It is recommended that any state interested in this development shall have the right at its election to contribute an equitable part of the cost of the construction of the reservoir and receive for its contribution a proportionate share of power at cost to be determined by the Secretary of the Interior.

5. It is recommended that the Secretary of the Interior be empowered after full hearing of all concerned to allow the various applicants their due proportion of the power privileges and to allocate the cost and benefits of a high-line canal.

6. It is recommended that every development hereafter authorized to be undertaken on the Colorado River by the federal government or otherwise be required, in both construction and operation to give priority of right and use—

1. To river regulation and flood control;
2. To use of storage water for irrigation;
3. To development of power.

Rochester Begins Work of Making Subway Out of Erie Canal

Abandoned Section of Canal Bed Being Fitted for Rapid-Transit Service and Vehicular and Pedestrian Traffic

By Edwin A. Fisher
Consulting Engineer to the City of Rochester, N. Y.

RECONSTRUCTION by the city of Rochester, N. Y., of a portion of the abandoned Erie Canal to fit it for rapid-transit service and vehicular and pedestrian traffic began early in April. Through the construction of the Barge Canal, south of the center of the city, a 13-mile section of the Erie Canal has been vacated, and 8⅛ miles of that section were acquired late last year by the city to be used as the basis of a rapid-transit system.

The reconstruction contemplates the placement of four main tracks, together with sidings where required, on the canal property at the grade of the canal bottom. Two tracks will be for freight and will eventually be connected with all the railroads in the city as well as with industries either located or to be located along the line of the canal. The other two tracks will be for interurban and local trolley service, and will connect with all interurban lines, thereby permitting the removal of interurban cars from surface streets. Above the canal bed will be constructed a superstructure for

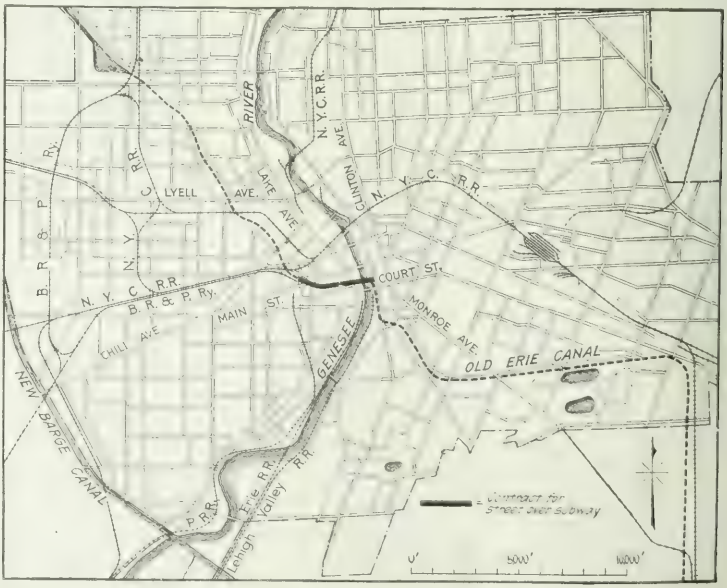


FIG. 1. ROUTE OF ABANDONED ERIE CANAL THROUGH THE CITY OF ROCHESTER

vehicular and pedestrian traffic. The width of the street will be from 52 to 60 ft., and the sidewalk 14 to 18 ft.

The particular contract now being executed is for work extending from Oak Street on the west to Court Street on the east.

The aqueduct which carried the waters of the Erie Canal across the Genessee River is to retain its general character in the reconstruction. The railroad will be

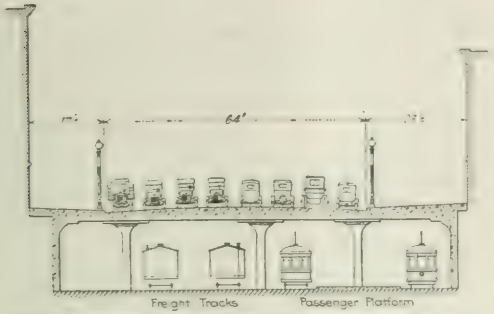
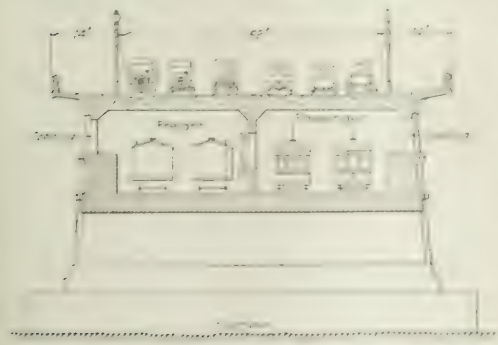


FIG. 2. CROSS-SECTION OF RECONSTRUCTED CANAL.

built inside of the aqueduct and the street surface on the masonry structure on top of the present parapet walls.

Three main stations are provided within the city, and other stations are located as shown on the accompanying general map of the city. At these stations the tracks are to be spread a distance of 30 ft. from center to center, leaving a platform on either side 29 ft. in width.

The ordinance which was passed Nov. 21, 1921,



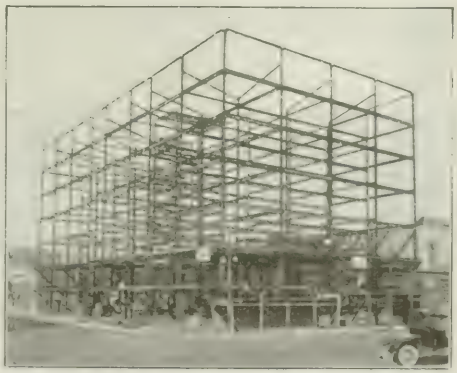
authorizing the construction of the subway and superstructure through the main part of the city also authorized a certain amount of excavation necessary to connect the proposed subway with the Lehigh Valley R. R. on the east, and with the B. R. & P. R. R. on the west, a total distance of about one mile.

The price paid for the abandoned section of the Erie Canal by the city was $1,500,000 in round numbers. The contract for building the subway and the superstructure was let recently to Scott Bros. of Rome, N. Y., for $1,183,780.

The detailed study of the project was made by Legrand Brown under the general direction of Edwin A. Fisher, consulting engineer and superintendent of city planning. The detailed plans of the portion of the work recently let were prepared by Mr. Brown under the general charge of the city engineer, C. Arthur Poole. B. H. Davis, New York City, was the consultant on concrete construction. Prof. George F. Swain of Boston examined and reported favorably on the entire project. The general plan was also approved by the City Planning Bureau.

Sixty-Foot Columns Economical in Five-Story Building

IN erecting a five-story steel-frame office building at Santa Rosa, Cal., considerable time was saved in detailing, in shop work and on erection by the use of columns 60-ft. long. Using columns of this length no splices were required above the second floor and above this level it was not necessary to plank entire bays for riveting. Another item of delay eliminated was the necessity for repeated raising of the derrick as is the ordinary procedure when erecting two stories at a time. There



VERTICAL COLUMNS WITHOUT SPLICE ABOVE THE FIRST STORY

was no difficulty due to kinked columns and very little pulling by cable and toggle had to be done.

Sixty feet is a popular length for steel shapes carried in stock on the Pacific Coast because, 20, 30 or 40-ft. lengths can be cut therefrom without waste. For this job H-columns of the 60-ft. length were selected of a weight sufficient to give the required strength at the lower end. The weight of the splice material and the shop cost saved by the elimination of splices more than made up for the added material used by making the columns the same sectional area through all stories above the first. The first-story columns had to be of a considerably heavier section. The 60-ft. length was sufficient to extend from the second floor into the parapet, the latter adding practically a sixth story.

The foregoing was supplied by Clarence E. Seage who was consulting engineer on the job. Sylvain Schnaittacher was the architect and Al Coutts the erector. Credit for aiding in the deviation from ordinary methods is given to the Central Iron Works by [illegible] the steel was supplied

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

In Support of Aerial Surveys

Sir—With reference to P. J. Barry's letter in your issue of Nov. 17, 1921, p. 828, I would like to challenge his statements in regard to one or two points.

On perusal of Mr. Barry's letter it is evident that he has had little or no experience in aero-survey work. That "the results achieved during the war . . . only served to demonstrate that for all practical purposes the making of maps from photos is impossible" is a futile statement to make. Had Mr. Barry been in the Army Zone—and no man who was there would underrate the value of aero photography—he would have seen whole maps prepared from air photos for the artillery and actual shots carried out from them alone. If this is not a "practical application" I would draw his attention to the fact that all trenches shown on service maps were plotted from air photos and were just as accurate when plotted to a scale of 1:10,000 as the same trenches determined with all the theodolites and chains that Mr. Barry can manage to collect. For a sample of mapping done from the air I would refer Mr. Barry to any British ordnance map showing enemy and British trenches in, say, the Ypres salient.

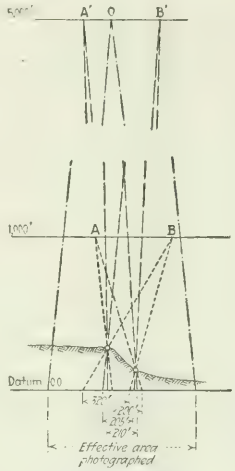
In the second paragraph of his letter Mr. Barry refers to the different altitudes flown and the subsequent disastrous results to the photos obtained. Investigation of Mr. Barry's sketch on p. 828 will show that he has assumed the plane to be flying at 1,000 ft. I would like to point out that, unless under exceptional circumstances, the average height for a photo is between 4,000 and 8,000 ft. and that a photo taken at 1,000 ft. for survey use is practically useless.



MELBOURNE DOCKS PHOTOGRAPHED AT HEIGHT OF 4,000 FT.

At a height of 5,000 ft. or more the error referred to is practically eliminated and decreases as the height increases. Again, the middle third of the photo only is used and with increased altitude the error at a scale of 1:10,000 is negligible. The accompanying drawing shows the advantages gained in flying at high altitudes. I also enclose a photo taken at a height of 4,000 ft. of some of the Melbourne docks. This photo has not been specially selected but is one of many covering some 20 sq. miles of docks and part of a mosiac map prepared for a local department.

Mr. Barry expresses his sympathy with the draftsman called upon to trace the mosiac. I employ a process where no tracing is required in making a line plan from the photos, so no draftsman need be heartbroken.



ERROR REDUCED BY FLYING AT HIGH ALTITUDES

That "the day of the airplane as a survey instrument has not arrived" is a rather prodigal statement to make as the Shaw Ross Aviation Co. of this city is making surveys of country hitherto untouched by the theodolite methods, showing, forests, rivers, spurs, and all topographical detail, but of course giving no levels.

As the greater part of Australia is, up to the present time, unsurveyed and as the only feasible way of doing it is from the air, I would ask Mr. Barry to watch the development of aero survey in this country and he may then, perhaps, refute some of the wild assertions made in his letter.

HUNTER ROGERS,
Engineering Branch,
Public Works Department,
Melbourne, Australia.

Sir—The article entitled "Uses of Aerial Photographs in Map Making" by Glenn S. Smith, U. S. Geological Survey *(Engineering News-Record,* Feb. 2, p. 194*)*, deals rather severely with what is described as "ground methods" of topographic surveying. The author could have maintained a much safer position, however, if he had explained that the methods referred to were merely those which came under his own personal observation, instead of leaving it to his readers to infer that the allusions were meant for all survey methods. Comparison with maps which are not complete and are only in the class of sketch maps does not show that aerial photographs are superior to maps based upon precise field surveys, and it is with the latter comparisons must be made to prove anything conclusive.

On p. 194 we are told that "the data obtained from air photographs are far more complete, and in most cases more accurate, than are obtained by means of ground surveys." And at the conclusion of the same paragraph it is stated that "the wealth of information shown in the photographs and the availability of this information for reference makes this method of securing survey data superior to the ground methods." Does the writer seriously inform his readers that they will obtain more accurate information about map details at a distance of two miles from them than can be got by a close inspection? Or, that a process which has no mathematical values is superior to the actual and calculated measurements of a precise plane survey? It is too much!

The frequent references in the article to a 1-in. map and engineering requirements causes the reader to wonder where the connection is, because it is not very evident that a mosaic map without contours or elevations and upon which 1-in. represents 5,280 ft., can be of much use to engineers; it fulfils no requirements beyond being a guide map. The statement that "any *method* employed in making ground surveys is subject to errors" is very wide of the mark, if its meaning is taken from the context. In countries where it is absolutely necessary to have accurate surveys made, the original survey is not taken for granted, and a system of examination is applied which ensures that field and office errors are eliminated before printing.

For reconnaissance purposes and certain classes of outline maps aerial photographs are often useful, but as a substitute for the regular methods of topographical surveying, when accuracy and clearness of detail are essential, they are of little practical use. In examining the claims of aerial mappers it is only too evident that they are very much exaggerated. For example: Mr. Smith admits that

a mosaic is not a map because the features shown on it "are in no case in their correct relative position to all others shown on the mosaic." They are subjected to a process of adjustment (which is not explained) in order to agree with points which are assumed to be in correct position.

So much being admitted, the characteristics which make a map intelligible may be briefly dealt with. These requirements are classified under six headings: (1) Boundaries; (2) names; (3) altitudes; (4) areas; (5) geology; (6) detail. The first five can be dismissed as having no connection with aerial photography because the data under these headings will have to be collected on the ground. It may be claimed that (4) areas can be taken from the photograph, i.e. condition of roads; material of bridges, dams, computation are frequently bounded by undefined lines, wire fences, or something which will not show on the photo, and, besides, irregularity of the ground will cause a discrepancy between the picture area and the plane of the survey on the ground.

As far as (6) is concerned the air photograph merely gives a distorted view of *some* of the detail, unclassified and requiring inspection on the ground to identify and write descriptions. The table of conventional signs which usually accompanies standard topographic maps will show that very little detailed information can be gleaned from a photograph: this cannot be conveniently done because areas for buildings; telegraph and telephone lines and offices; the presence of water in watercourses, depth and direction of flow; nature of woods; characteristics of land; and a great deal of valuable information is lost in the shadows and vagueness of the photograph. A liberal allowance, therefore, for (6) would be one-half, which, added to the five-sixths already discounted, leaves approximately 8 per cent of the information required as possible by the aero-photograph method.

A distinguished U. S. professor of civil engineering writing upon aerial photos for mapping expresses the opinion that "under most conditions I am ready to argue that the results are in the class with mere sketches and that the claims of the promoters of work of this character ought to be discounted about 95 per cent." My estimate of aerial photographs being deficient in topographic information by about 92 per cent agrees very closely with this.

Winnipeg, Canada P. J. BARRY,
Feb. 16. Dominion Water Power Branch.

Sir—P. J. Barry is correct in his statement that the writer of the article entitled "Uses of Aerial Photographs in Map-Making," (*Engineering News-Record*, Feb. 2, p. 194) should have explained that "the methods referred to were merely those which came under his own personal observation."

This personal observation, however, extended over a period of seven or eight years, during which the writer has had direct supervision of the results obtained from the use of aerial photographs in connection with the field surveys executed by the A. E. F. in France and the aerial photographing of the complete coast line of the Dominican Republic and Haitian Republic, as well as about 5,000 sq. miles of the interior of those republics involving the taking of more than 20,000 photographs; he has also supervised or been in close touch with the aerial photographic mapping undertaken by the federal government in different parts of the United States.

The information obtained from these sources, together with 30 years' experience as a topographic engineer with the U. S. Geological Survey in topographic mapping, led the writer to make the deductions published in *Engineering News-Record*. In answer to Mr. Barry's question in paragraph 2, attention is called to the writer's statement that "the use of air photographs in connection with the general mapping of the country is confined at present to maps [illegible] larger than 1:10,000, and wherever photographs are used in connection with engineering problems they are for the purpose of facilitating the study of those problems as a whole, and only in exceptional cases can they be used for working plans."

The "frequent references" to the use of photographs in connection with the 1 in. to 1 mile map are explained by the fact that the standard scale for the general mapping of the United States is 1:62,500, or approximately 1 in. to 1 mile, and it is maps of this scale which will eventually receive the greatest benefits from the use of aerial photographs.

The use of aerial photographs for procuring other data than those which are usually obtained by plane-table methods, such as traverse or roads, watercourses, outlines of timbered areas and fence lines, has been given serious study and consideration, but the results of this investigation have shown that the methods employed in aerial photography have not yet been developed to the point where the photographs can supplant the ground surveys except as above mentioned, and the additional topographic data required to complete the map will have to be obtained by ground methods notwithstanding the fact that aerial photographs have been used.

The photographic method furnishes all the horizontal data usually obtained with the plane-table and in addition numerous data which have been found of sufficient value in the contouring of the area to enable the topographic engineer to complete the map in less time than would have been possible without the aid of the photographs, thus reducing the total cost of the completed map from 15 to 30 per cent, according to the character of the country under survey.

It is apparent that Mr. Barry has not had an opportunity to use aerial photographs in connection with the topographic mapping of large areas and his criticisms are, no doubt, due to the fact that he has in mind the use of aerial photographs in connection with surveys of small areas where a large scale is employed, such as 100 or 200 ft. to 1 in. It may be of interest to Mr. Barry to know that the committee on photographic surveying of the Board of Surveys and Maps of the federal government has published a report entitled "The Use of Aerial Photographs in Topographic Mapping," which goes into considerable detail. This report can be obtained from the Chief of the Air Service, War Department, Washington, D.C. GLENN S. SMITH,

Acting Chief Topographic Engineer,
U. S. Geological Survey.

Washington, D. C., April 8.

Comparison of Designs for Wabash Bascule Bridge

Sir—Referring to the article in your issue of Mar. 2, p. 363, describing the bascule bridge recently completed for the Wabash Ry. across the Rouge River at Detroit, I note the statement to the effect that this design is considered more economical than others and that it was selected after consideration of four other types of movable bridge, one of these types being a Strauss bascule.

This would lead your readers to believe that the Strauss type was proposed for this crossing among others, and that the design selected was given preference because of greater economy. This, however, is not the case. The Strauss company did not submit a design for this crossing and in fact did not know that the matter was up for consideration until long afer the order had been placed with the American Bridge Co. and the plans begun. The Strauss company was not requested to make any estimate of quantities or cost and furnished no such estimates, and it is self-evident therefore that the article was in error and that the Strauss design was not considered in the sense of a cost comparison to determine which type was the most economical.

The design selected is very interesting and is a compliment to the excellence of the bascule-trunnion principle embodied in the Strauss patents, which patents seem to embrace the Wabash design, but we believe it only just to us and to the bascule-trunnion type that it be clearly understood that a cost comparison between the Strauss bascule trunnion and the Wabash bridge has not yet been made.

THE STRAUSS BASCULE BRIDGE CO.
J. B. STRAUSS, President.

Chicago, March 17.

Teaching Descriptive Geometry

Sir—An interesting letter, "Teaching Descriptive Geometry," appeared in your issue of March 30, on p. 540. The *direct practical* value of the science is well brought out.

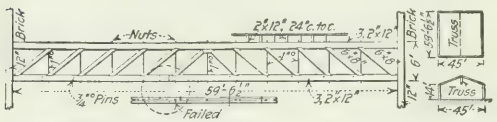
In this connection, a noteworthy point is the difference between the European and the American point-of-view. In Europe, specially in France, descriptive geometry is taught for its great value in developing the power of making clear mental pictures and in quickening the imagination. In our country, the *direct practical* use is stressed. In Europe, it is rather the *general educational* value that is stressed. There it is considered that sufficient justification for teaching descriptive geometry lies largely in the mental benefits of the study itself, a fact not generally known elsewhere.

J. A. DORST,
Major, Corps of Engineers, U. S. Army.

West Point, N. Y.,
April 22.

Defective Roof Truss in Service Five Years

Sir—I recently came across the truss pictured in the accompanying sketch and thought that some of your readers might like to figure as to what held it up for the five years that it was in service. As can be seen from the sketch, all the stress in the bottom chord was taken by the middle



TRUSS SAGGED 8 IN. AFTER BOTTOM CHORD BROKE

member and it had been reduced one half in section by the hole for the 1-in. rod. Failure finally occurred at this point, but instead of collapsing as might have been expected the truss sagged about 8 in. and showed no other signs of failure while being propped and braced.

Baltimore, AUGUST MENCKEN.
April 22.

Early Report on the Hydraulic Jump

Sir—In some recent articles in the professional journals the impression is conveyed that the principles governing the application of the hydraulic jump as a means of absorbing high velocities in water were first developed and applied in the structures of the Miami Conservancy districts, subsequent to 1916. As a matter of history, in June, 1914, I submitted to the Knoxville Power Co. a report entitled "Studies on the absorption of kinetic energy and action of water at the toe of models of Cheoah Dam," giving the results of six months' experimental work on the subject, all of which resulted in definite and clear-cut conclusions. These conclusions were summarized in the exact words of that report as follows:

"Practically all of the kinetic energy of water flowing at high velocities in open channels may be internally absorbed by directing the water into pools of water exceeding a certain minimum depth and a certain minimum length.

"The theoretical minimum depth of the pool is given by the equation

$$2\sqrt{\frac{d_1 V_1^2}{2g}}$$

In which d_1 is the depth of the water before entering the pool and V_1 is the velocity of the water at the same point. This equation gives the depth of the pool above the same horizontal datum above which d_1 is measured.

"The required length of the pool is at least approximately equal to the net velocity head absorbed by expansion divided by 1.35. This gives the distance in which the bottom velocity is completely absorbed. About 20 per cent should be added to allow for complete absorption of velocities above the bottom.

"The depths and lengths of the pool must be uniform. Wherever V_1 is greater than the value used in computing the depth of the pool or the actual depth of the pool is less than the computed value, the probabilities are that the velocity will not be completely absorbed, and more or less agitation will ensue.

"The pool must be of the same width as the channel in which the water is flowing at high velocity and must continue at this width until the velocity is completely absorbed. Increasing the width of the pool beyond the channel width does not gain anything.

"In a channel of uniform cross-sections, such a pool may be formed by placing an obstruction at a sufficient distance down stream to permit of securing the required pool length. The dimensions of this obstruction must be such that the minimum depth required may be obtained.

"In high dams, subject to high velocities at the toe, complete absorption of the high velocities within the shortest distance possible, is desirable to prevent channel erosion and turbulent conditions in tail races, as much as possible.

"An efficient method of absorption is by directing the water into pools having the minimum depth given in preceding paragraphs.

"The height of the lip of the bucket above the bottom of the pool has little effect on the general efficiency of the absorption, if the lip is kept within the lower half of the pool's depth. The bucket with the lowest possible lip will allow the least wear on the concrete but as this is negligible on a well designed and constructed dam, the advantages of the highest possible bucket in decreasing the height through which the water falls and also allowing the use of longer buckets with less excavation and less concrete, may be considered paramount. The highest possible position of the lip with present knowledge is perhaps about half the depth of the pool.

"The required depth of pool varies as the depth on the crest, hence the longer the crest, the shallower the pool but also the bucket must be made longer.

"In no case must the product of the depth and the square of the velocity for any part of the water entering the pool exceed the value of this quantity used in computing the capacity of the pool.

"For the same head on the crest, arched dams by increasing the value of d_1 for the same discharge, require greater depths than do straight dams.

"Where pools of sufficient depth are not provided, it is probable that the entire kinetic energy of the water will be expended upon the channel and erosion will continue at a rapid rate until a pool of sufficient depth is excavated by the water."

These principles were recognized and used in the design of a number of overfall dams over 200 ft. high, two of which—the Narrows Development on Yadkin River and Cheoah Development on Little Tennessee River—were placed in operation in 1917 and 1919 respectively.

I am sure that the idea of the stilling basin has been long used by hydraulicians on the basis that the best way to stop a runaway horse is to head him into a haystack, and I believe that engineers in England and India recognized the jump as occurring at the toe of many completed dams, although its significance in the absorption of the high overfall velocities does not appear to have been appreciated. On the other hand I know of a long concrete wasteway on the Strawberry Valley Irrigation Project of the Reclamation Service, built many years ago with a total drop of about 90 ft., in which the designing engineer skillfully introduced one stilling basin half way down the slope and at the bottom put in another and turned the water abruptly exactly 90 deg. The sides of this basin were not over six feet high but no water left the basin except at the proper outlet and the high velocities at the entrance were completely stilled. I doubt if he understood theoretically what he was doing, but the device worked, or, as the article that started this discussion states, "the hydraulic jump is a success." ROBERT F. EWALD.

Pittsburgh, Pa., March 9.

NEWS OF THE WEEK

New York, May 4, 1922

Fort Worth Flood Highest on Record

City Engineer Reports a Stage 2 Ft. Higher Than 1908 Resulting from 10.6 in. Rain in Two Days

A flood stage of 39 ft. on the government gage was reached in the Trinity River at Fort Worth, Texas, in the highwater beginning April 25. This is 2 ft. higher than the stage reached in the 1908 flood, the highest previous high water. City services were interrupted and great destruction was done in the lowlands, resulting from failure of the levee system above the city, according to D. L. Lewis, city engineer.

Fort Worth is located on the Trinity River and on the Clear Fork of the Trinity, the two streams joining near the center of the city. The business and main residential districts are on high ground, above flood stage. All damage was done in the lowlands, where there is a considerable dwelling-house district, factories, the city water pumping and filtration plants, and the plant of the Fort Worth Power & Light Co. The lowlands in and adjacent to the city are protected by a levee system on both rivers, but owing to the rapid rise of Clear Fork on the morning of the twenty-fifth a crevasse occurred at the upper end of the levee system and the flood waters flowed straight through the lowlands, producing a number of additional levee breaks which destroyed the effectiveness of the system.

Excessive Rainfall

Rain began falling about 11 p.m. on the twenty-fourth, and in six hours, by 5 a.m. of the twenty-fifth, a total of 7.54 in. had fallen. At 9:30 p.m. rain began again, and by 7 a.m. of the twenty-sixth another 3.06 in. had fallen. The cloudburst of the night of the twenty-fourth, apparently most intense over the upper drainage area of Clear Fork, produced a rise of 5 ft. per hour, in which the levee system failed. The city pumping plant and filter plant were flooded 3 ft. above the main floor, and both plants were shut down at 7 a.m. on the twenty-fifth. This deprived about three-quarters of the city of water supply. At 10 a.m. of the following day the water had gone down to 14 in. below the fire boxes and pumping again started, but another rise occurred from the rains of the night of the twenty-fifth-twenty-sixth, and the pump had to be shut down again at 11:30 a.m., for another 3-hr. period. The pumping plant was equipped with oil and natural-gas burners; oil was used regularly, but as the fuel oil-storage tank was washed away the resumption of pumping depended on one unit equipped with gas burners. On the following day, 8 a.m. of the twenty-seventh, the filter plant also resumed operation; all the filter beds had been flooded.

The electric plant of the Fort Worth Power & Light Co., at the junction of the rivers, was also shut down. Current supply, however, was maintained by the high-tension line connected with the Waco plant, 100 miles way, except during the early hours of the twenty-sixth, when an electric storm interrupted transmission service. This storm also paralyzed the telephone system.

Mr. Lewis estimates that 5,000 people were driven from their homes. The loss of life is now estimated at 35. Many persons were injured, and a great many families lost all they had. Much damage in the way of washouts was done to the steam and electric railways; nearly all lines were tied up.

By good fortune, only one fire occurred while the city was without water. This was extinguished by pumping water from a storage tank at a nearby ice plant.

Tree Wrecks Steel Bridge

A steel truss bridge over Sugar Creek near Washington Court House, Ohio, was wrecked on March 30 by a large tree falling on one of the trusses. The bridge was a county structure. The state in co-operation with the county is replacing it with a pony truss bridge of 104-ft. span and new abutments and slightly revised alignment to eliminate danger of curves at the approaches.

Mississippi Flood Stationary

Main levees are holding along the Mississippi, which continues to be in flood. Three breaks in river levees have flooded large areas; one at Ferriday, La., on the west bank a few miles above Natchez, one on the east bank 12 miles below New Orleans at Poydras and one on the west bank at Myrtle Grove, 35 miles below New Orleans. The upper break flooded by far the greatest area of the three but the flow will for the most part reach the river again below the Old River entrance. The lower two breaks will probably serve to reduce the maximum height at New Orleans.

Portland Cement Specification Made Standard

According to recent action of the American Engineering Standards Committee, the A.S.T.M. specification for portland cement has been advanced from the rank of tentative to the rank of "American Standard." The form in which it was thus approved is the form as revised in 1921 by compromise between the American Society for Testing Materials and the government interdepartmental committee. Other recent action of the American Engineering Standards Committee includes approval as tentative of the A.S.T.M. specifications for drain tile.

All-Embracing Construction Council Planned

Tentative By-Laws Drawn for Body Giving Equal Representative to All Interests

Representatives of all elements of the construction industry except labor and the construction departments of public utilities met in Cleveland April 28 and 29 and drafted a set of by-laws under which it is intended to form a federation or conference board representative of the entire construction industry and "dedicated to the improvement of the service which the construction industry renders to communities, states and nation." The name proposed for the organization is the American Construction Council.

Origin of Plan

Last week's meeting is an outgrowth of an informal discussion held in Chicago last month while the National Federation of Construction Industries was in session. During this discussion there was expressed by many interests the feeling that an all-embracing and balanced conference organization was needed and that no existing body met the requirements. The better part of three days was consumed in the discussion, resulting in the crystallization of the broad lines along which the new body should be formed. A committee was delegated to draw up a set of tentative by-laws conforming with the prevailing views, to set a date for a subsequent meeting and to invite through the appropriate associations, the attendance of representatives of the ten major groups into which the industry had been divided.

The representatives as appointed met for discussion of the draft in Cleveland last week, revised it and will now, through a steering committee composed of the secretaries of the Federated American Engineering Societies, the American Institute of Architects, the Building Trades Department of the American Federation of Labor, the Associated General Contractors, the National Federation of Construction Industries, and the National Lumber Manufacturers Association, endeavor to secure the adherence of as many as possible of the 250 associations in the construction industry and their participation through authorized delegates in the organizing meeting, to be held some time after June 19. The place of that meeting has not been determined.

Plan of Council

As outlined in the tentative by-laws the industry would be divided into ten groups, each with equal voting power. From each group would be elected two members of the executive board, of which the president, vice-president, secretary and treasurer would be members. The main body would meet in annual

(Continued on p. 751)

Government Near End of Its Case in Cement Trial

Evidence in North American Co. Case Allowed—Government Accountant Proves Interesting Witness

Before the end of the present week it is expected that the government will close its side of the case in the criminal trial of cement manufacturers of the Eastern District before Federal Judge Knox in New York City. It will probably take at least three weeks for the defense to make its case and at present it is not expected that a verdict will be reached much before the end of May. One of the popular features of the defense will be the exhibition of moving pictures showing the history of cement manufacturing.

Outstanding in the past week's evidence-taking has been the allowance by the presiding judge of the introduction as evidence of the minutes of meetings of the North American Portland Cement Co., a company organized in 1907 and the stock of which was held by six prominent cement concerns. The company was organized for the purpose of controling the patent uses of a then new method of burning cement with powdered coal. The patent was issued to the Alpha Portland Cement Co. and the other companies in the North American Company—Atlas, Lehigh, Lawrence, American and Vulcanite—were allowed the use of the patent upon a yearly payment of $200,000 and a royalty in addition, based upon shipments. The company was dissolved by common consent about four years after its organization, when some Western superior judge decided that the patent, though valid, was not basic.

All this history is being gone into by the government with the idea in mind that some control of cement production and distribution can be imputed to the North American company, and that such collusion, if proven, will reflect upon the present defendants, indicating a like disposition to production restriction.

Mill Bases Found Uniform

One of the most interesting of the government witnesses so far called was examined May 1. He is Walter Lewis, an accountaint permanently attached to the Department of Justice. Mr. Lewis testified to the fact that within the past three years he examined 928 out of 5,000 contract prices, and found, by deducting the bag charges and the freight rates, that in 95 per cent of the cases the prices bid showed an exact uniformity as between mill bases of competing concerns.

During the week the government examined a number of purchasing agents of large New York City contractors who testified as to the uniformity of cement quotations, discount practices, bag charges and bag-refund allowances. All of these men examined testified on cross-examination that they preferred to handle their purchases from dealers in view of the lack of storage and warehouse space, particularly where large amounts of cement were to be needed for specific jobs. The government has tried to make a strong point out of the fact that cement could be purchased only through dealers. The ability of dealers to truck cement to the job, as it was needed, was said by these witnesses to be a decided advantage.

The government also introduced as documentary evidence the statistics indicating the yearly productions of each mill reporting to the National Association as well as shipments and stocks on hand for the years 1916-1920. Included in these statistics were shipments made by mills for other mills for the years 1918-1920, and the percentage of each of these items—production and shipments—to the production and shipments of each mill. In the introduction of such evidence the government sought to show that the percentage was the same from year to year and therefore there was a definite allocation of business. The evidence was introduced through James W. Allen, a government accountain who has not yet been cross examined.

Other documentary evidence introduced by the government was in the form of Interstate Commerce freight tariffs which were to be checked against the freight-rate books circulated among members of the Cement Manufacturers Protective Association. It was charged by the government that there was an arbitrary variation made in the freight rate books. Selecting 25 out of thousands of cases it was found that errors had crept into the government compilations as well, and that in important instances there was a variation only of a fraction of a cent.

Seattle Contracts for 66-Inch Steel Water Conduit

The contract for furnishing and laying 16 miles of 66-in. water conduit from Swan Lake to the Volunteer Park reservoir (see *Engineering News-Record*, Feb. 16, p. 297) has been awarded to Grant, Smith & Co., Seattle, for $1,468,603. Riveted-steel pipe will be used. For part riveted-steel and part wood-stave pipe the same bidder offered to do the work for $1,523,231. The only other bid for the entire work was $1,890,735 for lock-bar steel pipe throughout from the Puget Sound Bridge & Dredging Co. There were six bids for material alone and three for pipe-laying only. A. H. Dimock is city engineer.

Educators Would Ask Industry To Help Define Basic Studies

Conclusions reached by the second public conference on commercial engineering held under the direction of the committee on commercial engineering of the U. S. Bureau of Education, at Pittsburgh, May 1 and 2, favored the introduction into engineering schools of instruction in the elements of commerce, and into schools of commerce, instruction in the elements of engineering. These elements should be determined, the conference believed, after co-operation with industry to determine its requirements. It was recommended also that study be directed toward vocational selection and guidance for engineering students.

The conference was under the general direction of Dr. G. L. Swiggett, chairman of the committee on commercial engineering of the U. S. Bureau of Education, and was attended by about 160 representative technical and commercial educators.

Building Officials Discuss Improved Practice

Urge Restriction of Supervision To Competent Persons—Chimney Ordinance Approved

The collapse of the Knickerbocker Theater at Washington, D. C., in January of this year, furnished the principal topic of discussion at the annual meeting of the Building Officials' Conference, held at Indianapolis, Ind., on April 25, 26 and 27. The cause of the collapse was explained and the responsibility for it was discussed (see *Engineering News-Record*, Mar. 30, 1922, p. 532), resulting in the emphatic reiteration of the view expressed at the Pittsburgh meeting, two years ago. "It is the sense of the Building Officials' Conference that, for the better protection of the public against unsafe and illegal building construction, suitable legislation should be enacted by which building operations shall be restricted to architects, engineers, builders, superintendents of construction or others who have by proper evidence shown their ability or capacity for undertaking such building operations and on whom individual responsibility for the safe prosecution of the work and a compliance with the laws relating to buildings can be placed."

Building-Code Enforcement

Much the same conclusion was reached in the discussion of "The Enforcement of Building Code Provisions," a paper read by J. R. Hesser, commissioner of inspection of Toledo. Putting out of business the violator of building requirements was considered as perhaps the most effective method, much the same as lawyers are disbarred from practice for illegal or improper actions.

A plea was made in the treatment of "Fire-Resistive Qualities of Frame Buildings Protected by Stucco and Plaster on Metal Lath" by Wharton Clay, of the Associated Metal Lath Manufacturers, for recognition of such construction as suitable within the fire limits of cities, on the ground that brick walls with window openings do not afford any greater protection against exposure hazards.

The committee appointed a year ago to consider the "Ideal" wall, (see *Engineering News-Record* of May 5, 1921, p. 775) reported and recommended favorable recognition in building codes of this form of wall, but the meeting refused to commit itself farther than to declare that such walls can be safely constructed.

Other topics dealt with at the meeting, included "The Actual Strength of Brickwork and Its Relation to Code Allowances," a paper in which the use of 4-in. brick partitions was proposed by the author, William Carver, architect of the Common Brick Manufacturers' Association; "Building Code Requirements for Concrete Units and Practical Means for Their Enforcement," a paper by A. J. R. Curtis, manager of the cement products bureau of the Portland Cement Association, who advocated the licensing of block manufacturers; "Approval of New Materials of Construction Not Provided for in Building Codes," a paper by Albert E. Kleinert, superintendent of buildings, borough of Brooklyn, New York City, which

(*Continued on p. 754*)

All-Embracing Construction Council Planned

(*Continued from p. 749*)

session and at other times at the call of the executive board. The latter would meet at least three times a year and would have as its functioning representative an executive secretary.

Two classes of membership are provided — association and sustaining. Sustaining members may be individuals, firms or corporations interested in the industry. Only association members, through their delegates, would have the right to vote, and for such voting would be assigned to the appropriate group. The dues for association members have been fixed at $100 per annum; for sustaining members, at $25.

Objects of the council, as set forth in the tentative by-laws, are as follows:

"1. To consider subjects affecting the general welfare of the construction industry and the service which it should render the public.

"2. To establish the standards and principles which should govern the construction industry.

"3. To provide a medium for cooperative action among the several groups in the construction industry."

These objects are expanded somewhat by the preamble, which is as follows: "With the desire to place the construction industry on a high plane of integrity and efficiency and to correlate the efforts toward betterment made by the existing organizations, all the component parts of the industry herewith join in the formation of American Construction Council, a conference association representative of the whole industry and dedicated to the improvement of the service which the construction industry renders to communities, states and nation."

Among the suggestions of work that might be undertaken by the council, though not included in the by-laws, are federal legislation, collection of statistics, study of seasonal employment, development of apprenticeship system in the building trades, ethics, building codes, co-operation with government departments, transportation, publicity, encouragement of local assemblages representative of the whole industry such as the New York Building Congress, elimination of waste, and co-operation with the United States Chamber of Commerce.

Groups

The following ten groups, all to have equal voting strength, are provided for in the tentative by-laws:

(1) Architects; (2) Engineers, (3) General Contractors; (4) Sub-contractors; (5) Construction labor; (6) Material and equipment manufacturers; (7) Material and equipment dealers; (8) Financial, bond, insurance and real estate organizations; (9) Public utility construction departments; (10) Representatives of federal, state, county and municipal bureaus and departments concerned with construction.

The following engineers and contractors attended the meeting last week: L. W. Wallace, Washington, and E. J. Mehren, New York, representing the Federated American Engineering Societies; W. A. Rogers, Chicago, Leonard C. Wason, Boston, N. F. Hoggson, New York and R. C. Marshall, Jr., representing the Associated General Contractors; C. M. Upham, Raleigh, N. C., representing the American Association of State Highway Officials; and P. St. J. Wilcox, of the U. S. Bureau of Public Roads.

E. J. Russell, the well known St. Louis architect, acted as chairman of the meeting and W. H. Hays, of Philadelphia, was secretary.

Urge $75,000,000 Road Bond Issue in Georgia

The Georgia Good Roads Association, of Atlanta, is conducting a campaign in support of a proposed $75,000,000 bond issue for highway improvement. It is planned to raise this money without any additional property tax by retiring the bond issue, both as to interest and principal, by motor-vehicle license fees and a gasoline tax.

New Standard Mechanical Filter Specifications Adopted

At a recent meeting of the Associated Manufacturers of Water Purification Equipment standard specifications for pressure filters of the mechanical type were adopted. These include rates of filtration for water for various purposes; standard sizes of filters for various capacities, together with standard sizes of pipe connections, minimum rates of wash water; and figures to control the design of both steel and cast-iron filters under various working pressures. Copies of the specifications may be obtained from F. B. Leopold, secretary, Associated Manufacturers of Water Purifying Equipment, 618 Farmers' Bank Building, Pittsburgh, Pa.

Asphalt Association Convenes

The Asphalt Association, at its annual convention in New York, April 12 adopted a resolution embodying the views of its president, J. R. Draney, urging a minimum width of 24 ft. for highways serving large cities to afford more room for the increasing traffic. "I have ridden over more dangerous roads in the vicinity of New York," said Mr. Draney, "than one will find, for instance, in the whole of England."

Other resolutions adopted by the convention urged that President Harding take such steps as are necessary for the United States to become a member of the International Good Roads Congress; demanded a reduction in freight rates on asphalt and other road-building materials so as further to reduce the cost of highway construction; and expressed vigorous opposition to a tariff on crude oil in view of the fact that 60 per cent of America's supply of asphalt is now obtained from Mexican petroleum and in view of the further fact that asphalt enters not only into 60 per cent of the roofing materials used in the United States but into practically every type of street and road paving.

"That American cities are making tremendous strides in street paving," continued Mr. Draney, "is indicated in reports from city engineers which show that over 30,000,000 sq.yd. of asphalt equivalent to 1,750 miles of pavement 30 ft. wide, were laid on city streets in 1921. About 23,000,000 sq. yd. were laid on state highways and the area laid on county and district roads brought the total for 1921 up to 68,000,000 sq.yd.

20-Mile Steel Conduit To Cost Over $4,000,000

Spring Valley Co. and San Francisco Agree on Additional Supply of 24 m.g.d. from Calaveras

Under an agreement recently made between the city of San Francisco and the Spring Valley Water Co. the company's water supply is to be augmented by 24 m.g.d. brought by conduit from the Calaveras water-shed to the company's reservoirs in San Mateo Co. The new line will be about 20 miles long and will consist of 5-ft. steel pipe except for about 8,500 ft. of tunnel and a half mile of submarine line across the lower part of San Francisco Bay. The 5-ft. pipe is larger than is required for the supply now to be brought in but is to be located on the Hetch Hetchy aqueduct right-of-way and is expected to carry 45 m.g.d. from Hetch Hetchy sources at a later date. The city expects to spend between $4,000,000 and $5,000,000 on the work which is to commence in June. To deliver Calaveras water to the Hetch Hetchy conduit grade line will require pumping against a head of about 220 ft. The city is to pay for and install the necessary pumping station and the company is to pay its operating costs.

To bring Calaveras water to the city's right-of-way the Spring Valley Co. will spend about $2,000,000 in increasing the height of the Calaveras dam, increasing the capacity of the Sunol aqueduct, and building about 20,000 ft. of new conduit from Irvington to the Niles screen tanks.

The arrangement between the city and the company provides that the city shall build nad pay for the 5-ft. pipe and all necessary structures on the Hetch Hetchy right-of-way and these only. The company is to have the use of the line in return for the payment of 5 per cent interest on the investment, which payment shall not exceed $250,000 per year. The company will pay interest during a construction period of not more than three years. Ordinary maintenance on the aqueduct is to be paid by the company, while extraordinary repairs will be made by the city. The agreement can be terminated by either party on three years' notice.

Santa Fe to Build Branch Line to Los Angeles Harbor

Plans are under way for the construction of a 12-mile railroad spur from the line of the Atchison, Topeka & Santa Fe Ry. Co. near El Segundo to Wilmington, Cal., where connections can be made with the Belt Line R.R. serving Los Angeles harbor and which is operated by the city of Los Angeles. No large terminals will be constructed at the harbor, according to officials of the Santa Fe Ry. because these facilities are largely under city control.

Arrangement has been made between the city and the railroad company under which the construction will be handled by the Santa Fe and Los Angeles Harbor Ry. Co. which was incorporated for this purpose. The new line will not involve any heavy grading or difficult construction. A considerable portion of the right-of-way has yet to be secured and no construction will start until this has been done.

Kruttschnitt Attacks Federal Maintenance of Railroads

Testifying recently before the Senate Interstate Commerce Committee, now investigating the railroad situation, Julius Kruttschnitt, chairman of the board of the Southern Pacific Co., asserted that statistics compiled by the Interstate Commerce Commission show that during the period of federal control the director general of transportation skimped in the use of both ties and rails. "In two years," said Mr. Kruttschnitt, "cross-tie renewals were 32,628,360 short—enough to lay 11,500 miles of track. Rail renewals were cut 440,230 tons—enough to lay 3,120 miles. There was also a shortage of 1,816,155 cu.yd. of ballast used in repairs.

"Mr. McAdoo tries to convince himself that it was not his duty to put into the track an average number of ties annually, determined by the test-period average, in order to fulfill the obligations of the government to return the properties in substantially as good repair as they were on Jan. 1, 1918. If the federal administration had discovered a way to maintain a track for two years on a 28-per cent reduction annually from the number normally used, it had discovered something of inestimable value to maintenance engineers."

Citing the Louisiana and Texas lines of the Southern Pacific system specifically Mr. Kruttschnitt charged that tie replacement made during federal control in those lines was inadequate both in quantity and quality and that "hundreds of thousands of low-grade ties were used in violation of the President's promise and contract obligation."

"The damage to the railroad property," he said "is continuing until the inferior ties are removed, but as long as they remain in the tracks the maintenance expense is increased largely over what it should be under the company's specifications."

Trenton Also to Fight State Water-License Fee

The city of Trenton, N. J., has decided to appeal to the U. S. Supreme Court against the decision of the New Jersey courts, upholding the legality of the water tax or license on water diverted from streams of the state for municipal water supply in excess of diversions being made in 1907, when the diversions exceed 100 gal. per capita.

The State Department of Conservation and Development secured a judgment for $14,310 against Trenton. The New Jersey State Court of Errors and Appeals on March 6 sustained the judgment.

The board mentioned has also a judgment of $18,104 against Newark for the diversion of water, which also has been sustained by the highest court of New Jersey. It is now proposed that the two cities join in an appeal to the United States Supreme Court, alleging that Chapter 252 of the New Jersey laws of 1907 offends against Article 1, Section 10, of the Constitution of the United States, which limits the powers of individual states.

A note on the revenue received from the State Water License in New Jersey appeared in *Engineering News-Record*, April 27, p. 702.

Wisconsin Road Contracts Show Lower Prices Than Last Year

Comparing the contract prices of roads in Wisconsin up to April 1, 1922, with those of 1921, A. R. Hirst, state highway engineer, in his quarterly report to J. G. D. Mack, state chief engineer, states that the total cost is 26 per cent less this year. Last year surfacing 95.36 miles of road cost $2.77 per yard; grading 323,235 cu.yd. cost $1.17 per cubic yard; and clearing, grubbing, culverts and guard rails cost $1,000 per mile. This year's figures are $2.05 for paving, $0.81 for grading and $900 for clearing, grubbing, culverts and guard rails, making a mile of road cost $25.383, or $8.953 less than in 1921.

Estimated money available for 1922 construction and maintenance for state and county roads is $26,744,000, of which $4,587,000 is for maintenance.

American Science to Have Home in Washington

C. L. Walcott, president of the National Academy of Sciences, has announced that a large building to cost in the neighborhood of $1,300,000 is to be erected in Washington, D. C., to be used as a center for American science. The building will be the home of the National Academy of Sciences and the National Research Council. In it investigators from all parts of the country and abroad may be brought together for counsel and co-operation.

The building will face the Lincoln Memorial. It will have a frontage of 260 ft. The building is a gift of the Carnegie Corporation of New York City. The ground was bought at a cost of about $200,000 through private donations. The architect is Bertram Grosvenor Goodhue of New York City.

Citizens Committee of Engineers to Advise Town Officer

A citizens advisory committee of six engineers has been appointed by Dr. James T. Hanan, town commissioner of Montclair, N. J., in charge of the Department of Streets and Public Improvements. The chairman of the committee is M. N. Baker, associate editor, *Engineering News-Record*. Other members are: A. P. Folwell, editor *Public Works;* H. P. Hamlin, designing engineer, Raymond Concrete Pile Co.; Albert W. Hemphill, a utilities engineer; Malcolm McFarlane, a railway and coal engineer, and John J. Swan, of the Engineering Business Exchange.

Reconditioning Leviathan Begins

The steamship Leviathan contract for the reconditioning of which was recently awarded by the U. S. Shipping Board to the Newport News Shipbuilding and Drydock Co. docked at one of the piers of the latter's plant at Newport News, Va., April 10. Homer L. Ferguson, president of the company, states that work on the giant liner will start at once and that about 1,200 additional men will be employed at the plant during the period of reconstruction.

Neil Christianson will supervise the installation of and repairs to machinery; E. I. Cornbrooks will superintend the hull construction, and T. W. Ross will have charge of refitting.

Engineering College Holds Three-Day School for City Officials

The school of engineering of the University of Kansas, Lawrence, Kan., recently conducted a "Three-Day School" for mayors, city managers, commissioners, councilmen, city clerks, health officers, engineers, superintendents and operators, the latter referring particularly to operators of sewage and water treatment plants, for whom round-table discussions were held. There were a number of addresses on each of the topics—water purification and sewage treatment.

Other topics were municipal administration, city planning, municipal building codes, and financing municipal improvements. Among the "faculty" of 17 speakers were Prof. W. C. Hoad. University of Michigan; C. A. Haskins, R. E. McDonnell, W. Kiersted, and E. B. Black of Kansas City; Profs. P. F. Walker, C. C. Williams, W. C. McNown, and A. H. Jewell of the University of Kansas.

Seeks to Enjoin City Engineer from Taking Private Work

Unfair competition by the city engineering department of South Bend, Ind., with other professional engineers is charged in an injunction suit filed there recently to enjoin the city from engaging in private engineering work. When the case is tried, questions will be raised as to a city's authority to engage in private enterprise and the decision may establish a precedent applicable to all Indiana cities.

The suit was filed by Charles W. Cole, a civil engineer, against the City of South Bend, the city comptroller and Frederick Anderson, city engineer. Mr. Cole alleges that competition of the city officer with professional engineers is unfair because the prestige of the city is used and also that his fees are much below the regular engineering fees. Some cities in Indiana have specifically forbidden their city engineers to engage in private work.

Detroit Votes To Acquire Street Railway System

By a vote of 82 per cent of the ballots cast Detroit electors have indorsed the purchase by the city of the Detroit United Railway's city system. A 60-per cent favorable vote was required for a decision.

The city will take over the system on May 15, whereupon Detroit will have the largest municipally-owned street railway in the world, comprising 263 miles of track with 1,457 cars and all necessary equipment.

According to the plan of purchase a bond issue of $4,000,000 has been voted of which $2,770,000 will be paid down to the railway company when it turns over the property. The remainder will be required to purchase supplies and materials now in the company's hands and to provide working capital. Semi-annual payments of $500,000 will be made by the city until 1933, at which date the balance of the $19,850,000 purchase price will come due. Interest at the rate of 6 per cent will be paid on all the unpaid balance. The money will go to a trust company to the credit of mortgage and bond holders of the company.

Large Generator Bursts at Niagara Plant

On April 20, about 3 a.m., the generator of a 20,000 hp. water-wheel unit in the plant of the Ontario Power Company, at Niagara Falls, Ont., burst, putting out of commission a neighboring unit of similar capacity and causing the shut-down, on account of flooding, of four 16,000 hp. units. Some of the flying pieces struck the roof trusses causing the failure of the roof and the consequent destruction of some of the auxiliary apparatus.

The unit which burst, No. 15, was one of two identical units installed during the war and was located in an extension of the original power house, forming a separate room for the two machines. Both units are horizontal shaft machines with two water wheels each. The sequence of events is not entirely clear, though it is known from testimony of operators at the plant of the Canadian Niagara Falls Power Co., with which the Ontario lines were tied in, that their units began to speed up as a result of a short circuit probably carrying the Ontario units with them. There was only one man in the room at the time and he is unable to explain satisfactorily what happened.

Apparently the wheels on both units in the extension are intact except for a hole in one of the casings of No. 15. A piece of the rotor of the burst machine passed through the roof over the main part of the plant and down again through the roof, landing about 150 ft. from the center line of the destroyed machine. Fortunately it struck merely the base of one of the other units without doing any other damage than the punching of an additional hole through the roof. The flooding was due to the hole in the casing of No. 15.

A thorough investigation of the accident is now being made by the engineers of the Ontario Hydroelectric Power Commission, which owns and operates the plant, and the results will be published shortly.

The water-wheels were built by the S. Morgan Smith Co., and were purchased from the plant of the Aluminum Company of America at Baden, N. C. The generators were built by the Canadian General Electric Company.





LOOKING FROM CLIFF TOP INTO WRECKED POWER HOUSE OF ONTARIO POWER CO. AT NIAGARA

New England Water-Works Men To Meet at New Bedford

The New England Water Works Association will hold its 52nd annual convention at New Bedford, Mass., May 23-25. Ernest J. Gifford, Treasurer Temple, Boston, Mass., is secretary of the association.

Chapter Activities Feature of A. A. E. Annual Meeting

At the Salt Lake meeting of the American Association of Engineers, June 5, 6 and 7, a symposium on chapter activities will be one of the outstanding features. It will include the following subjects: Principles of chapter success; a standard chapter constitution; how to rate your chapter; local civic responsibility and co-operation with other civic bodies; chapter bulletins and news letters; how to do chapter work; obtaining and holding members; publicity and public affairs; conducting chapter meetings; selection of chapter officers; how to make officers function; how to arouse and sustain the membership interest; how to assist national headquarters in collecting dues and the sphere of women in chapter activities.

Of the internal problems to come up probably the most vital one refers to the foundation of departments within the organization to look out for the branches which represent any considerable portion of the membership. A plan for a greatly-extended employment service bureau has been under consideration by the board of directors and will come up for adoption. K. H. Talbot, chairman of the employment service committee has recommended that there be set aside for this purpose $1 of the national dues independent of any division between chapter and national activities.

No Reorganization in Tennessee Highway Department

An error was made in the news item which appeared in the April 20 issue of this journal, p. 669, stating that a bill reorganizing the Tennessee Highway Department had been approved by the Governor. No reorganization has been authorized.

Senate Passes Relief Bill for Naval Contractors

After months of effort the Senate passed on April 22 the bill providing for the relief of naval contractors, subcontractors and material men who suffered losses as a result of the interference by the Government with the performance of their contracts. Most of the claimants who will profit by the bill are small contractors.

In the great majority of the cases there is no question as to the responsibility of the Government. The losses were occasioned during the war by the action of Government agencies in commandeering materials, or by reason of the inability of contractors to secure materials due to the priority policy in the matter of transportation.

Outdoor Exhibition of Sculpture in Central Park Abandoned

The National Sculpture Society has withdrawn its application for a permit to use a portion of Central Park, New York City, for an exhibit of outdoor sculptural work. The application was strongly opposed by the New York Parks and Playgrounds Association, the New York Chapter of the Society Landscape Architects and other organizations. [illegible] comment on the proposal appeared in *Engineering News-Record* April 20, p. 69.

$4,000,000 for Narrows Tunnel

An appropriation of $4,000,000 for preliminary work on the Narrows tunnel between Brooklyn and Staten Island, was voted by the committee of the whole of the New York Board of Estimate and Apportionment May 1.

Tri-State Water and Light Men Enlarge Field

At the twelfth annual convention of the Tri-State Water & Light Association of the Carolinas and Georgia, held at Spartanburg, S. C., April 18-20, it was decided to enlarge the geographical field of the association to include Florida, Alabama, and Tennessee. Action on a new name for the association was deferred until the next meeting.

The new president of the association is J. E. Gibson, superintendent and engineer of water-works, Charleston, S. C. W. F. Stieglitz, Columbia, S. C., was re-elected as secretary and treasurer. The next meeting place will be selected later.

Among those discussing the various topics presented were E. L. Filby, sanitary engineer, South Carolina State Board of Health; H. F. Lee, manager, Carolina Power & Light Co., Goldsboro, N. C.; and Wilder M. Rich, city manager of Goldsboro. There was an exhibit of water-works appliances.

Slate Producers Organize

Organization of slate producers in the United States into the National Slate Association was effected at the Hotel Commodore, New York City, April 20. The purpose of the organization is to promote uses of slate products and to disseminate generally information regarding such products. The organization was due largely to the efforts of Oliver Bowles of the U. S. Bureau of Mines.

The following executive committee was appointed to formulate a detailed organization: Wm. H. Keenan, Bangor, Pa., chairman; G. H. Shinville, Fairhaven, Vt.; N. M. Male, Pen Argyl, Pa.; Roscoe C. Berlin, Slatington, Pa.; F. C. Sheldon, Granville, N. Y.; E. R. Norton, Granville, N. Y.; G. F. Barnard, Boston, Mass.; A. H. Morrow, Pawlet, Vt., treasurer; and W. S. Hays, Philadelphia, Pa., secretary.

Abolish Board of Consultants on Vehicle Tunnel

By resolution of the New York and New Jersey tunnel commissions May 2 the board of consulting engineers has been abolished, but on the recommendation of C. M. Holland, chief engineer, the members of the board have been reappointed individually as consultants to be employed subject to the recommendation of the chief engineer on a basis of $150 a day. The consulting board, members of which formerly received salaries of $10,000 each, consisted of Col. William J. Wilgus, chairman; J. Vipond Davies, John A. Bensel, William H. Burr, Col. George L. Watson and Edward A. Byrne. Mr. Byrne served without compensation; he is chief engineer of the Department of Plant and Structures of New York City.

House Passes Federal-Aid Bill

(Washington Correspondence)

The federal-aid highway bill, recently agreed upon by the Committee on Roads of the House of Representatives, passed the House this week, with no amendments, by a vote of 239 to 31. The bill appropriates $65,000,000 for federal aid for the fiscal year ended June 30, 1923, and $75,000,000 for the fiscal year ended June 30, 1924. In addition the bill carries $6,500,000 for forest roads.

Francis Made Engineer to Board Investigating Chippawa Project

Walter J. Francis, of Montreal, has been appointed engineer to the Royal Commission (see *Engineering News-Record*, April 20, p. 669) recently created to investigate the Queenston-Chippawa power-development scheme of the Hydro-Electric Power Commission of Ontario. Two of the five members of the commission are engineers.

Building Officials Discuss Improved Practice

(Continued from p. 750)

brought out the suggestion that municipalities should join in the cost of having new materials investigated at laboratories of recognized standing through committees of their building officials; and "Fire Tests of Loaded Timber Columns" in which Theodore P. Laist, of the National Lumber Manufacturers' Association, called attention to the possibility of more than doubling the fire endurance of Southern pine or Douglas fir columns by adequate protection against fire of the ends of such columns.

Endorsement was given to the chimney ordinance recently recommended by the National Board of Fire Underwriters as worthy of favorable consideration in the preparation of building codes, and all similar "efforts to increase through the advocacy of good construction, the safety of the public against fire hazards" were commended.

At a joint session with the Indiana Limestone Quarrymen's Association it was contended that the requirements in most of the present building codes relating to use of stone, especially as ashlar, are antiquated and have not been changed to meet the new conditions prevailing in present-day construction. New Provisions were urged. A committee was appointed for their study. After the meeting, the members and delegates visited the limestone quarries and mills at Bloomington and Bedford, Ind., as guests of the association.

Reports were received from representatives of the Building Officials' Conference on the Building Code Committee of the Department of Commerce, and on the sectional committees of the American Engineering Standards Committee, on floor openings, railings and toe-boards, on building exits, on elevators, and on construction work.

The following officers were elected for the coming year: Rudolph P. Miller, New York, president; James G. Houghton, Minneapolis,, vice-president; Fred W. Lumis, Springfield, (Mass.), secretary. The executive committee for the coming year will consist of these officers and Walter R. Forbush, Newton (Mass.); Matt. S. Shinnick, Kansas City; Frank Burton, Detroit; and H. E. Plummer, Portland, (Ore.).

McConnell Returns from Brazil

Ira W. McConnell, vice-president of Dwight P. Robinson & Co., engineers and constructors, New York City, who has been in Brazil since last September in active charge of the irrigation work under construction for the Brazilian Government by his company in the states of Ceara and Parahyba, returned to New York April 30. During the past few months Mr. McConnell has been in Rio de Janeiro giving general supervision to the beginning of the work on the Embassy building, being constructed for the United States Government in connection with the Rio Centennial Exposition. Mr. McConnell will probably be in New York several months before returning to Brazil.

Cargo Handling Discussed

Economical handling and storage of cargoes at marine terminals was the subject of a meeting held by the American Society of Mechanical Engineers, in New York, on April 28. Dr. R. S. MacElwee, of Georgetown University, presented a paper on "Location of Warehouses with Relation to the Handling of Material," and Francis Lee Stuart, consulting engineer, discussed the "Rehabilitation of Old Piers to Reduce the Cost of Handling." John Meigs, consulting engineer of Philadelphia, discussed both of the papers.

Engineering Societies

Calendar

Annual Meetings

NATIONAL FIRE PROTECTION ASSOCIATION, Boston, Mass.; Annual Meeting, Atlantic City, May 9-11.

NATIONAL HIGHWAY TRAFFIC ASSOCIATION, New York City; Annual Meeting, New York City, May 12.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, Philadelphia, May 15-19.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Annual Convention, Salt Lake City, Utah, June 5-7.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Annual Convention, Portsmouth, N. H., June 21-22.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, University of Pittsburgh; Annual Convention, University of Illinois, June 20-23.

The New York Section, Am. Soc. C.E., will discuss the need of regional planning for the New York District at its regular monthly meeting, May 17, 1922. Charles D. Norton, first chairman of the plan of Chicago will open the discussion.

The Boston Society of Civil Engineers has elected the following officers: President, Dugald C. Jackson; vice-president, Charles M. Allen; secretary, John B. Babcock, 3rd; treasurer, Frank O. Whitney.

The Richmond Chapter, A. A. E., has elected the following officers: President, J. C. Carpenter; vice-president,

E. T. D. Myers, Jr.; secretary, Albert C. Dunn; treasurer, E. E. Davis.

Personal Notes

JOHN S. DOYLE, principal assistant to the United States Engineer in charge of the Baltimore harbor, has been appointed a major to command the second battalion of the Three-Hundred and Forty-Third Regiment of Organized Reserve Engineers, the headquarters of which are in Baltimore. The appointment was made by Lieut.-Col. R. Keith Compton, of the regiment, who is chairman of the Paving Commission.

FRANK H. CLARK, formerly superintendent of motive power of the Baltimore & Ohio R.R., who has for the past two and a half years been technical advisor to the Ministry of Communications of the Republic of China, engaged in motive power and equipment standardization work at Peking is now visiting in the United States and is at present in New York.

H. E. BECKMAN has resigned his position of assistant engineer in charge of the southern district engineer's office of the C. M. & St. P. Ry. at Chicago to enter the roofing contracting business as secretary and treasurer of the Interstate Roofing & Supply Co. of Cicero, Ill.

S. H. LEA, County Engineer of Mineral County, W.Va., has resigned to accept appointment as district engineer in charge of road construction for Cacapon District, Morgan County, W. Va.

W. H. NORCKAUER has been appointed office engineer of the State Highway Commission, Maison Blanche Annex, New Orleans, succeeding W. F. Cooper, who was recently made a member of the newly created State Highway Commission. Mr. Norckauer was graduated from the Louisiana State University in 1909, and immediately became identified with highway work in Louisiana, under the Federal government. When the state highway department was created in 1911, Mr. Norckauer was retained by the state authorities, first as field, then as district, and more recently as assistant office engineer under Mr. Cooper, whom he now succeeds.

W. H. DAVIS, formerly resident engineer, West Virginia State Road Commission, with headquarters at Martinsburg, W. Va., was appointed February 1, 1922, maintenance engineer, West Virginia State Road Commission, with headquarters at Clarksburg, W. Va.

R. E. STOELTING, until recently city planning engineer, Milwaukee, Wis., has been appointed commissioner of public works.

ALEXANDER W. GRAHAM, chief engineer of the Missouri State Highway Commission has resigned, effective May 1. C. W. Brown, his assistant, becomes acting chief until election.

C. W. MURRAY, for many years city engineer of Tampa, Fla., was given the title of director of public works and public welfare with an increase in salary when the city commission took office several months ago and will have charge of preparing plans for the city's $400,000 harbor development.

LEONARD A. BERGMAN has been appointed city engineer, Jamestown, N.Y.

Business Notes

THE LAKEWOOD ENGINEERING CO., Cleveland, Ohio, announces that the CONTRACTORS TRADING CO., INC., New York, will handle their building construction equipment exclusively. Geo. H. Edbrooke, formerly with the Lakewood Engineering Co. is sales manager, and Lloyd Wilson of the Lakewood Engineering Co. is associated with them as factory representative.

Obituary

MORRIS A. TALBOT, member of the engineering firm of M. A. Talbot Co., Rome, N. Y., died recently in Seattle, Wash.

HENRY BUTLER HUGHES, who had been connected with the Philadelphia Department of Public Works, specializing in tunnel and filtration work, died in New York City, April 16. During the World War he was appointed senior structural engineer with the construction division of the army. Later he was appointed engineer of the Bureau of Mines, which position he held until 1920 when he became connected with some of the municipal work in New York City.



Equipment and Materials

Full Diesel Engine for Shovel, Dragline or Crane

An oil shovel which will use any cheap low-grade fuel oil of high heat-value has been developed by the Bucyrus Co., South Milwaukee, Wis. The engine is of the full Diesel type with mechanical injection under constant pressure and [illegible] at 1,000 r.p.m. The cylinders are 8 x 10½ in. Two fuel is burned in the cylinders without the aid of a carburetor, spark plug or outside heating appliances, the charge being fired by the heat developed by the compression of air in the cylinder on the previous stroke.

On test under winter conditions it is [illegible] The engine consumed 11 to 12 gal. of fuel oil per hour. The engine was designed to handle the recently-developed type of gasoline shovel which operates the thrust without the use of an independent engine mounted on the boom.

Longitudinal Floatbridge for Concrete Pavement

A hand-operated floatbridge facilitating the use of the longitudinal float, to eliminate waves and to increase the riding qualities of a concrete road, has recently been put on the market in California by Edward G. Carr. It consists of a rectangular frame of 2 x 12-in. trussed cross planks and 2 x 6-in. sides mounted on 8-in. wheels riding the side forms. A finishing belt is attached to the frame to rub out the marks left by the longitudinal float. The belt is moved back and forth in 10-in. strokes by the upright lever shown at the right. The lever operates a ratchet wheel on the rear axle, propelling the floatbridge forward 2 in. per stroke. The bridge is moved ahead about 10 ft. at a time, thus giving a 6-ft. lap of the longitudinal float, which is a light 16-ft. straight edge with plow handles and a 10-in. float board. The edge of the float is not used to strike off the concrete, but its whole bottom surface is used to work down the high places.

Operation of the longitudinal float for best results is a deliberate pull back and forth with a 6-to 18-in. stroke. Fast operation is not desirable, as the float then slips over the surface of the concrete without disturbing more than a thin layer at the top, whereas the suction attending a slow movement pulls and readjusts the concrete to a greater depth. To accentuate the suction the ¾ x 10-in. float board is made of a fine-grained soft wood soaked in paraffin. The soft wood wears even and smooth, but does not polish. The paraffin keeps out all the excess moisture.

Out-of-the-Ordinary Trade Publications

Illustrated booklets on the different types of asphalt pavement construction including sheet asphalt, asphaltic concrete, asphalt macadam, asphalt filler, asphalt [illegible] and asphaltic road oil have been prepared by the Texas Co., New York. "What is Your Highway Problem" is the name of a portfolio issued by this concern which gives a resume of each type of highway construction in which asphalt is used.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Contracts for Four Months Worth $479,000,000

Of This $143,000,000 is Total for April —$100,000,000 in Street and Road Work Put Under Contract

Since Jan. 1, 1922, up to and including April 25 there were put under contract throughout the United States construction jobs the total value of which approximates $479,000,000. Of this amount $143,000,000 in round numbers is the record for April. This total compares with $688,000,000 worth of work contracted for during January, February, March and April, 1920, and $332,000,000 in 1921.

One of the notable features in an examination of the contract-value figures is the fact that during the past four months approximately $100,000,000 worth of street and road work has been put under contract. In actual dollars this represents an increase over the corresponding period of 1920 and 1921 of 13 and 28 per cent, respectively. According to the rate at which street and road work is being contracted for at the present time, there will probably be put under contract during the year approximately $350,000,000 worth of work.

During April of 1922 considerable activity was noted in the number and value of railroad contracts let. In the tabulations herewith railroad work is included under the general classification of "Miscellaneous." Though *Engineering News-Record* in its Construction News lists railways under a separate classification there was practically no railroad work done during 1920 or 1921, which fact accounts for the absence of the railway classification from the tables herewith.

Another feature revealed in examining the contracts let for April of 1922 is the fact that in public-works construction, though the total value is not remarkably high, there is indicated quite a widespread activity because of the number of small contracts being let.

The total value of contracts let in April, 1922, represents in the volume of construction done at least 75 per cent more work than was done in April, 1921. In actual dollars the April, 1922, figure exceeded the 1921 figure by $37,000,000, though the April figure fell short of the March, 1922, figure by about $50,000,000.

VALUE OF CONTRACTS LET IN THE UNITED STATES IN MARCH, 1922

	New England	Middle Atlantic	Southern	Middle West	West of Mississippi	Western	Total
Waterworks	$15,000	$456,000	$91,000	$173,000	$349,000	$9,000	$1,093,000
Sewers	32,000	942,000	372,000	1,660,000	583,000	207,000	3,796,000
Bridges	45,000	36,000	656,000	85,000	233,000	82,000	1,137,000
Excavation and dredging	68,000	.....	151,000	100,000	240,000	10,000	569,000
Streets and Roads	721,000	7,574,000	13,315,000	6,094,000	4,705,000	7,260,000	39,669,000
Indus works	2,590,000	6,077,000	680,000	3,238,000	1,620,000	2,288,000	16,403,000
Buildings	4,806,000	34,821,000	3,026,000	21,387,000	8,734,000	12,110,000	84,884,000
Fed. gov't wk	19,000	5,594,000	441,000	47,000		1,186,000	7,287,000
Miscellaneous	301,000	21,348,000	160,000	171,000	382,000	1,227,000	23,589,000
	$8,507,000	$76,848,000	$18,892,000	$32,955,000	$16,846,000	$24,379,000	$178,427,000

In the geographic distribution of contracts let for the month of February, the heaviest percentage was reported from the Middle Atlantic, about 30 per cent of the work for the month being contracted for in that district. The high figures for the Middle Atlantic and Middle West are due to the large amount of work which is under way in New York, Philadelphia, Boston, and Chicago.

Engineering News-Record Construction Cost Index Number

May, 1922	164.62
April, 1922	164.72
May, 1921	210.82
Peak, June, 1920	273.80
1913	100.00

Engineering News-Record's Construction Cost Index Number is practically the same as last month, although there have been certain price adjustments. Structurals are now sold at $1.60 per 100 lb., with a tendency toward $1.70. Cement prices generally firm. Pine lumber cheaper, but fir price is rising with growing demand and scarcity. Average hourly rate for common labor is 42c. Thus, general construction cost is 23 per cent cheaper than one year ago and 40 per cent under the peak; it is 65 per cent above the 1913 level.

Engineering News-Record Construction Volume Index Number

Monthly	
April, 1922	150
March, 1922	202
April, 1921	86
1913	100
Yearly	
1921 (entire year)	88
1920 (entire year)	91
1913	100

Engineering News-Record's Construction Volume Index Number is 150 for the month of April, and 88 for the whole of 1921, as against 100 for 1913. This means that the actual volume of construction in 1921 (not the mere money value of the contracts let that year) is 12 per cent under the volume of construction for 1913. Our monthly volume number, 150 for April, 1922, is really the increment of construction, and indicates the rate at which contracts are being let as compared with 1913 awards.

VALUE OF CONTRACTS LET IN THE UNITED STATES IN FEBRUARY, 1922

	New England	Middle Atlantic	Southern	Middle West	West of Mississippi	Western	Total
Waterworks	.....	$87,000	$20,000	$118,000	$338,000	$89,000	$652,000
Sewers	.....	240,000	410,000	1,521,000	266,000	25,000	2,462,000
Bridges	.....	351,000	136,000	143,000	320,000	145,000	1,095,000
Excavation and dredging	.....	.....	.....	8,000	291,000	.....	299,000
Streets and roads	.....	673,000	2,922,000	3,034,000	1,733,000	690,000	9,052,000
Industrial works	1,855,000	850,000	115,000	2,847,000	440,000	300,000	6,407,000
Buildings	2,103,000	13,013,000	2,201,000	6,190,000	3,070,000	1,142,000	27,719,000
Fed. Gov't work	14,000	158,000	482,000	.....	.....	200,000	854,000
Miscellaneous	122,000	1,612,000	19,000	.....	8,000	761,000	2,522,000
	$4,094,000	$16,984,000	$6,305,000	$13,861,000	$6,466,000	$3,352,000	$51,062,000

During March, as is indicated by Table 2, 43 per cent of the work contracted for for the month was in the Middle Atlantic states. The other geographical sub-divisions reported the following percentages of the total: Middle West, 19 per cent; Western, 14 per cent; Southern, 11 per cent; West of Mississippi, 9 per cent, and New England States, 4 per cent. The percentage, however, for the Middle Atlantic, as well as the total figures for March, were considerably affected by one $20,000,000 contract.

For any month the value of contracts let as reported in *Engineering News-Record* does not include any residential building except the construction of apartment houses. Experience has shown that residential building for any month usually equals the total contract value as reported in *Engineering News-Record*. This would indicate that the total value of contracts let throughout the United States during the month of March was in the neighborhood of

$450,000,000 and for the month of February over $200,000,000.

COMPARISON OF VALUE OF CONTRACTS LET DURING APRIL, 1920, 1921, 1922

Classification	April, 1920	April, 1921	April, 1922
Waterworks...	$2,719,021	$3,342,150	$2,672,751
Sewers.....	4,123,907	3,817,401	2,794,468
Bridges.....	5,586,877	1,987,808	1,677,066
Excavation, dredging....	415,512	580,039	1,735,287
Streets, roads..	33,340,330	31,026,312	32,991,321
Industrial.....	65,879,005	9,346,586	11,558,563
Buildings	90,776,835	51,647,900	76,037,497
Federal Gov't..	4,124,269	1,186,403	676,056
Miscellaneous..	9,602,630	2,732,799	12,656,358
Total.....	216,568,386	105,667,398	142,799,367

Large Contracts Are Let During the Week

Among this week's announcements of contracts awarded in Construction News, pp. 211 to 228, are the following large projects:

A plant addition at Buffalo, N. Y., to DuPont Eng. Co., DuPont Bldg., Wilmington, Del., $2,000,000.

An apartment house at Long Island City, N. Y., to Stone & Webster, 120 Bway., New York City, $1,250,000.

A college at New York City, to Nugent Constr. Co., Inc., 21 East 40th St., New York City, $1,000,000.

An apartment house at Philadelphia, Pa., to Metzger, Fisher & White, Otis Bldg., $6,000,000.

Substructure and superstructure of Girard St. piers, Nos. 3 and 5, Philadelphia, to Triest Contg. Co., Penna Bldg., $1,959,798.

A theatre at Chicago, Ill., to Van Etten Bros., 11055 South Michigan Ave., $1,500,000.

Sewers at Detroit, Mich., to Brandon & Hanna, 1624 Dime Bank Bldg., $738,559.

Labor Rates and Conditions Throughout the Country

Industrial conditions in the United States, particularly in the building trades, the lumber, agricultural and manufacturing industries, have shown definite improvement during the past month.

Skilled building trades mechanics have no difficulty in obtaining employment anywhere throughout the country and a very large proportion of the unskilled common labor class has been absorbed by the iron, steel and metal industries and agriculture. Very few wage reductions in the skilled building trades are noted in the 21 cities reporting to *Engineering News-Record* for the month of April, 1922.

Unemployment, exclusive of those involved in the coal, granite, or textile strikes, appears to have reached the highest point in New York state, with Pennsylvania ranking next and Massachusetts third. The states in which industrial conditions are at their best run in the following order: New Jersey, North Dakota, Ohio, Idaho, Utah and Nebraska.

Hoisting engineers were reduced to 70c. from $1, in Atlanta and to $1.12½, from $1.25 per hr. in St. Louis. Structural iron workers rates are quoted at 65c., reduced from $1, in Atlanta and at $1.05, down from $1.06¼ per hr. in St. Louis. Pile drivers receive $1 as against $1.06¼ per hr. in St. Louis. A slight reduction in the common labor schedule quotes 20c.@30c. as against 25c.@30c. in Montreal and 25c.@50c. as compared with 30c.@60c. per hr. in Pittsburgh; bringing the average common labor rate to 42c. per hr. throughout the country.

Although common labor is available at 15c.@20c. per hr. in Birmingham and other points, the Landis award of 72½c. per hr. for pick and shovel men still holds good in Chicago, and in many instances a higher rate is paid.

The standard scale for excavation work is 75c. per hr. in New York City but on construction projects being erected by day labor, as low as 60c.@65c. per hr. is frequently received.

With an unprecedented construction boom already under way, 1921 labor rates still in effect and labor efficiency on the increase, New York building trades show no tendencies toward strikes. Bricklayers and plasterers, taking advantage of scarcity in skilled building trades mechanics do not strike for more pay but leave the job abruptly upon being offered $1@$2 more per day.

The current wage scale in Cincinnati will remain in effect until Dec. 23, 1922 with the exception of the bricklayers. The rate of $1.25 per hr. for bricklayers runs to May 1. The union demands a continuance of this scale but contractors favor a reduction to $1 per hour.

Despite the clash between union and non-union mechanics, building operations in San Francisco continue to gain in volume.

Lumber mills in the Seattle district are running full time with heavy crews. The unemployment situation is well in hand and within the present month nearly all unemployed will have returned to work.

Skilled building trades mechanics practically all employed in Los Angeles. Conditions among the unskilled expected to return to normal during this month.

Scarcity of bricklayers reported in Pittsburgh; all other trades plentiful.

Although the carpenters' wage scale was recently cut to 95c. by the master builders of St. Louis, the trade is now working at $1.12½ per hr. pending final settlement of the controversy.

The number of men employed on construction work in Detroit at the beginning of April, 1922, showed an increase of approximately 15 per cent over the preceding month.

(Higher rates indicated by +, decreases by—)

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$0.90	$0.70	—$0.70	$0.30		—$0.65	$0.20
Baltimore	1.25	.80	.87	.54	$0.74	1.00	.30
Birmingham	1.00	.75	.50@1.00	.15@.25		1.00	15@20
Boston	.90	.90	.90	.60	.90	.90	.40
Cincinnati	1.25	.95	.95	.72½	.77½	.95	.40
Chicago	1.10	1.00	1.10		1.10	1.05	.72½
Cleveland	1.04	1.04	1.04	.60	.91	1.04	.57½
Dallas	1.00	1.00	1.00	.60	1.00	1.00	.25
Denver	—	1.00	1.00	.75@.81¼	1.00		.35@.50
Detroit	1.00	.80	.80@.90	.50@.60	1.00	.60@.80	.50
Kansas City	1.07½	1.00	1.00	.80	1.07½	1.07½	
Los Angeles	1.25	1.00	1.00	1.12½	.87½	1.00	.56¼@.62½
Minneapolis	1.00	.80	.80	.65		.80	.40@.50
Montreal	.80	.60	.50	.30@.35	.50	.55	—.20@.30
New Orleans	1.00	.88	.90	.40	.80	1.00	.30
New York	1.25	1.25	1.25	.87½	1.00	1.12½	60@.65
Pittsburgh	1.00	1.00	1.00	.80	1.00	1.00	—.25@.50
St. Louis	1.25	1.12½	—1.12½	.85	—1.00	1.05	.35@.40
San Francisco	1.12½	1.00	1.00	.75	1.00	1.12½	.47½@.80
Seattle	1.00	.80	.90	.70	1.00	.80@.90	.50@.60
Philadelphia	1.00	.90	.90	.75@.90	1.00	.90	.25@.35

Heavy Bond Sales Last Week

Bond sales for the week ending April 28 totaled over $232,000,000, according to the weekly summary of the *New York Times;* the highest previous one-week sale this year was $150,000,000 the week before. The $232,000,000 was thus made up: State and municipal (U. S.), $59,204,000; industrial, $51,-050,000; railroad, $11,325,000; utility, $4,500,000; foreign, $106,150,000, of which $100,000,000 were 5 per cent Canadian bonds that sold at par and interest within two hours of the time they were offered.

The most notable American sale was $45,000,000, New York City 4½ per cent 50-year refunding bonds, which sold at 104, to yield 4.06. A Newark, N. J., issue of $3,503,000 4½ per cent 1-39-year improvement bonds sold to yield 4.10.

Of 19 state and municipal offerings the interest rates of two were 4¼ per cent; of five, 4½; of one, 4¾; of six, 5 to 5½; and of five, 6 per cent. The yield rate of 8 of the 19 issues was 4¼ per cent or less, and of 12, 4½ per cent or less.

Production Paragraphs

Building permits issued in 166 cities amounted to $259,508,703 in March compared with $141,715,243 in February and $126,472,031 in March, 1921. Increases in March over February varied from 18 to 188 per cent, while increases over March, 1921, ranged from 8 to 238 per cent.

Production and shipments of lumber, brick, cement and other building materials increased in March in response to the greater volume of construction. The marked increase in the movement of enamel sanitary ware is indicative of the increase in building.

Copper exports in March totaled 80,-853,000 lb. showing a marked gain over recent months and registered the largest total for any month in nearly two years. Imports of both tin and zinc were larger. Tin imports for March at 15,783,000 lb., have been exceeded only once in the last two years.

Petroleum industry set new high records in March. Production of crude totaled 46,916,000 bbl. compared with the previous record output last January of 43,141,000 bbl.

Automobile factories' March production totals 152,920 passenger cars, compared with 109,121 in February. Truck production totaled 19,422 or approximately 5,000 more than the February output.

Iron and steel export trade in March increased 55 per cent over February and was the largest since March last year. Imports of iron and steel also increased 2,000 tons, with a total of 14,000 tons, which is the largest amount imported in one month since January, 1921.

Railroad and steel companies' reports indicate the country's business is weathering the coal strike with comparative inconvenience.

Car Surplus and Freight Loading Gain in Week

Serviceable surplus cars totaled 333,-393 for the week ending April 15, according to statistics compiled by the Car Service Division of the American Railway Association. This is an increase of 73,788 cars over the previous week, and the first gain recorded in many months. Of this, the principal increase, or 65,559 was coal cars, due to the miners' strike, 6,293 were box cars and the balance miscellaneous.

Loadings of revenue freight for the week ending April 15 totaled 706,713 cars, an increase of 4 597 cars over the corresponding week in 1921.

Decline in coal and coke loading due to the strike of the miners continues to be the contributing factor in the reduction in revenue freight loading. Grain and grain products loading declined 1,729 cars compared with the preceding week, and ore loading decreased slightly. Loading of lumber, merchandise and miscellaneous are steadily increasing.

Generally speaking, revenue freight loading other than coal and coke holds up very well. This average loading for the past three weeks is on the basis of 83 per cent of the average for the three record weeks in October, 1920.

SURPLUS AND SHORTAGE STATEMENT—April 8 to 15, 1922

Districts	Flat Cars — Surplus	Flat Cars — Shortage	All Box Cars — Surplus	All Box Cars — Shortage	All Coal Cars — Surplus	All Coal Cars — Shortage	Total All Cars — Surplus	Total All Cars — Shortage
Eastern	1,510	..	18,360	37	71,416	..	95,939	37
Allegheny	630	..	13,645	..	71,908	..	88,551	
Pocahontas	226	..	647	..	4,432	..	6,272	
Southern	2,550	43	8,375	132	13,199	38	28,254	238
North Western	1,849	..	25,307	..	2,406	..	36,372	
Central Western	1,595	..	24,275	25	21,461	50	61,413	75
South Western	686	..	9,877	8	3,186	..	16,792	8
Total	9,046	43	98,686	202	187,918	88	333,393	358
Canadian Roads	3,600	..	23,850	..	2,030	..	36,515	
Grand total	12,646	43	122,536	202	189,948	88	369,908	358
April 8, 1922	13,595	40	118,208	185	123,709	114	298,830	349

Monthly Prices of Construction Materials

Ups and Downs of the Market

Pig Iron—Scarcity of pig iron causes advance of 50c.@$1 in Philadelphia and $2@$3 per ton in Pittsburgh; firmer prices at Birmingham.

Railway Supplies—Light rails up $1 per ton at Pittsburgh mills. Slight advance in white oak ties in St. Louis. Spikes up 10 c.@15c.; track bolts 10c.@ 50c. and section angle bars 90c. per 100 lb., Pittsburgh. Larger specifications for car materials are being placed by the railroads.

Pipe—Rise in pig iron reflected in cast-iron pipe advances of $1 in Chicago, $1.50 in Birmingham and $2 per net ton in San Francisco. New York prices firmer. Big drop in clay drain tile in San Francisco. Sewer pipe also down in St. Louis, Seattle, New Orleans, Atlanta and Detroit.

Road and Paving Materials—Wood blocks quoted in Atlanta at $2.30 as against $2.09 per sq.yd. Wood blocks, asphalt and road oils all firmer in tone with price tendencies upward, induced by extensive road building operations.

Sand, Gravel and Crushed Stone—Both sand and gravel quoted at $1.80 as against $2 per cu.yd. in Chicago. Sand, gravel and crushed stone prices fairly firm throughout the country; crushed slag down 15c. per ton in Birmingham.

Lime—Lump finishing lime quoted at $2.35 as against $2.50 in St. Louis and at $2.80 as compared with $3 per bbl. (180 lb. net) in Seattle. Prices stable elsewhere.

Structural Material—Steel shapes, plates and bars quoted at $1.60 per 100 lb., Pittsburgh. Several producers quoting as high as $1.70. Rise in mill price reflected in advances of 10c. per 100 lb. in New York and Chicago warehouses. Structural rivets up 15c. in New York and 10c. per 100 lb. in Chicago. Slight advance in wire nails at Pittsburgh mills. Declines in prices of triangle mesh in New York and expanded metal lath in Chicago warehouses. Rise of $2 per ton in steel sheets at Pittsburgh results in similar advances in San Francisco, St. Louis, Chicago and New York warehouses.

Brick and Hollow Tile—Common brick, New York, quoted at $17 per 1,000, wholesale; demand continues heavy with inadequate supply. Salmon brick down $2 in St. Louis. Rise in hollow tile in Atlanta; decline in St. Louis. Prices stable elsewhere.

Roofing Materials—Asphalt roofing quoted in New York at $40.50 as against $47.50 and asphalt felt (light) at $64.50 as compared with $67 per ton, f.o.b. plant.

Lumber—Yellow pine down $1 in Chicago and Douglas fir, $2 per M ft. in San Francisco. Decline of $3 in Douglas fir and hemlock in Los Angeles. All lumber up $2 in Denver; fir, $1 per M ft. in Minneapolis. Increase in Denver due to heavy demand and shortage at mills. Demand also increasing in Seattle, particularly from Eastern seaboard, California and the Orient.

Piles—Average drop of 1½c. per lin. ft. in pine piles, New York. Steel sheet piling up 25c. per 100 lb., Pittsburgh.

Scrap—Steel scrap prices up $1 per gross ton, New York. Scarcity of pig iron inducing furnaces to use steel scrap.

Manila Rope—Advances of ¼c. in Detroit, 1c. in Atlanta, 1¼c. in Seattle and 2¾c. per lb. in St. Louis.

Explosives—Slight advances in dynamite in Los Angeles and Seattle.

Linseed Oil—Raw oil quoted at 91c. as against 82c.@83c. per gal. (5 bbl. lots) one month ago, in New York. Prices tending upward throughout the country.

Price advances since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Per Gross Ton—Quotations compiled by The Matthew Addy Co.:

	Current	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25 @ 2.75)	$20.50†	$29.50
Northern Basic	*20.78*†	27.52
Southern Ohio No. 2 (silicon 1.75 @ 2.25)	*20.50*†	28.52
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25 @ 2.75)	*26.16*†	35.26
BIRMINGHAM		
No. 2 Foundry (silicon 2.25 @ 2.75)	**16.50**†	24.00
PHILADELPHIA		
Eastern Pa., No. 2X, (2.25 @ 2.75 sil.)	**22.34**†	26.25@28.50*
Virginia No. 2 (silicon 2.25 @ 2.75)	**28.24**†	28.00*
Basic	*20.35*†	26.25†
Grey Forge	**21.00**†	27.00*
CHICAGO		
No. 2 Foundry Local (silicon 1.75 @ 2.25)	20.00†	24.00
No. 2 Foundry Southern (silicon 2.25 @ 2.75)	*16.00*†	32.92
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley (silicon 1.75 @ 2.25)	**21.96**†	26.96
Basic	**21.46**†	26.86
Bessemer	**21.96**†	27.00

*F.o.b. furnace. † Delivered.

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh			
	Current	One Year Ago	Birmingham	Chicago
Standard bessemer rails	$40.00	$45.00		$40.00
Standard openhearth rails	40.00	47.00	$40.00	40.00
Light rails, 8 to 10 lb.	**30.00**	2.30*	1.60*	1.60@1.70*
Light rails, 12 to 14 lb.	**30.00**	2.25*	1.60*	1.60@1.70*
Light rails, 25 to 45 lb.	**30.00**	2.20*	1.60*	1.60@1.70*
Rerolled Rails	*28.00*			

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8½ Ft.	7 In. x 9 In by 8½ Ft.
Chicago, White Oak	$1.35	$1.50
Chicago, Hardwood and Red Oak	1.20	1.30
Chicago, Empty Cell Creosoting (add'l)	.45	.50
San Francisco, Green Douglas Fir	.85	1.10
San Francisco, Empty Cell Creosoted, Douglas Fir	1.86	2.30
St. Louis, White Oak*	1.10	**1.44**
St. Louis, Red Oak*	.97	1.17
St. Louis (creosoted)	No. 1, $0.86.	No. 2, $0.96. No. 4, $1.28

*Standard specifications 38c. per tie additional. Zinc chloride process 27c. per tie additional.

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh					San Francisco	Birmingham
	Current	One Year Ago	Chicago	St. Louis			
Standard spikes, ⅜-in. and larger	$2.15@2.25	$3.30	$2.55	$		$4.25	$3.10
Track bolts	3.00@3.50	4.35	3.65			5.25	4.05
Standard section angle bars	2.40	2.50	2.40			4.00	3.25

PIPE

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the latest Pittsburgh basing card:

BUTT WELD

Inches	Steel Black	Galv.	Inches	Iron Black	Galv.
⅛ to 3	71	58½	⅛ to 1¼	44½	29½

LAP WELD

2	64	51½	2	32½	15½
2½ to 6	68	55½	2½ to 6	42½	27½
7 to 8	65	51½	7 to 12	40½	27½
9 to 12	64	50½			

BUTT WELD, EXTRA STRONG, PLAIN ENDS

⅛ to 1¼	69	57½	⅜ to 1½	**44½**	**30½**
2 to 3	70	58½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	62	50½	2	**40½**	**27½**
2½ to 4	66	54½	2½ to 4	**43½**	**31½**
4½ to 6	65	53½	4½ to 6	**42½**	**30½**
7 to 8	61	47½	7 to 8	**35½**	**23½**
9 to 12	55	41½	9 to 12	**30½**	**18½**

STEEL—From warehouses at the places named the following discounts hold for steel pipe:

	Black		
	New York	Chicago	St. Louis
1 to 3 in. butt welded	66%	62½%	59%
2½ to 6 in. lap welded	61%	59½%	56%

	Galvanized		
	New York	Chicago	St. Louis
1 to 3 in. butt welded	53%	48½%	45%
2½ to 6 in. lap welded	47%	45½%	42%

Malleable fittings, Class B and C, from New York stock sell at list less 10%. Cast iron, standard sizes, *38-5%* off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	New York						San Francisco
	Current	One Year Ago	Birmingham	Chicago	St. Louis		
4 in.	**$50.80@51.80**	$73.30	**$38.50**	**48.10@48.60**	$43.70		**$54.00**
6 in. and over	**46.80@47.80**	63.30	**34.50**	**44.10**	39.70		**50.00**

Gas pipe and Class "A," $4 per ton extra; 16-ft. lengths, $1 per ton.

CLAY DRAIN TILE—The following prices are per 1000 lin.ft.:

	New York					
Size, In.	Current	One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	$40.00	$50.00		$50.00		$55.00
4	50.00	*60.00*	$80.00	60.00	*$76.50*	65.00
5	80.00	90.00		80.00	*97.75*	84.00
6	100.00	115.00	140.00	100.00	*127.50*	110.00
8	150.00	185.00	200.00	150.00	*212.50*	181.00

SEWER PIPE—The following prices are in cents per foot for carload lots f.o.b.:

Size, In	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3	$0.14	$0.087			$0.12	$0.12	
4	.14	.087	$0.08	*$0.0875*	.12	.15	$0.18
5	.21	.1305	.10		.18	.18	.165
6	.21	.1305	.12	*.1225*	.18	.21	.25
8	.35	.203	.20	*.20*	.28	.30	.35
10	.52	.3045	.26	*.28*	.42	.42	
12	.67	.3915	.30	*.36*	.54	.54	.80
15	1.15	.522	.50	**.52**	.72	.90	
18	1.55	.725	.68	*.68*	1.00	1.32	
20	1.98	.87	.90	*.92*	1.20		
22	2.64	1.16	1.10		1.60		
24	2.97	1.305	1.30	*1.50*	1.80	2.16	2.40
27	4.50	1.885		*2.00*	3.75	3.00	
30	5.00	2.088		*2.45*	4.75	3.60	
33	6.55	2.61		*3.00*	5.50		
36	7.50	2.9725		*3.35*	6.00		

	3	5	8	12	24	36
Boston	$0.105	$0.1575	$0.245	$0.4725	$1.575	$4.408
Minneapolis			40	77	2.55	5.66
Denver	135*	18*	27	47	1.70	
Seattle	*.15*		*.32*	*.65*	*1.84*	
Los Angeles	11*	165*	275	495	1.65	
New Orleans		*.106*	27	459	**1.756**	
Cincinnati	096	144	224	43	1.44	4.382
Atlanta	078*	117*	.195	.3315	*1.15*	
Montreal, *delivered*	30*	45*	70*	1.35	4.50	6.50
Detroit	*099*	*1485*	*.41*	*1.755*	*5.765*	
Baltimore	1225	2275	35	6870	2.29	5.23
Kansas City, Mo.	15*	21*	335	60	2.41	4.74
Philadelphia	105	.1575	245	4725	1.575	3.5875

*4-in., 6-in., 9-in., respectively.

ROAD AND PAVING MATERIALS

ROAD OILS—Following are prices per gallon in tank cars 8,000 gal. minimum f.o.b. place named:

		Current	One Year Ago
New York, 45% asphalt	(at terminals)	$0.05	$0.07
New York, 65% asphalt	(at terminal)	.045	.07
New York, binder	(at terminal)	.055	.074
New York, flux	(at terminal)	.05	.07
New York, [illegible] asphalt	(at terminal)	.06	.08
St. Louis, 50-[illegible] asphalt [illegible]		**.05**	.04*
Chicago, 45-50 asphalt		.05	.06
Chicago, 60-70 asphalt		.05½	.06½
Dallas, 45-50 asphalt		.10	.10
Dallas, 65-70 asphalt		.13	.13
Dallas, 75-90 asphalt		.15	.15
[illegible] tar binder per ton		13.00†	15.00

*Freight $21.75 per ton to Whiting, Ind.

†Freight from Coal Dock to San Francisco, $8.00 per ton.

ASPHALT—Price per ton in packages (350-lb. bbls. or 425-lb. drums) and in bulk in carload lots:

	Package	Bulk
New York (Bayonne, N. J.)	$25.00	$15.00
Boston	No quotations	
Chicago, *f.o.b. refinery*, Oleum, Cal. (natural)	24.35	18.0
San Francisco	19.50*	13.50*
Dallas	35.00	27.00
Seattle	28.90	.....
Denver	40.00	.....
Minneapolis	.....	19.95
St. Louis (natural)	*22.35*	*14.00*
Baltimore	25.00	18.0
Los Angeles, *at factory*	22.50	15.00
Montreal	28.00	21.00
Atlanta	28.00	.....
Detroit (petroleum asphalt)	25.00	19.00
Cincinnati	32.00	28.00
Maurer, N. J. (natural asphalt)	36.00	33.00
Maurer, N. J.(artificial asphalt)	22.00	20.00
Philadelphia	24.00	17.50
Kansas City	28.83	22.83

*Freight to San Francisco, 80c. per ton.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums. Rebates of about $1 per bbl., no rebate for drums.

PAVING STONE—

New York	5-in. granite, 28@29 blocks per sq yd.	$130.00 per M
Chicago	About 4x8x4 dressed	3.20 sq.yd.
	About 4x8x4 common	3.00 sq.yd.
San Francisco	Basalt block 4x7x8	70.00 per M
Boston	5-in. granite	125.00 per M
Atlanta	Granite	2.00 sq.yd.
Detroit	Granite, 26½ blocks per sq.yd.	3.05 sq.yd.
Baltimore	Granite	2.00 sq.yd.
Montreal	Granite	125.00 per M
New Orleans	Granite, 4 x 8 x 4	3.25 sq.yd.
Cincinnati	Granite	3.84@4 sq.yd.
St. Louis	4x8x4 dressed	3.35 sq.yd.
	4x8x4 common	3.00 sq.yd.
Kansas City	No. Granite	3.95 sq.yd.
Philadelphia	Granite	125.00 per M.

FLAGGING—

New York	Bronx	$0.25	sq.ft.
	Manhattan, 4 ft.	.26	sq.ft.
	Queens, 5 ft.	.26	sq.ft.
	6x20-in. cross-walk	1.00	lin.ft.
Chicago	18 in. wide	.99	lin.ft.

CURBING—Bluestone per lineal foot, in New York, costs 77c. for 5x16 in., 88c. for 5x18 in.; in cargo lots.

WOOD BLOCK PAVING—

	Size of Block	Treatment	Per Sq.Yd.
New York (*delivered*)	3	16	$2.04
New York (*delivered*)	3½	16	2.17
New York (*delivered*)	4	16	2.36
Boston	3	16	2.17
Chicago	4	16	3.00@3.25
Chicago	3½	16	2.50@2.75
St. Louis	3½	16	2.50
St. Louis	4	16	3.00
Seattle	4	16	Off market
Minneapolis	3½	16	2.13
Atlanta	3½	16	**2.30**
New Orleans	3	16	1.60
New Orleans	3½	16	1.80
New Orleans	4	16	2.00
Dallas	4	18	3.90
Baltimore	3½	16	3.44
Montreal	4	16	4.50
Detroit	3	16	2.84
Detroit	4	16	3.00
Cincinnati	4	16	2.10
Kansas City	4	16	2.15
Philadelphia	3½	16	3.50

CONSTRUCTION MATERIALS

SAND AND GRAVEL—Price for cargo or carload lots to contractor is as follows, per cu.yd.:

	Gravel 1½ In. Current	Gravel 1½ In. One Year Ago	Gravel ¾ In. Current	Gravel ¾ In. One Year Ago	Sand Current	Sand One Year Ago
New York	$1.75	$2.50	$1.75	$2.50	$1.00	$1.25
Denver	2.50	2.00	2.50	1.80	1.10	1.60
Chicago	*1.80*	2.75	*1.80*	2.75	*1.80*	2.75
St. Louis, *per ton*	1.25	1.55	1.50	1.60	1.10	1.60
Seattle	1.50	1.50	1.50	1.50	1.50	1.50
Dallas	2.25	3.50	2.25	4.00	2.25	3.00
Minneapolis	1.50	2.00	1.50	.....	1.00	1.00
Cincinnati	1.87½	2.56½	1.87½	2.62½	1.43	1.95
San Francisco	2.25	2.50	2.25	2.50	1.50	1.65
Boston	2.40	2.65	2.40	2.65	1.65	2.00
New Orleans	2.08½	2.85	2.08½	.....	1.35	1.65
Los Angeles, per ton	1.50†	1.55	1.50†	1.45	1.35†	1.00
Atlanta, per ton	1.85	2.62½	1.85	.....	1.15	1.52½
Detroit	2.00	2.50‡	2.00	2.50*	2.00	2.50
Baltimore, per ton	1.40	1.40‡	1.60	1.60‡	2.00	.70
Montreal, per ton	1.25	1.50‡	1.50	1.75	1.25	1.50
Birmingham, per ton (Crushed slag used instead of gravel)					1.25	1.43‡
Philadelphia	1.50		1.55		1.60	...
Kansas City	2.00	3.25	2.00	3.75	1.20	1.25

* Fine white sand: Pacific, $4 per ton; Ottawa, $4.50.
† Freight from quarry to Los Angeles is 85c. per ton, and is included in above price.
‡ Per cu. yd.

CRUSHED STONE—Price for cargo or carload lots f.o.b. city, unless stated otherwise, is as follows, per cu.yd.:

	1½ In. Current	1½ In. One Year Ago	¾ In. Current	¾ In. One Year Ago
New York	$1.65	$1.90@2.00	$1.75	$2.15
Chicago	1.60	2.75	1.60	2.75
St. Louis *delivered*	1.65	2.60	1.65	2.60
Dallas, *delivered*	2.73	2.80	2.73	2.80
San Francisco	2.25	2.50	2.25	2.50
Boston, *delivered*	3.00*	3.00* (del.)	3.00*	3.00* (del.)
Minneapolis, *ct plant*	2.00	2.00	2.25	2.25
Kansas City, *at plant*	2.10	2.52	2.10	.....
Denver	3.50		3.50	
Seattle *delivered*	3.00	3.50 (del.)	3.00	3.50 (del.)
Atlanta	1.90*	2.50*	1.90*	
Cincinnati *delivered*	1.75	3.06½	1.75	3.06½
Los Angeles	1.75*	1.75*	1.85*	1.80*
Detroit	1.90*	2.00*	1.90*	2.00*
Baltimore	1.75*	1.75*	1.65*	1.75*
Montreal	2.00*	2.00*	*2.00**	2.10*
Birmingham *delivered*	3.20	....	3.10	.....
Phildelphia	1.70*	....	1.55*	.....
Pittsburgh	2.85	....	2.85	.....
Cleveland	3.25*	....	3.25*	.....

*Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plants:

	1½-In.	¾-In.	Roofing	Sand
Youngstown District	$1.30	$1.30	$2.00	$1.30
Steubenville District	1.40	1.40	2.00	1.40
Ironton District	1.40	1.40	2.00	1.40
Emporium, Pa.	1.25	1.25	.....	1.25
Easton, Catasaqua, Pa.	1.00	1.00	2.00	0.90
Birmingham, Ala.	*0.90*	*1.00*	.....	*0.40*
Buffalo, N. Y., and Erie, Pa.	1.25	1.25	2.25	1.25
Cleveland, Ohio	1.20	1.20	....	1.00
Eastern Pennsylvania and Northern New Jersey	1.20	1.20	2.00	1.20
Western Pennsylvania	1.25	1.25	2.00	1.25

LIME—Warehouse prices:

	Hydrated, per Ton Finishing	Hydrated, per Ton Common	Lump, per Barrel Finishing	Lump, per Barrel Common
New York	$15.80@$16.80	$12.50	$3.68	$2.75@$3.18*
Chicago	18.00	.....	.....	1.40†
St. Louis	23.20	20.00	*2.35*†	.....
Boston	23.00	19.50	3.30†	3.00†
Dallas	25.00	.....	.....	2.50†
Cincinnati	15.10	12.50	10.75	12.50‡
San Francisco	22.00	18.00	.....	1.75†
Minneapolis	29.00	22.00 (white)	1.70†	1.40†
Denver	24.00	.....	....	2.70†
Detroit	18.00	16.00	....	17.00‡
Seattle *per sacks*	*2.40*	.....	*2.80*†	2.75†
Los Angeles	30.00	30.00	3.00	3.00*
Baltimore	15.00	13.00	....	12.00‡
Montreal	21.00	21.00	15.00‡	11.00‡
Atlanta	18.00	12.50	2.00†	1.25†
New Orleans	.....	17.25	1.75†	.....
Philadelphia	13.00	11.50	10.50‡	9.50‡

*280-lb. bbl. (net). †Per 180-lb. bbl. (net). ‡Per ton—Refund of 10c. per bbl.
Minneapolis quotes brown lime; Kelly Is. white is $1.70, Sheboygan $1.55.

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, f.o.b., exclusive of bags:

	Current	One Year Ago
Minneapolis (Rosendale)	$2.80	$2.80
Kansas City (Ft. Scott)	1.60	1.60
Atlanta (Magnolia)	11.00 ton	11.00
Cincinnati (Utica)	1.77	2.75
Boston (Rosendale) per bag	.80	3.00
St. Louis (Carney hydrated)	2.10	....

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b. points listed *without bags*. Cash discount not deducted.

	Current	One Month Ago	One Year Ago
New York*	$2.40	$2.30	$3.20
New York, alongside dock to dealers	2.30	2.00	2.35
Jersey City	2.12	2.12	2.67*
Boston	2.50	2.50	2.62
Chicago	1.97	1.94	2.17
Pittsburgh	2.02	2.02	2.17
Cleveland	2.26	2.26	2.43
Detroit	2.17	2.17	2.43
Indianapolis	2.21	2.21	2.43
Toledo	2.20	2.20	2.49
Milwaukee	2.18	2.13	2.39
Duluth	*1.94*	1.95	2.10
Peoria	2.08	1.98	2.45
Cedar Rapids	2.21	2.11	2.51
Davenport	2.16	2.06	2.47
St. Louis	2.20	2.20	2.80
San Francisco	2.73	2.73	2.63
New Orleans	3.00	3.20	2.96
Minneapolis	2.24	2.24	2.41
Denver	2.90	2.90	2.82
Seattle	2.94	2.94	3.03
Dallas	2.25	2.40	2.15
Atlanta	2.39	2.39	2.70
Cincinnati	2.35	2.32	2.57
Los Angeles	3.30	3.30	3.85
Baltimore*	2.50	2.50	...
Birmingham	2.27	2.27	....
Kansas City	2.40	2.40	2.56
Montreal	**2.50**	2.50*	2.95
Philadelphia	2.21	2.21	....
St. Paul	2.24	2.24	2.41

NOTE—Bags 10c. each, 40c. per bbl.;

Current mill-prices per barrel in carload lots, without bags; to ocntractors:

Buffington, Ind	$1.70	Mason City, Ia.	$1.95
Universal, Pa.	1.75	Hudson, N. Y.	1.90
Steelton, Minn	1.75	Leeds, Ala	1.95
Fordwick, Va.	1.95	Hannibal, Mo.	1.85
Mitchell, Ind.	1.95	Lehigh Valley District	1.70
LaSalle, Ill.	1.70	Kingsport, Tenn.	1.95
Iola, Kan	1.95	Richard City, Tenn.	1.95

*Delivered by truck at site of work.

TRIANGLE MESH—Price per 100 sq.ft. in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh, Mill	Warehouse: New York	Chicago	Dallas	San Francisco
032	22	$0 68	*$0 95*	$0 76	$1 15	$1 15
049	28	87	*1 23*	98	1 46	1 48
068	35	1 05	*1 48*	1 18	1 80	1 80
093	45	1 35	*1 91*	1 52	2 30	2 32
126	57	1 65	*2 35*	1 87	2 86	2 87
153	68	1 97	*2 81*	2 23	3 40	.....
180	78	2 26	*3 22*	2 56	3 93	.....
245	103	2 99	*4 26*	3 38	5 15	.....
287	119	3 45	*4 90*	3 90	5 96	6 01
336	138	4 00	*5 69*	4 52	7 32	.....
395	160	4.64	*6 60*	5 20	8 00	.....
			PAVING			
036P	17	$0 52	*$0 72*	$0 58	$0.88	.....
053P	24	.73	*1 02*	82	1.24	.....
072P	31	91	*1 29*	1 00	1 57	.....
097P	40	1.18	*1 67*	1 29	2 02	.....
049R	24	.73	*1 02*	.67	1 24	.....
067R	31	91	*1 29*	1 00	1 57	.....
089R	40	1.18	*1 67*	1.29	2 02	.....

In rolls 16-, 20-, 24-, 28-, 32-, 36-, 40-, 44-, 48-, 52-, and 56-in. wide and in 150-, 200- and 300-ft. lengths. Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in wide x 150 ft. long, or 600 sq. ft.

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted are as follows:

Gage	Weight	*New York	Chicago	St. Louis	San Francisco	Dallas
27BB	2 3	$21 20	*$20 39*	$21 25	$23 87	$25 50
26BB	2.5	22 65	*22 00*	22 75	26 21	27.56
25BB	3.0	25 30	.....	27 10	.....	30.71
24BB	3.4	27 10	*26 33*	29.25	27.90	33.16
22PO	4.33	31 75	**31 00**	31.75	.....	35.10

* Price to contractors at warehouse or delivered on job in Manhattan, Bronx or Brooklyn.

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Inches	Pittsburgh Mill	Birmingham Mill	Warehouse, Uncut: New York	Chicago	St. Louis	Dallas	San Francisco
½ and larger	**$1 60**	$1 60	**$2 48**	**$2 38**	$2 47½	$3 50	$2 55
⅝ and larger	**1 65**	1 65	**2 53**	**2 43**	2 52½	3 55	2 60
¾ and larger	**1 70**	1 65	**2 58**	**2 48**	2 57½	3 60	2 65
⅞ and larger	**1 85**	1 70	**2 63**	**2 63**	2 72½	3 75	2 80
1 and larger	**2 10**	1 70	**2 68**	**2 58**	2 97½	4 00	3.05

Includes 15c charge for cutting to lengths of 2 ft and over. Twisted bars cut to length take extra of 27½c. per 100 lb.

ROLLED FROM RAILS

	Chicago	St. Louis	Dallas		Chicago	St. Louis	Dallas
½ and larger	**$1 60**	$2 25	$3 25	½	**$1 85**	*$2 50*	$3 50
⅝ in.	**1 65**	**2 30**	3 30	¼	**2 10**	2 75	3 75
¾	**1 70**	2 35	3 35				

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common: Current	One Month Ago	One Year Ago	Paving Block: 3-inch*	4-inch*
New York (del.)	**20 40**	$19.40@19.90	$18 40	$44 50†	$49.50†
New York (at dock)	**17 00**	16 00@16 50	15 00		
Chicago	11 00	11 00	12 00	34 00	42 00
St. Louis, salmon	*14 00*	16 00	15 00		*28 00*
Denver, salmon	12 00	12 00	14 00		
Dallas	11 15	11 15	16 00	no market	
San Francisco	15 00	15 00	18 00		
Los Angeles	15 00	15 00	15 00	(not used)	
Boston (del.)	16 00	16 00	21 75	46 50†	52 60†
Minneapolis (del.)	15 00	15 00	18@20		43 00
Kansas City	14 50	14 50	20 00		
Seattle	14 00	14 00	19 00		
Cincinnati	15 00	15 00	20 00	41 00	36 50
Montreal (del.)	16 00	16 00	18 00		*65 00*
Detroit (del.)	16 50	16 50	18 00	*38 50*	*39 50*
Baltimore (del.)	20 00	20 00	20@25	36 00‡	
Atlanta	9 00	9 00	12 00		
New Orleans	12 50	12 50	17 50		
Birmingham	9 50	9 50			
Philadelphia	16 00	16 00			42 00
Pittsburgh (del.)	17 50				

* For paving blocks 3½x8½x3 and 3½x8½x4 respectively. † F.o.b. ‡ Vitrified, f.o.b. plant, Baltimore.

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York: Current on Trucks*	New York: One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Perth Amboy N. J. Factory*
4x12x12	$0 11120	$0 1895	$0 0821	$0 095	$0 [illegible]	$0 108	
6x12x12	16670	2526	0950			156	
8x12x12	20840		1295	175		244	$0 17890
10x12x12			1584				21050
12x12x12			1811	255			27370
* 5 per cent off for cash							
			4x12x12		8x12x12		12x12x12
Boston			$0 94		$0 177		$0 244
Minneapolis (f.o.b. cars)			0872		165		[illegible]
Minneapolis (delivered)			0752		1475		[illegible]
Cincinnati			0670		1263		175
Kansas City			085		162		220
Denver			08		144		21
Seattle			12		24		[illegible]
Los Angeles factory			095		176		22
New Orleans			12		21		[illegible]
Detroit (delivered)			070		135		225
Montreal			095		18		[illegible]
Baltimore			14		24		19
Atlanta			**072**		**12**		
Dallas			115				
Birmingham			09		16		
Pittsburgh (del.)			066		124		179

San Francisco, Philadelphia and New York quote on hollow partition tile.

STRUCTURAL MATERIAL—Following are base prices f. o. b. mill, Pittsburgh and Birmingham together with quotations per 100 lb. from warehouses at places named:

	Pittsburgh, *Mill*	Birmingham *Mill*	New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in.	**1.60**	**$1.65**	**$2.58**	**$4.00**	**$2.57½**	**$2.48**	**$3.10**
Channel, 3 to 15 in.	**1.60**	1.65	**2 58**	**4.00**	**2.57½**	**2.48**	**3.10**
Angles, 3 to 6 in., ¼ in. thick	**1.60**	1.65	**2.58**	**4.00**	**2.57½**	**2.48**	**3.10**
Tees, 3 in. and larger	**1.60**	1.65	**2.58**	**4.00**	**2.57½**	**2.48**	**3.10**
Plates	**1.60**	1.65	**2.58**	**4.00**	**2.57½**	**2.48**	**3.10**

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Pittsburgh, Mill	New York: Current	New York: One Yr. Ago	Warehouse: Chicago	St. Louis	San Francisco	Dallas
½ in. and larger	**$2.10@2.25**	**$3.50**	**$4.65**	**$3 10**	$3 09½	$4 50	$5 50

CONE HEAD BOILER

½ in and larger	**2.20@2.35**	**3.60**	**4.75**	**3 20**	**3.19½**	4.60	5 65
⅝ and ¾	**2.35@2.50**	**3.76**	4 90	**3 35**	**3.35½**	4.75	5 80
⅞ and 1	**2.60@2.75**	**4.00**	5 15	**3 60**	**3 59½**	5 00	6.05

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in. take an extra of 25c.

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh, Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire	**$2.40@2.50**	$3.15	$3.90	$5 00	*$3.25*	$4.95
Cut	2.25	5.80	5.90	7.75	....	5 00

PREPARED ROOFINGS—Standard grade rubbered surface, complete with nails and cement, costs per square as follows:

	New York: 1-Ply l.c.l.	New York: 2-Ply l.c.l.	New York: 3-Ply l.c.l.	Philadelphia: 1-Ply l.c.l.	Philadelphia: 2-Ply l.c.l.	Philadelphia: 3-Ply l.c.l.
No. 1 grade	$2 00	$2.45	$2.90	$1 90	$2 35	$2 80
No. 2 grade	1.80	2.10	2 50	1 70	2 00	2.40

Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs $1.95 per roll in carload lots and $2.20 for smaller quantities f.o.b. Philadelphia.

Shingles, red and green slate finish, cost $5.50 per square in carloads; $5.75 in smaller quantities, in Philadelphia.

ROOFING MATERIALS—Prices f.o.b. New York:

Tar felt (14 lb. per square of 100 sq.ft.) per roll of 432 sq.ft	$2 00
Tar pitch (in 400-lb. bbl.), per 100 lb	1 60
Asphalt roofing (in barrels), per ton, f.o.b. plant*	*40.50*
Asphalt felt (light), per ton, f.o.b. plant*	*64.50*
Asphalt felt (heavy), per ton, f.o.b. plant*	68.50

* Delivered in Metropolitan Dist., $3.00 additional.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh, Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10	**$2 40**	**$3 62½**	$3 38	$4 15	**$3 38**
No. 12	**2 45**	**3 67½**	3 43	4 20	**3 43**
No. 14	**2 50**	**3 72½**	3 48	4 25	**3 48**
No. 16	**2 70**	**3 82½**	3 58	4 35	**3 58**
Black					
*Nos. 18 and 20	**3 00**	**3 70**	**4 10**	**5 45**	**4 05**
*Nos. 22 and 24	**3 05**	**3 85**	**4 15**	**5 50**	**4 10**
*No. 26	**3 10**	**4 00**	**4 20**	**5 55**	**4 15**
*No. 28	**3 15**	**4 30**	**4 30**	**5 65**	**4 25**
Galvanized					
No. 10	**3 15**	**4 30**	**4 30**		**4 25**
No. 12	**3 25**	**4 40**	**4 40**	**5 60**	**4 35**
No. 14	**3 25**	**4 40**	**4 40**	**5 60**	**4 35**
Nos. 17 to 21	**3 55**	**4 60**	**4 70**	**5 90**	**4 65**
Nos. 22 and 24	**3 70**	**4 85**	**4 85**	**6 05**	**4 80**
*Nos. 25 and 26	**3 85**	**5 00**	**5 00**	**6 20**	**4 95**
*No. 28	**4 15**	**5 30**	**5 30**	**6 50**	**5 25**

*For painted corrugated sheets add 30c. per 1,000 lb. for 5 to 28 gage. 25c. for 12 to 24 gages, for galvanized corrugated sheets add 15c., all gages.

LINSEED OIL—These prices are per gallon.

	New York: Current	New York: One Year Ago	Chicago: Current	Chicago: One Year Ago
Raw in barrel (5 bbl. lots)	**$0 91**	$0 67	$0 90	$0 68

WHITE AND RED LEAD—Base price in cents per pound:

	Red				White	
	Current		1 Year Ago		Current Dry or	1 Yr. Ago Dry or
	Dry	In Oil	Dry	In Oil	In Oil	In Oil
100-lb. keg	12.25	13 75	13 00	14 50	12 25	13 00
25 and 50-lb. kegs.	12.50	14 00	13.25	14.75	12.50	13 25
12½-lb. keg	12 75	14 25	13 50	15 00	12 75	13 50
5-lb. cans	15 25	16 75	16 00	17 50	15 25	16 00
1-lb. cans	17 25	18 75	18 00	19 50	17 25	18 00

LUMBER

Prices wholesale to dealers in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in carload lots to dealers at yards. To contractors, $2 per M ft. additional.

	6–8 and 12 Ft.	10–16–18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$24 00	$24 00	$25 00	$26 00
3x6 and 8	25 00	25 00	26 00	27 00
4x4-6 and 8	25 00	26 00	27 00	32 00
3x10 and 12	25 00	26 00	27 00	32 00
3x14	29.00	30.00	31 00	33 00
4x10 and 12	25 00	26 00	27 00	32 00
x14	29 00	30 00	31 00	33 00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft
6x10	$27 00	$30 00	$32 00
6x14	29.00	32.00	34 00
8x10	27 00	30 00	32 00
8x14	29.00	32.00	34.00

New York, Chicago, St. Louis and Detroit—Wholesale prices to dealers of long leaf yellow pine.

	New York*		Chicago	
	20 Ft. and Under	22 24 Ft	20 Ft. and Under	22-24 Ft.
3x 4 to 8x8	$38 00	$39 00	$36 00	$38 00
3x10 to 10x10	41 00	42 00	38 00	40 00
3x12 to 12x12	43 00	44 00	40 00	42 00
3x14 to 14x14	47.50	48 50	44 00	46 00
3x16 to 16x16	52 50	53 50	49 00	51 00
3x18 to 18x18	60 00	61 00	55 00	57 00
4x20 to 20x20	70 00	71 00	62 00	64 00

* Wholesale price to dealers; to contractors, on lighters or cars, about $5 additional. Short leaf pine up to 14 x 14 costs $15 per M. less.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12 x 12 and under, for sizes over 12 x 12 add $2, for merchantable add $2 to sizes 10 x 10 and under. For pine add $2 to the price of merchantable for all sizes.

Other Cities

	8 x 8-In. x 20 Ft. and Under			12 x 12-In. 20 Ft. and Under	
	P.	Fir	Hemlock	Spruce	P.	Fir
Boston	$50 00	$52 00	$55.00	$45 00	$54 00	$52 00
Seattle		20 00				20 00
New Orleans	20 00				25 00	
Baltimore	36 45				38 50	
Cincinnati	39.00	50 00			40 00	64 00
Montreal		47 00	35.00	35 00	82 00	47.00
Los Angeles		41 00	40.00			41.00
Denver		35 75	35.75	35.75		36.75
Minneapolis	40 00	39 00	38 00		47 00	39.00
Atlanta	30 00				36 00	
Dallas	33 00				34 50	
Kansas City	33.00	34 00			36 00	35 00
Birmingham	21 00				26 00	
Philadelphia	35 00	36.00	39 00	44 00	44 00	36 00
Detroit	40 00	43 00			45 00	44 00
St. Louis	35.00				38 00	

	1-In. Rough, 10 In. x 16 Ft. and Under			2-In. T. and Gr. 10 In. x 16 Ft	
	P.	Fir	Hemlock	P.	Fir
Boston	$47.00	$48 00	$32 00	$45 00	$48 00
Seattle		16 00			18 50
New Orleans, at mill	63 00			32 00	
Baltimore	35.00			36 45	
Cincinnati	62.50	80 00		33 50	
Montreal	66.00	48 00	35 00		45 00
Los Angeles		37 00	36 00		63 00
Denver		30 75	30 35		30 25
Minneapolis	38 50	37 25	34 25	36 00	34 75
Atlanta	17 00			21 00	
Dallas	34 00	30 00		36 00	
Kansas City	35.00	34 50		20 00	31 00
Birmingham	19 00			18 00	
Philadelphia	28.00	34.00	40.50	30 00	34 00
Detroit	42 00	33.75		38 50	36 25
St. Louis	36.00			35 00	

Montreal—Up to 32 ft.; over which, $3.00 per M. increase up to 30 ft.

Birmingham—Quotes carload lots, f.o.b. sidings. $1.50 additional per M. ft. to contractor.

Boston and Cincinnati—Prices to contractors in carload lots, f.o.b.

Denver—Quotes dealers prices to contractor on large projects.

St. Louis—Wholesale price to contractors, $4 50@$6 per M ft. additional.

FREIGHT RATES

On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

Baltimore	$0 33½	Detroit	$0 32½
Birmingham	.76½	Kansas City	81½
Boston	40½	New Orleans	51½
Buffalo	29½	New York	.38
Chicago	.38	Pacific Coast (all rail)	1 66½†
Cincinnati	.325	Philadelphia	.35
Cleveland	.24	St. Louis	47½
Denver	1.35*	St. Paul	66½

* Minimum carload, 40,000 lb.

†Minimum carload, 50,000 lb., structural steel only; 80,000 lb. for other iron steel products.

CONTRACTORS' SUPPLIES

STEEL SHEETPILING—The following price is base per 100 lb. f. o. b. Pittsburgh, with a comparison of a month and a year ago:

Current	One Month Ago	One Year Ago
$2 00	$1 75	$2.55

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern Territory New York and East of Missouri River
Hercules red strand, all constructions	30%
Patent flattened strand, special and cast steel	30%
Patent flattened strand, iron rope	15%
Plow steel round strand rope	45%
Special steel round strand rope	40%
Cast steel round strand rope	32½%
Round strand iron and iron tiller	15%
Galvanized steel rigging and guy rope	17½ %
Galvanized iron rigging and guy rope	+2½%

California, Oregon, Nevada and Washington Discount 5 points less than discount for Eastern territory.

Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.

Arizona: Discount 10 points less than discount for Eastern territory.

Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.

North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ¾-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ¼-in., 8 ft., ⅜-in., 6; ½-in., 4½; ⅝-in., 3½; ¾-in., 2 ft. 10 in.; 1-in., 2 ft. 4 in. Following is price per pound for ¼-in. and larger, in 1200-ft. coils:

Boston	$0 20	New Orleans	$0.17½
New York	.17	Los Angeles	.16½
Chicago	19	Seattle	.18
Minneapolis	.19½	St. Louis	.21
San Francisco	.17	Montreal	.30
Atlanta	.21	Detroit	.19½
Denver	.20	Baltimore	.20
Cincinnati	.20	Kansas City	.18½
Dallas	.29	Birmingham	.20½
Philadelphia	.17		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0.2950	$0 3250
Boston	.24	.275
Kansas City	.24	.2750
Seattle	.1875	.2125
Chicago	.2450	.2750
Minneapolis	.2144	.2347
St. Louis	.2475	.2775
Denver	.2250	.2550
Dallas	.29	.375
Los Angeles	.25	.29
Atlanta	.2575	.2925
Baltimore	.2550	.27
Cincinnati	.2350	.255
Montreal	.215	.255
Birmingham, *delivered*	.155	.175
New Orleans	.2725	.3075
San Francisco	.195	.23
Philadelphia	.24	.27

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York.

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.14	$0.17½
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	0.17½	0.22
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	0.19½	0.24
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	0.23	0.32
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	0.25	0.34
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	0.32	0.38

SCRAP—The prices following are per gross ton paid to dealers and producers in New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

	New York	Chicago	St. Louis
No. 1 railroad wrought	$13 00	$11 50	$12 00
Stove plate	12.00	12 00	13 50
No. 1 machinery cast	18.00	16.50	14 50
Machine shop turnings	7 00@7 50	4 00	5 00
Cast borings	9.00@9.50	5 50	6 75
Railroad malleable cast	11 00	12.50	10 25
Re-rolling rails	11@11.50	13 00	15 00
Relaying rails	28.50@28.50	30 00	15.00

SHIP SPIKES—Current prices per 100 lb.:

In.	San Francisco Galv.	San Francisco Black	Seattle Black
½	$6 75	$5 50	$8.55
⅝	6 30	5 05	8.25
¾	6 15	4 90	8.30

Pittsburgh base in lots of 200 kegs or more $2.50

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren *Editor*

Volume 88 — NEW YORK, MAY 11, 1922 — Number 19

Our Water-Works Issue

THE American Water-Works Association meets next week in Philadelphia. In accordance with a time-honored custom of this journal and the two which it succeeds, this issue, as the one immediately preceding the convention, contains a larger and more varied list of articles on water-works and allied subjects than is ordinarily printed in a single issue. Both topically and geographically, the articles have a wide range, as is fitting in view of the wide scope of the association.

The Convention Program

THE program of the Philadelphia convention is well designed to attract, inform and inspire a large percentage of the membership of the association. It should do more. It should increase the membership. Half a hundred papers and committee reports are listed. That does not include the many topics suggested for the "informal get-together" group meetings. It leaves out of account the innumerable subjects on which individual members will gain both light for guidance and courage for action through the still less formal talks between old and new acquaintances and friends—among which the supply men will not be last or least.

Standardization

THE Standardization Council established two years ago and the sub-committees it announced at Cleveland last year are points of interest on the Philadelphia program. The council itself and a half dozen of its sub-committees are down for reports. As some of the relatively few subcommittees are hold overs—like the one on cast-iron pipe specifications—it would appear that either that "slow and sure" had been adopted as the motto of most of them or else that even a parental committee is not able to get much more life and action from numerous standing committees than when these committees were fatherless and motherless. But patience rather than hasty judgment is desirable.

Seventeen Committees

BESIDES the Council on Standardization there are associated with it no less than 17 sub-committees, with about 110 members in all—say 100 members, allowing for duplicate service. Although some of the committee titles disclose little if anything to standardize, all suggest opportunity for useful investigation and report. The parental or directing council affords a means of co-ordination, beginning with the choice of committee chairman and other members and continuing with advice as to the scope and methods of the committee work. Here again the prominence of matters of water quality and treatment are notable, seven committees with nearly 50 members appearing on the list. Judging from the number and character of its membership, the Committee on Colloid Chemistry and Its Relation to Water Purification has the most troublesome problems to solve. The committee, presumably will be one of research rather than standardization, at least for a time. Much seems to be likely to come of the other committees, as we have already indicated. Name and exact scope aside, the underlying idea of the council and its sub-committees promises added usefulness to the American Water Works Association. The hundred members who are co-operating to that end deserve commendation and support.

Water Quality and Treatment

THE fact that nearly half of the papers and committee reports have to do with some phase of the quality of water, its conservation and improvement, is significant. It is due primarily to the vital nature of the subjects indicated, which has led to the formation of various committees which are scheduled to report at Philadelphia, and which also caused the creation, some years ago, of a chemical and bacteriological section. Besides two sessions of its own, one of which will be devoted to the pressing questions of tastes and odors, the chemists and bacteriologists will provide the papers for a joint session with all the other members. The quality of water is most assuredly coming to the front.

The Engineer in Public Life

ENGINEERS have frequently been charged with neglecting their public responsibilities. When the results of an election or appointment are announced it generally happens that a lawyer, a merchant, a banker, a business man, or a politician is the man selected. Nevertheless, within the engineering profession there has been a growing appreciation of the desirability of more engineer representation in civic affairs. *Engineering News-Record* is endeavoring to discover what results have followed this change in attitude and has addressed to secretaries of national and local engineering societies requests for information on engineers who have been elected to some public office of a non-engineering character or who are otherwise taking an active part in public affairs. It is planned to publish a series of brief biographical sketches of these men in the news section and the first installment appears in this issue. Without the co-operation of our readers it is clear that this series cannot be made complete. It is requested, therefore, that you who read these lines send us the names of any engineers in your locality who are engaged in some form of public activity outside of regular professional duties. It is desired to limit the series to activities of a non-engineering character, so that a city engineer or a city manager, for example, irrespective of the value of their public service, would not qualify. What we would like to find out are the names of engineers who are mayors of cities, members of state legislatures, presidents of

chambers of commerce, aldermen, commissioners, or chairmen of committees engaged in civic or philanthropic works.

Our Largest Reservoirs

THE partial list of the largest storage reservoirs in the United States given elsewhere in this issue will surprise many because of its length and of the large capacity of so many of the reservoirs. A round dozen store 100 billion gallons or more of water that can be drawn off for *actual use*, while 35 store upwards of 50 billion gallons. Mr. Hazen, who compiled the list from data gathered by a committee of Engineering Council, recognizes that some large reservoirs may be omitted, while the gaps in the table afford evidence that for many of the reservoirs listed important figures are lacking, and also the uses which a large number of the reservoirs serve. Although compiled with care from the best available sources, Mr. Hazen states, some of the figures doubtless need revision. A service will be rendered the engineering profession and the conservation and use of one of the greatest of the natural resources of the country will be furthered by any and all who will assist in completing the list.

An Unobtrusive Strike

SINCE the beginning of the coal strike more than five weeks have elapsed. During that time the news of the strike has relinquished command of the first page and retired to a rear-rank position inside. The public has shown little interest. Indeed, the limiting factor in the production of those mines that are working is lack of demand rather than of capacity. Taking into account present production, possible increase under the spur of keener demand, and current drafts on consumers' stocks, another month probably will elapse before a shortage can be felt. Then will come the crisis in the current dispute. But further investigation has confirmed earlier diagnoses that the difficulties lie deeper than the issues now drawn and that the coal industry is seriously ill. Rumor has it that the President is to propose a solution of the problem. It is to be hoped that such a solution will be not merely balm for the present irritation but rather a thoroughgoing remedy that will attack the ailment at its source.

Do Designers Use Diagrams?

FOR some years this journal has discouraged the publication of diagrams for the design of reinforced-concrete beams. It has been observed that if a designer is of a certain type of mind he has some self-constructed curves which he insists on using to the exclusion of any other or if he is not diagram-minded, so to speak, he will not use any curves or tables whatsoever, no matter how cleverly they are constructed or how easily they can be used. Furthermore, if by any chance a concrete-beam diagram were published, the editors were immediately swamped with dozens of others of obvious superiority. Self defense alone indicated the aforementioned bar against designing diagrams. Of late, however, there has been a recrudescence of the concrete design curve and with them have come many authors who demand proof of the probable sorry fate of a diagram once published. They have been, some of them, quite insistent, so much so that we are led to make inquiry of concrete designers as follows: Do designers in general use diagrams for reinforced-concrete work; will they use those prepared by some one else; do they prefer comprehensive design tables or possibly simple tables plus extensive slide-rule work; is an all-embracing diagram preferable to a series of specialized curves?

Possibilities in Rural Engineering

RURAL engineering has come to mean a fairly definite thing. One bureau of the government at one time had the term in its name, and although the highway boom has now severed the titular tie, the work still goes on. Trade associations, too, dealing with engineering materials, have long recognized the market for their products on the farm and have devoted much of their professional literature thereto. There is, indeed, a society of agricultural engineers, with a publication and a fair-sized membership list. When all this is said, however, it remains that here is an attractive field that has not been properly tilled; there ought to be in our rural district openings for farm engineering practice which engineers, especially young engineers with the proper training and inclination, have been neglecting.

Farming and farmers need the engineer. No great amount of argument is required to prove that. From the problems of drainage and irrigation down to those of building design, house and barn sanitation, and machinery layout and selection, the overhead expenditures of the farm are all based on considerations essentially engineering in character. The farmer is the largest producer in the United States, yet even the casual observer in rural districts sees many examples of waste and loss resulting from the failure to apply the engineer's point of view in solving certain problems of farm operation and production. One might go even further and say that in large-scale farming under conditions common to the West the successful farmers are those who by natural bent or training use the engineer's method of approach in solving certain of their problems.

The difficulty is in persuading the farmer that he does need the engineer. He is, by hereditary usage and by environment, the most self-sufficient of men. Advice is the last thing he formerly paid for, especially if that advice was from what he considers a theoretical or non-practical source. More and more, though, the farmer is coming to look to outside sources of information. He is a great reader of farm papers. He consults machinery salesmen for type and size of equipment. He studies the government and trade-association bulletins. For such men the step to paid engineering service should be shorter than it would have been in the old days when the farm was isolated and the farmer too prone to depend on his own personal experience.

Here may be the opportunity for the engineer who is willing to study the field and accommodate himself to its peculiarities. A farm upbringing is almost a necessity; a wide acquaintance in and of the neighborhood is a requirement; a high and mighty detached air cannot succeed. The farm engineer must get down with his clients and work out their problems to the last detail, and a proper neglect of unnecessary theory should breed a respect that display of book learning or fancy practice would soon destroy. Land surveying might for a while at least be the backbone of such a practice and with it might come some business as township advisor on road, bridge and similar problems, for work with and for the farmer would develop slowly.

How Shall We Finance Our Highways?

ACCEPTED practice in highway financing runs strongly in the direction of short-term bond issues, and is based on the theory that the issues should be amortized in the "life" of the road. Now come the proponents of a theory, which starts from a basis fundamentally different and leads to the conclusion that 50-year bond issues are justified. These proponents, one of whom is Dr. Haig, who writes on the subject in this issue, lay down the premises that a road should never wear out. With their first stroke, therefore, they remove the whole basis of our present theorizing—namely, that roads *will* wear out, and that when worn out the bonds sold to construct them should have been paid off.

Obviously the advocates of the theory have had to write a new definition of "maintenance." They consider "maintenance" to include not merely the constant upkeep of surfacing but its rebuilding when necessary.

Under such maintenance a highway once built becomes a permanent improvement. It is then not unreasonable, say Dr. Haig and those who agree with him, to ask future generations to bear a share of the cost. In fact on purely theoretical grounds the bonds might never be amortized but each generation be asked to pay a rental on the improvement, in the shape of interest on a permanent bond issue. For practical reasons 50-year and not permanent bonds are advocated.

The advantages of the proposal are obvious. It would enable us to raise readily the sums necessary for extensive highway programs without unloading upon the present generation of general taxpayers, the heavy charge of amortizing highway securities in a 15 or 20-year period. The objections are that it increases the total cost of road improvement by spreading interest payments over a longer period of years and that it courts over-bonding. The larger interest charge, however, is probably more than offset by the savings in haulage due to earlier construction of improved roads.

The success of the theory in application would require the writing into the law of stringent requirements as to maintenance and a classification of re-surfacing as a maintenance charge. This accomplished, we believe that the issuance of 50-year bonds would be a defensible program, but, naturally, the total bonded indebtedness would have to be restricted to a definite proportion of the assessed valuation in order to keep within bounds of safe public financing.

As to the division of costs between the general taxpayer and the road user there will be, we believe, little dispute over Prof. Haig's suggestion. In fact, the same or closely similar proposals have been made before in engineering circles and have been well received. The vehicle user everywhere is willing to bear the maintenance cost, as usually understood, and will probably make no objection to the inclusion of re-surfacing as a maintenance charge. He will, we believe, also bear without protest the charges due to the excess cost incurred in building a highway up to the standards required by the motor. The proposal is reasonable.

All in all the theory as put together in Dr. Haig's article appeals to us as well considered. It raises question chiefly as to the advisability of piling up a large highway indebtedness. We instinctively dislike large public debts—and rightly so. Few of them have tangible assets. What will the public temper be when the permanent asset in road improvements is proved?

The whole theory deserves careful consideration and discussion from the standpoint of each interest affected —and chiefly from that of the public.

Construction Equipment Accounting

EQUIPMENT performance studies, fortified by cost accounting for individual machines, have been developed to practical purpose in conducting force-account water main extension in Detroit. As related in this issue, these means have accomplished improvements in the design and fabrication of trenching and pipe laying machines, in the materials of which they are built, and in the accessories which they require for efficient operation. By their use some degree of standardization has been attained as, for example, specialization in gas-engine power. Even broad principles of equipment design and construction have been formulated in a tentative way.

The practice of the Detroit water department engineers throws light on a path to improvement in plant management which has not been adequately opened up by construction engineers and contractors. As an owner and operator of construction plant, the department has considered it to be its duty to advance equipment engineering knowledge and standards. This is an obligation which the contractor, the operator for profit of construction plant, has not been eager to assume.

Aside from the efforts of a few individuals, the aid which contracting has given equipment engineering has been incidental. The Detroit water department engineers on the contrary have consciously planned to learn where improvements were possible and have specified these improvements in making purchases. The difference is vital, for it is the difference between scientific determination and accidental discovery. This is the lesson which contracting needs to learn.

Perhaps the first thing observed in examining the work at Detroit is that knowledge has not been gained by considering equipment in mass. It has been gained by considering machines individually in all the events of their field and shop life. With a number of types and patterns of each kind of machine, as for example trench excavators, in service, the relative merits of differences in detail were thus made capable of determination. At the same time individual defects or merits grouped according to kind, for all machines, led to a possible enumeration of general principles. It is in this way that the Detroit studies have been utilized to show on one hand the specific fact that the box-girder boom is best for trench excavation and on the other hand the general truth that cast-steel cut gears are worth their extra cost for all kinds of equipment.

A virtue of this method of individual machine-accounting is that it is equally applicable by the large plant owner and by the small contractor with one unit of major equipment. With the different accounting methods sufficiently explained, the records of a dozen machines operated by as many contractors are nearly as useful for generalization as are the records of a dozen machines operated by one contractor. The situation would obviously be improved by the use of a uniform system of accounting and here contracting organizations have a service to perform. They need to press the importance of equipment accounting and to provide them with means for keeping uniform accounts.

Mechanical Equipment for Detroit Water Main Extension

Day-Labor Organization—Machine Selection and Operation—Shop and Job Accounting—Standardized Power Units—Cost and Performance Records

FORCE account construction of water mains in Detroit, Mich., has approximated a hundred miles a year for a number of years. In 1920, 130 miles of mains were constructed. These mains range in size from 4 in. to 4 ft., but the greater number are 6 and 8 in. in size. To carry on these considerable construction operations the city has organized and equipped its forces elaborately. Machines are provided for trenching, handling pipes and back-filling and for many special shop and field operations. Altogether a construction plant exceeding that of any contractor doing pipe-laying work has been assembled. This equipment is kept in repair and new equipment is built in well outfitted department shops.

Department Organization—A chart of the organization of the department of water supply, Fig. 1, indicates clearly the leading place held by the division of distribution under which comes practically all engineering and construction except that occupied in developing the filtration works, which are not yet completed. The bureau of construction and of power machines and the bureau of repair, with its sections of shops and yards, are chiefly the ones which enter into the present consideration of force account water-main extension. Incidentally all water-main extension is not carried out by the department forces. During the last few years contract work has averaged probably 15 per cent of the total.

In general the organization for pipe-laying is simple. Each field operation is in charge of a foreman who receives his orders, and is furnished with his machine equipment and materials through the construction bureau in conjunction with the bureau of power machines. The foremen report daily to the construction bureau and a summation of these reports comes daily to the Division of Distribution in the form indicated in Fig. 2. A report of similar form is received from the contract operations. A complete record of the day's operations and the location of operations for the succeeding day are provided by the daily construction report. Further operations of accounting, handling requisitions, allotting supplies and equipment, etc., are clerical details ordinary in character except, perhaps, for the exactitude required.

It is in the application of mechanical equipment to pipe-laying and the management of this equipment that the kernel of distinction lies in the department's direction of force-account construction. Machine construction is employed whenever it is practicable. Pavement breaking, trench excavation, pumping, pipe handling and backfilling are performed by machines. So are supplementary operations such as stone crushing, concrete mixing, providing compressed air, pipe-cutting

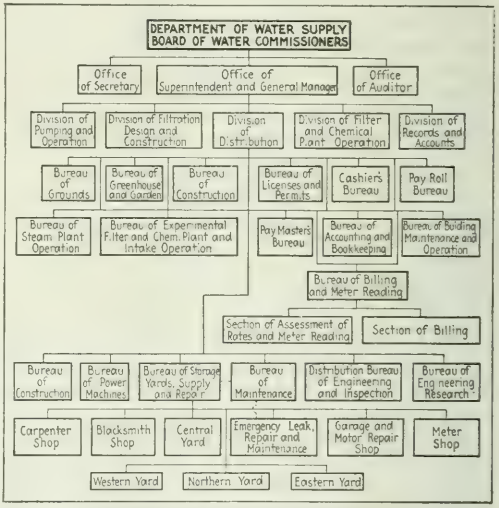


FIG. 1. ORGANIZATION CHART DEPARTMENT OF WATER SUPPLY, DETROIT, MICH.

and generating current for lighting the job. All machines are mobile, either self-propelling or mounted on wheels for hauling. In a large degree the power units are standardized. The machines are largely especially built or assembled to designs of the department engineers, or, where the standard designs of the manufacturers are employed, are altered in detail as by substituting steel for iron or cut gears for cast gears.

Pipe-Laying Equipment—Trench excavation is the

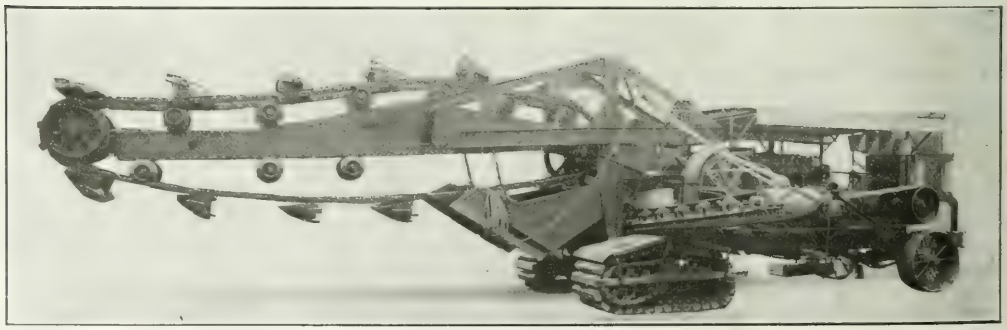


FIG. 3. CHAIN-BUCKET TRENCH EXCAVATOR
Latest type with box-boom, cut gears, multiple-cylinder gas engine, belt drive, screw hoist and oscillating crawler traction

THE BOARD OF WATER COMMISSIONERS OF THE CITY OF DETROIT

DAILY CONSTRUCTION REPORT

FIG. 2. DAILY CONSTRUCTION REPORT FORM
Original 16 x 14 in. filled out form, covering previous day's work, which is delivered to the construction division heads each morning.

big task of all pipelaying operations. In Detroit, the soil, generally a compact clay, lends itself well to machine trenching and a fleet of 10 trench excavators is operated. These machines date from 1917 to 1921, and, therefore include several styles. Except two wheel excavators, they are all of one make and of the chain bucket type. All, except one steam machine, are operated by multiple-cylinder gas engines. Trenches from 28 to 72 in. wide and from 8½ to 14 ft. deep are dug. Experience with these excavators indicates the following:

1. In Detroit soil, generally, as stated, a compact fine-grained clay, wheel machines give excellent service, but their use is limited by the shallow depth they can dig. The two Detroit machines dig 8½ ft. deep and are, it is believed, the deepest digging wheel excavators ever built.

2. In chain-bucket machines a box-girder boom, Fig. 3, is superior to the older double-channel type of boom. It is much stiffer and less likely to be distorted and to become loose.

3. Between screw hoists and cable hoists for the boom, the comparison may be stated as follows: With cable hoist, dependence is placed on the weight alone of the boom to force the buckets into the soil and in hard ground or frozen soil the digging cannot be crowded because the boom will lift. Where boulders or crossing pipes are encountered the cable hoist has the advantage that the boom will lift and ride over the obstruction. The screw hoist holds the boom down to the work and permits crowding in hard ground.

4. Gas-engine power is preferable to steam. The one steam machine, with a horizontal boiler, gives trouble due to the surging of the water which packs the frame unduly. A vertical boiler would be preferable. In any case, with steam machines the water haul is expensive unless a supply close to the machine is available.

5. The small sizes of chain-bucket machines lack frame rigidity and sufficient tread area to the crawler tractions.

6. Automobile type radiators, with fans, are

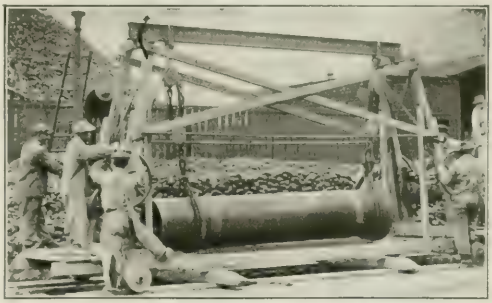


FIG. 4. PIPE-HANDLING GANTRY ON ROLLERS
Only pipe up to 30 in. is handled by these devices. For 36-in. to 48-in. pipe, valves and specials, locomotive cranes are altogether preferable.

superior to cooling tanks for gas-engine operated excavators.

7. Machine-cut gears add little to the cost and considerably increase the life of the excavator.

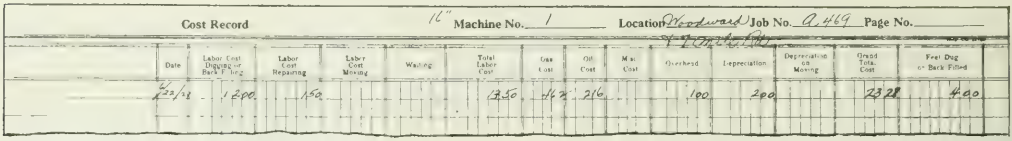
8. In crawler tractions, the oscillating type is superior to the rigid type because it reduces rack and tear of the machine.

Averages of trench excavation output, of the cost per foot of trench and of gasoline consumption do not signify much as these machines have to be operated to meet the conditions of pipe extension work. The jobs are numerous, only such output of trench is attempted as will keep the pipelaying steadily in progress, and the machines are of different styles, sizes and ages.

For handling large pipe, 36-in. to 48-in., locomotive cranes on crawler tractions have been found preferable to other machines. Three of these cranes are 3½ ton capacity for handling 36-in. pipe



FIG. 6. ASSEMBLING BAY OF MACHINE SHOP
Pavement cutter [illegible] assembled or in process of [illegible]

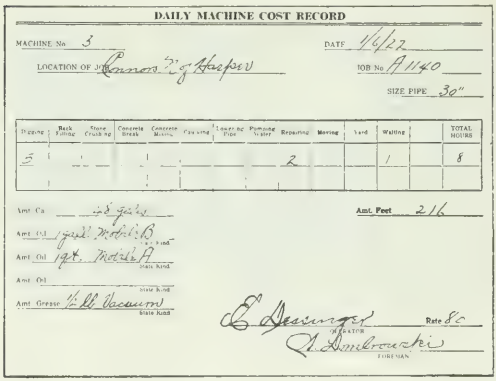

Cost Record 16" Machine No. 1 Location Woodward Job No. A 469 Page No.

Date	Labor Cost Digging or Back Filling	Labor Cost Repairing	Labor Cost Moving	Waiting	Total Labor Cost	Gas Cost	Oil Cost	Misc. Cost	Overhead	Depreciation	Depreciation on Moving	Grand Total Cost	Feet Dug or Back Filled
2/3/12	1200	150			1350	142	216		100	200		2328	400

FIG. 6. SUMMATION COST RECORD OF INDIVIDUAL MACHINES
Original 16 x 14 in. Includes all costs except materials which are entered on a separate ledger sheet.

and a fourth is a revolving steam shovel converted by removing the dipper and adding a block and hook. The converted shovel has a capacity of 5 tons and is employed to handle 42-in. and 48-in. pipe. The converted shovel and one crane have steam power and the two others are operated by gasoline engines.

These cranes are particularly interesting for their illustration of the practice of the department engineers in extending the usefulness and improving the construction of purchased equipment. As the result of experience with the first 3½-ton gasoline crane, which


DAILY MACHINE COST RECORD

MACHINE No. 3 DATE 1/6/12

LOCATION OF JOB Conner & Harper JOB No. A1140

SIZE PIPE 30"

Engine	Back Filling	Stone Crushing	Concrete Break	Concrete Mixing	Caulking	Lowering Pipe	Pumping Water	Repairing	Moving	Yard	Waiting		TOTAL HOURS
5								2			1		8

Amt. Ca ... Amt. Feet 216

Amt. Oil 1 gal. Mobil B (State Kind)

Amt. Oil 1 qt. Mobil A (State Kind)

Amt. Oil ... (State Kind)

Amt. Grease ½ lb. Vacuum (State Kind)

E. Deininger Rate 80
OPERATOR

A. Dombrowski
FOREMAN

FIG. 7. DAILY MACHINE COST RECORD

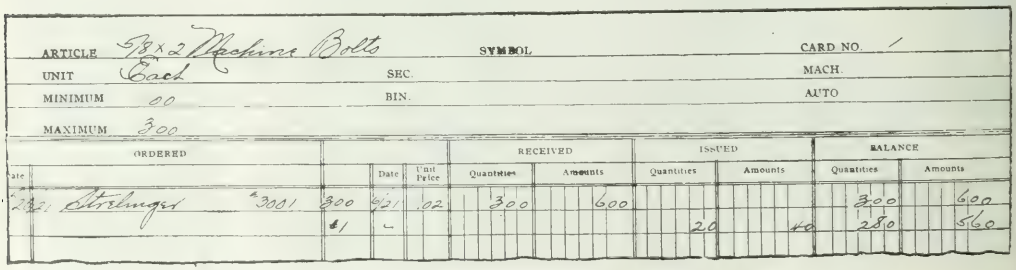
had a Buffalo engine and cast gears, the second 3½-ton crane was ordered equipped with an "Automatic" engine and built with machine-cut gears at an extra cost of $1,600. The experience of the department has been that the added cost of cut-steel gears is returned in longer life and less maintenance of almost any large and expensive piece of equipment.

In the case of the converted shovel the crawler traction treads which were wood blocks shod with steel, and had proved short-lived, were rebuilt, at the department shops, of cast steel. The cost was reduced and the life increased. This sort of reconstruction is regular practice, wherever weakness develops in purchased equipment. Additional outfit is also regularly installed wherever the machine can supply a supplementary service in connection with its major purpose. The two steam cranes are outfitted, for example, with vertical locomotive type air compressors and air receivers. These compressors give 90 cu.ft. of free air per minute for pipe caulking and other uses without bringing in a special compressor outfit and an additional operator. Practically all steam machines are outfitted with air pumps.

For more extensive uses of compressed air there are portable compressor outfits. These are hauled by motor trucks. The latest style has a four-cylinder automobile-type engine and has proved easier to keep in repair, and to put in operation and it causes less vibration than the older two-cylinder horizontal gas-engine outfits. Here it is noted that for all but small-size gas motors, the department has standardized on automobile-type engines. For small units standardization consists in using one make of engine. This uniformity has saved greatly in the expense of stocking repair parts and making repairs and replacements.

For smaller pipe handling operations, ordinary hand processes or gantry and winch outfits as indicated in Fig. 4, have been used. Backfilling, however, is again usually a machine process. Practice has settled definitely on boom machines with crawler tractions and two-cylinder gasoline engines of 12 to 15 hp. These heavier machines are more efficient, where the spoil bank is partly frozen or has set after long exposure. Maintenance on backfillers, in proportion to their cost, runs higher than on trench excavators and other equipment generally, which indicates the need of more sturdy manufacture.

Supplementary Equipment.—Supplementary to trenching, pipelaying and backfilling there are pavement cutting and repaving, pumping and the lighting of night work and underground operations. The department equipment includes pavement cutters, stone crushers, concrete mixers, pump and compressor outfits. In all these units a high degree of portability is sought. They are self-propelling or carriage-mounted and are kept down to reasonably small size. It is also the aim to


ARTICLE ⅝ x 2 Machine Bolts SYMBOL CARD NO. 1

UNIT Each SEC. MACH.

MINIMUM 00 BIN. AUTO

MAXIMUM 300

Date	ORDERED		Date	Unit Price	RECEIVED Quantities	RECEIVED Amounts	ISSUED Quantities	ISSUED Amounts	BALANCE Quantities	BALANCE Amounts
2/12	Strelinger #3001	300	6/11	.02	300	600			300	600
		#1					20	40	280	560

FIG. 8. PERPETUAL INVENTORY FORM
All machine supplies, replacement parts and repair materials are recorded on these blanks.

standardize on one-cylinder Novo engines or four-cylinder automobile type engines. So far as possible one-man operation is attained. These characteristics all fit in with the service of the machines, which is scattered and is not of long duration in any place.

Shops and Yard Service.—The success of force-account work with intensive use of labor-saving machines depends largely on perfect yard and shop service. In Detroit, materials and supplies are stored at three yards, as indicated by the organization chart, Fig. 1, which also indicates a projected future yard. At one of these yards are the machine shops. All have railway sidings, track-scales, and 15 or 20-ton locomotive cranes for unloading cars. The larger cranes will handle a 48 x 48-in. Y-casting which is about the heaviest piece used. Delivery from the yards to the work is by motor trucks; the department has standardized on 3-ton and 6-ton Packards.

Is is in its shop development, however, that the department's practice is more particularly distinctive. The shop is new, Fig. 5. It is large enough and well enough equipped with forges, hammers and machine tools to fabricate any part of any machine employed and to assemble at the same time several of the larger machines. This statement is important to bear in mind. The shops and their equipment are not the ordinary city department shops for making minor repairs and replacements; they are outfitted to fabricate construction machine parts or even complete machines capable of being produced from standard structural shapes, castings and forgings. Besides repairing equipment they produce, between repair jobs, various small forgings, etc., required by the department.

Precise shop records are kept on every piece of equipment. The items recorded include repair parts, supplies, shop labor, field labor operating the equipment, and daily output. For this purpose there is a complete system or order blanks, shop and field report blanks, ledger summation sheets, etc. A number of these, the extension of whose use to other cost recording systems is possible, are shown by Figs. 6, 7 and 8. The noteworthy idea is that there are a daily field cost record, Fig. 7, a repair part shop record and a summation cost record, Fig. 6, for every machine. This indicates a principal of equipment cost keeping which permits exact analysis of the service which every machine and every part of that machine gives in terms of useful work done. It is these studies which are enabling the department to standardize on types and sizes and to specify special construction of parts prone to wear or breakage.

Bascule Bridge Introduced in China

It is reported that the first bascule bridge in China is to be built over the Grand Canal in Tientsin in the near future. The bridge, which will have pagoda-like towers and ornaments typical of Chinese architecture, has been designed by the Strauss Bascule Bridge Co. of Chicago, and will have a total length of 280 ft. between abutments. It consists of a vertical-overhead-counterweight double-leaf span of 130 ft. flanked on each side by fixed spans of 75 ft. The traffic on the Grand Canal at Tientsin (or Pei Ho as it is known at this point) is very dense and the bascule type of bridge was decided upon in order to facilitate the movement of river traffic at this point.—*Journal of the Association of Chinese and American Engineers*, Peking, December, 1921.

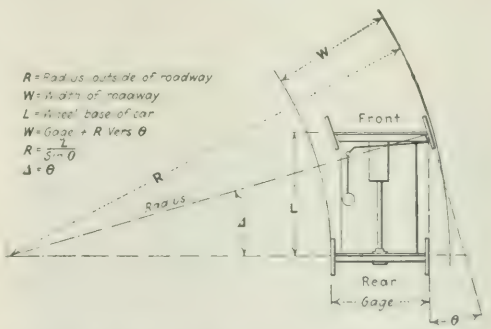
Should Highway Curves Contain Transition Spirals?

By Ernest L. Culbreth

Former Instructor in School of Engineering, Mississippi A. & M. College

From recently-published data on highway design the writer has found that most authorities reviewed have recommended simple or compound circular arcs for all roadway curves—an hypothesis that may be premature. It appears that the duty of the highway engineer is first to determine the nature and effect of the operation of vehicles upon highways and then, with consideration for safety and economy, recommend the design that most nearly satisfies the requirements. Following this thought, the present and growing popularity of automotive vehicles demands that the highways be designed entirely for their use; therefore study of the operations of automobiles is necessary in order to design properly.

In a recent design with which I am familiar the requirements permitted only curves of short radii.



PLAN FOR DETERMINING HIGHWAY CURVE FUNCTIONS

These curves were made simple circular arcs. The roadways were, of necessity, narrow. It was a great surprise to find that automobiles did not follow these arcs but formed curves sharp at the center and flattening into straight lines at the tangents or at points of reverse curvature. Upon investigation the tracks were found to form spiral transitional curves. I have measured a number of automobile tracks and, finding them to be spirals, have sought the reason in the mechanical operation of the vehicles.

In the sketch herewith the angle θ is the angle formed by the front wheels of an automobile and the chassis and is equal to the central angle Δ. Then it may be seen that when θ is increased from 0 to any value by the will of the driver, angle Δ will change with it and at all times be equal to it. The radius R of the curve at any position equals sin θ divided by the wheelbase of the car. θ is a variable and so is R. The wheelbase is constant for any given car.

In view of these facts it can readily be seen that the driver would be compelled to stop on the tangent at the point of curvature and turn the steering wheel enough to orient the car on the same radius at the curve were he to follow circular arcs. After he had driven around the curve he would have to stop and orient it on the forward tangent. However, in practice the driver on approaching a curve simply continues to turn the steer-

ing wheel till the car is oriented on the curve and reverses the operation at the forward tangent. Thus angle θ is a variable, increasing from 0 on the first tangent to the value required for the circular arc, and decreasing at the end of this arc to 0 on the forward tangent. It is clear that the increase and decrease of angle θ is regular, therefore the curve formed is a transition spiral.

A good reason why highway curves should be joined to tangents by spirals is, that to prevent unequal distribution of the weight of the car on the wheels, lateral skidding and possible overturning as a result of the centrifugal force acquired, it is necessary to superelevate the outside of the roadway on a curve. To prevent torsion in the chassis and shock to passengers this superelevation should be obtained by regularity of increase from the tangent to the required value at the circular arc of the curve.

From about fifty actual tracks measured, it was found that short curves having a central angle of 90 deg. or less were simply two spirals having a common tangent at the middle. Those having a larger central angle, and long curves generally, contained a circular arc in the middle and differed from the typical railroad curve only in the length of spiral which was found to be much shorter and of nearer constant length. The speed of the cars making a number of the tracks measured could not be ascertained.

The spiral length that appears to meet the demands of the driver differs from the following railroad spiral length

$$L = \frac{2D}{\left(\frac{60}{V}\right)^3}$$

and from the highway curves measured we get an approximate formula something like this:

$$L = \frac{3D}{\left(\frac{60}{V}\right)^3 121 D}$$

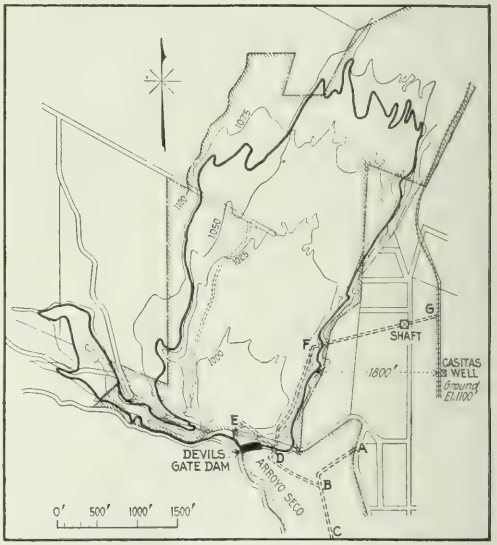
in which L equals length of spiral in 100-ft. stations, D the degree of curve of circular arc, and V the velocity of the machine in miles per hour. Having found the length we may proceed as in railway work.

For any point the width of required roadway is equal to the gage of the car plus the wheel base multiplied by the sin θ. Due to the dragging action of the car this extra width should in all cases be on the inside of the curve.

Flood-Control Dam Replenishes Underground Water Source

Results of Two Seasons' Experience with Devil's Gate Dam at Pasadena—Flood and Water Storage Functions Conflict

DEVIL'S GATE DAM, completed in September 1920, in the Arroyo Seco near Pasadena, Cal., was built by the Los Angeles County flood-control district as a control measure. To serve its primary function, the reservoir is being kept empty, or nearly so, during the season of the year when heavy runoff occurs. This, unfortunately, keeps, down the water level in the reservoir at a time when water is available for distribution into the gravel beds adjoining. However, on the occasions when the reservoir has held large volumes of water there has been opportunity to observe the effect on these underground gravel beds. The con-



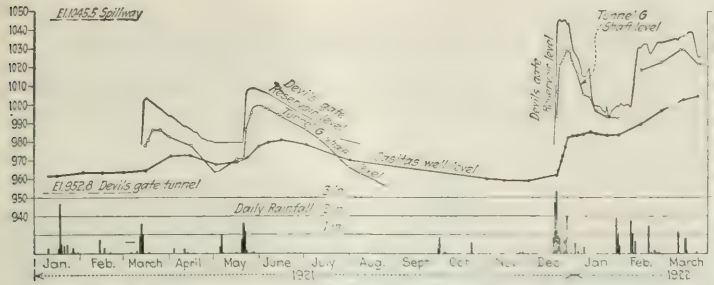
WATER INFILTRATION GALLERIES NEAR RESERVOIR

The galleries or tunnels indicated by letters A to G are on a 1 to 1,000 grade, 165 ft. below the mesa surface at their upper ends. To increase their yield a submerged dam was built some years ago below the end of tunnel E and just above the present Devil's Gate dam.



RESERVOIR FORMED BY DEVIL'S GATE DAM

Porous bank at right through which water passes to tunnels. Old bridge to be removed.



RELATION OF WATER LEVELS IN RESERVOIR TUNNEL G AND CASITAS WELL.
The water levels in the tunnel and wells fluctuate with the depth of water in the reservoir.

clusions are that accumulations of water in the reservoir are of direct and very material benefit in replenishing and sustaining the dry season's supply in the underground sources.

The dam is an arched structure 120 ft. high, located in a narrow gorge where the stream passes through a gap in a granite spur extending from the range of hills on the west into the alluvial mesa on the east. The construction of the dam was described in *Engineering News-Record*, July 29, 1920, p. 202. The drainage basin includes an area of 30.5 sq.mi. of which only 3.5 sq.mi. are table land or mesa and the remainder is in the precipitous Sierra Madre. During the flood of 1914 the Arroyo Seco carried a maximum flow of 11,400 sec.-ft. The highest flow since the completion of the dam occurred in December, 1921, and carried about 2,300 sec.-ft. or 21 per cent of the 1914 flood. The reservoir has a capacity of 4,600 acre-ft., covering 154 acres at spillway level.

For a considerable distance along the east rim of the Arroyo above the dam the mesa has an average height of 40 ft. above the stream bed and slopes gently away from the Arroyo to the south and east. This mesa is the debris cone consisting largely of porous material which was formed by the stream flow from the same watershed. After the formation of the cone the present channel of the stream was apparently cut through to a lower level. Water from the present channel seeps rapidly into the porous material and percolates in a southeasterly direction, supplying the underground storage known as the Pasadena water basin from which many pumping plants extract water for Pasadena, South Pasadena, Alhambra and San Gabriel.

In the mesa close to the southeast corner of the present reservoir the city of Pasadena some years ago constructed about a mile of water infiltration tunnels or galleries to collect seepage water from the basin and convey it to points where it could be used conveniently. These tunnels (see map) are 4 x 6 ft. in cross-section and are lined with concrete except in the portions through solid rock. Water seeping into the tunnels is retained by concrete bulkheads at their lower ends, into which pipes are tapped and from which the flow is controlled by valves.

On March 14, 1921, after a heavy rain, water collected in the reservoir to a maximum depth of 15 ft. At that time 600 acre-ft. of water was estimated to have been in the reservoir. On March 15 the water suddenly rose about a foot. It continued to subside for the next ten or twelve days at about the same rate, passing entirely into the adjoining gravel beds and mesa land tapped by the tunnels. A second rainstorm, May 21-24, stored about 825 acre-ft. of water in the reservoir in addition to the amount collected in the previous runoff. This second accumulation brought the height of the water to 52 ft. on May 27.

The rains of last December caused a runoff exceeding any that had occurred since the completion of the dam and afforded a practical demonstration of its flood protective value, as well as an opportunity to observe the effect on the underground water storage.

An accurate record of the amount of water flowing from the collecting tunnels and particularly the water level in Casitas Well, and in the shaft in tunnel G, kept by S. B. Morris, chief engineer of the Pasadena Water Department, shows a very definite relation between the reservoir water level and the rate of percolation. The history of rainfall, reservoir level and percolation is given in the accompanying chart prepared by Mr. Morris.



DEVIL'S GATE DAM WITH RESERVOIR FULL
Built for flood control. While serving this function the reservoir increases Pasadena's underground water supply.

The rate of percolation has been found to be greatest when the water is at maximum height in the reservoir and to vary in inverse proportion to the water level, i. e., the rate of percolation is much slower as the head diminishes. The loss due to evaporation is considered negligible at the time of year when the floods occur.

The arrival of any substantial flood in the reservoir causes an almost immediate effect in the collecting tunnels. After the floods of March 13-14 and May 21-24, the use of water from the Pasadena water tunnels had to be discontinued for five days because for that period the turbidity was too high for domestic use. Bacterial counts, Mr. Morris states, show that the water passes through the banks of the reservoir with very little effect of filtration, the bacterial count going as high as 2,000 per c.c., immediately following flood, as compared with the normal count with no water in the reservoir of about 5 to 10 per c.c.

Central Repair Shop for Philadelphia Water-Works

Units Heretofore Scattered Over City Brought Together—Machine, Blacksmith, Tinsmith, Carpenter, Pattern, Foundry and Auto-Repair Departments—Maintenance Headquarters and Storage Shed Adjacent

By John M. Broggini
Chief Draftsman, Bureau of Water, Philadelphia, Pa.

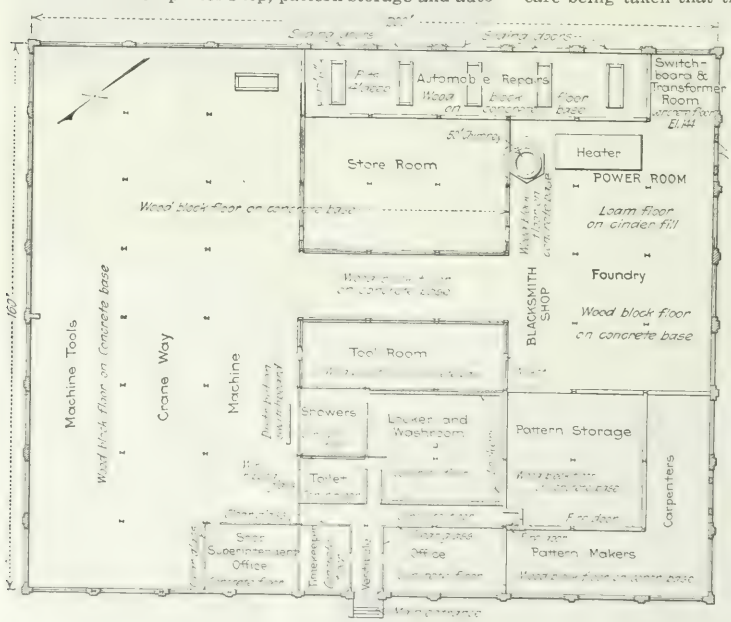
ONE general repair shop just completed for the Philadelphia Bureau of Water was decided upon because the large repair equipment otherwise needed at many plants would be almost prohibitive in initial cost and maintenance. Heretofore the units that now comprise the general repair shop were not only inadequate but were so located as to make the various steps necessary for hauling, repairing, etc., a serious problem. The routing of orders through many hands was necessary. With a single shop the overhead will be cut to a minimum and will be far more direct and efficient than before. The new central shop, which is 160 x 200 ft. in plan, is located close by a 100 x 280-ft. headquarters building and a storage shed 40 x 230 ft. in plan, both of which are now under contract. The group will make a compact maintenance unit. This article will be confined to the new shop.



FRONT VIEW OF GENERAL REPAIR SHOPS

The building is of strictly fireproof construction—brick and steel with terra cotta trimming. For the safety of the materials stored, a sprinkler system was installed in the carpenter shop, pattern storage and automobile repair shop. As the building has a ground floor only it covers an area of 32,000 sq.ft. Due to the large roof area the deck material was carefully considered as it was desirable to keep the steel tonnage as low as possible and still have a permanent and fireproof construction. Gypsum roof tile was used, which besides being light and fireproof is an efficient insulator.

The repair shop is subdivided into the following departments: Machine, blacksmith, tinsmith, carpenter, pattern, auto repair and foundry. The convenience of the layout may be seen in the accompanying plan. As access to any part of the shop by truck is through two gates only, all deliveries are controlled from the clerk's office, located just inside the main entrance. Delivery of heavy materials is facilitated by the trucks being able to drive under the crane runway which is equipped with a 10-ton three-motor electric traveling crane. To facilitate heavy deliveries, the machine tools are grouped according to their operation—lathes in the turning group, planers in the planing group—particular care being taken that the large machines of each group were placed under the crane-way so that heavy work could be handled with ease.



PLAN OF CENTRAL REPAIR SHOP, PHILADELPHIA BUREAU OF WATER
A one-story building 160 x 200 ft. in plan concentrates the repairs for a water-works system of many units serving a large area.

Consideration was given individual drive in cases where the machines were large, and daily use probable. Group drive was selected in the majority of cases, but with division into small groups, as, unlike a production shop, the kind and quantity of work is more or less uncertain. Motors were used in both individual and group drives. One very noticeable feature of the shafting layout is that no wood footing pieces are used. The hangers are bolted directly to the channel stringers, with adjustment bearing set screws.

The blacksmith equipment at the other end of the building consists of an 100-lb. and a 600-lb. electric-driven hammer, four 40-in. forges, one 50-in. forge and a billet furnace. The electric hammers were kept as far away as practicable from the foundry to prevent vibration of the molds.

The large forge, both hammers and the billet furnace are located near each other, a hand-operated jib crane being provided to lift material from one to the other.

The foundry is planned to take care of small casting work of which there is considerable. Equipment for large work seemed impracticable due to the uncertainty as to its being needed. A small core oven, pit



BLACKSMITH SHOP, WARM AIR FURNACES IN REAR

crucible furnace and two melting pots are provided. To handle the crucible from the furnace to the moulding floor, a monorail hand-operated hoist and crane, supported overhead on beams connected to building columns and pilasters, was installed.

The forges, furnaces, core oven and melting pots are all oil fired by a low-pressure system. The oil is stored in a 12,000-gal. tank in a pit outside the building. A pump lifts the oil to an auxiliary tank of 250-gal. capacity provided with a float switch which automatically controls the supply to the units. In view of the fact that heavy crude oil of 16 to 14 deg. Baumé is to be used, steam lines and coils were placed inside the oil lines and in both tanks, thus insuring a greater reliability of operation. Air is supplied through galvanized-iron piping by a direct-connected motor-driven fan blower. All oil and air lines were run in underground concrete ducts covered over with plates. The system was designed for an oil pressure of 20-lb. per sq.in. and an air pressure of 12 oz. per sq.in. at the burners when operated at a maximum capacity.

Both store and tool rooms are centrally located in relation to all departments. They are equipped with modern steel racks and bins permitting the storing of a great variety of tools and spare parts, and with machines for their adjustment and care of the tools.

In the rear of the building is an automobile repair shop with five work pits for passenger machines and small trucks and one for large trucks. Access to this shop is through large sliding doors from the court. Automobiles may come in or leave any bay without disturbing others that are being repaired.

The carpenter shop and pattern storage room are separated from the remainder of the building by fire walls and doors. The wood-working machinery is such that the lumber to be used for the various purposes can be handled from the rough, thus permitting advantageous buying of market sizes.

The current for power and lighting is bought from a local electric company but a chimney of ample capacity has been provided so that a power plant can be installed at any time. Due to the numerous lines necessary, all conduits, except lighting circuits from the individual panel boxes, are concealed in the concrete subfloors. Receptacles for small electric hand tools are provided at frequent intervals. With the fact in view that on many occasions it would be necessary to work at night, the lighting was arranged in small circuits so that only one particular part around the machines needed could be lighted. In addition to the general lighting, each machine tool is equipped with an individual lamp for close work, which may be shifted to light any part of the machine.

In laying out the plumbing, a sanitary base was provided around all toilets, showers and washrooms, and the fixtures were placed in the center of their respective rooms, thus avoiding any contact with the walls and partitions. Light and ventilation is provided by the roof.

To heat this large building hot air was chosen. Heating with steam would have required 10,000 sq.ft. of cast-iron radiation, which, with all the other equipment, would have meant a very large expenditure. As the foundry is not separated from other parts of the shop, steam rising from the moulds when pouring off, as well as the smoke and noxious gases, were also to be considered. Although roof ventilation was provided, most of these gases are heavier than air and lie near the floor and are not affected by the roof vents. Further, instead of removing the steam, roof vents would only accelerate the annoyance from it, as the warm air which escapes must be supplanted by the outside air, and this not being properly heated chills the air within the building, thus reducing its capacity to carry moisture and causing greater precipitation. A blower warm air furnace heating system was decided on, with overhead galvanized-iron ducts as a means of distribution. The heated air is discharged where most needed. When ventilation is required this system affords a positive



LARGE MACHINE TOOLS CONVENIENT TO CRANE

means of accomplishing this particularly desirable result, which is independent of the changing climatic conditions.

The plant described in this article was designed under the direction of Carleton E. Davis, chief of the Bureau of Water.

Western Logging Companies Own Railroads

At the 1921 Pacific Logging Congress, the secretary's report contained the following figures as to the mileage of logging railroads and the kind and amount of railroad equipment employed by Western logging companies: logging trucks, 8,362; flat-cars, 4,039; steam shovels, 101; locomotive cranes, 62; geared locomotives, 725; direct connected locomotives, 240; logging railroad mileage, 5,240.

CO_2, Odor and Iron Removal at Virginia Beach, Va.

Water from Wells in Marsh Land Aerated, Treated with Milk of Lime and Chloride of Lime Settled and Filtered

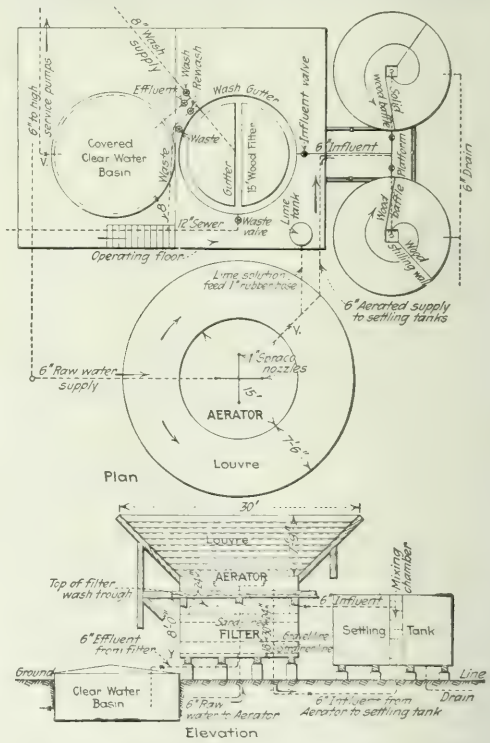
Official Summary of a Report by the Engineering Division of the Virginia State Board of Health—Richard Messer, Chief Engineer, A. Wagner and Linn H. Enslow, Assistant Engineers, Richmond, Va.

VIRGINIA BEACH, a sea-side summer resort on the Atlantic Shores of Virginia, is an incorporated town with a resident population of 900 and a transient population of 10,000 to 12,000 which is rapidly increasing year by year. Its water supply has always been its poorest asset in that it has been objectionable on account of odors and iron content. These objectionable qualities have apparently been on a continuous increase, being worse in summer than in winter, until during recent summers the water has been used only for bathing, sprinkling and automobile washing. Water for laundry and kitchen uses has been gathered by cisterns, while table water has been purchased from commercial water bottling establishments. The town having tried to remedy the situation in the past through treating the raw water with lime and then passing it through a pressure filter without success had abandoned the plan and was using the untreated raw water. The authorities were pursuaded by the Division of Engineering of the Virginia State Board of Health to build an aeration-filtration plant, assurance being given that considerable improvement to the supply would result. Construction was started in the spring of 1921 and the plant placed in operation in the summer of the same year. Because of the unusual CO_2, iron and odor content of the raw water used and the satisfactory plant efficiency obtained, it was thought that the following information might serve to clear the minds of many as to what may be expected during treatment of waters of similar quality.

Source and Character of Supply—The supply is taken from 31 driven wells in an old marsh area. These wells are 2 in. in diameter and 20 ft. deep, the strata penetrated being 12 ft. of clay, then a 2-in. layer of "hard pan" of high iron content and finally 8 ft. of fine white sand. During the past few years, the tap water has been impregnated with an intense odor caused by the decomposition of nitrogenous animal tissue in the pipe system. The odor was especially noticeable at hot water spigots. Frequent blowing off of mains was necessary. In brief, the water was unsatisfactory for laundry and culinary purposes. The town had been anxious for some time to obtain a satisfactory supply, but not until 1920 could a method of financing it be worked out.

After an investigation by this Division, including chemical analysis of the water at various points in the system, recommendations outlining a treatment plant were made to the authorities. The City of Norfolk was at the time replacing its wood-tub filter plant with concrete units. The Town of Virginia Beach was offered, free of charge, any parts of the discarded plant which might be suitable for the erection of the contemplated iron removal plant. This offer was accepted and the plant built.

Aerator and Chemical Treatment—From the wells the water is forced by a gasoline-engine-driven duplex pump through four "Spraco" nozzles inside of a shallow elevated tank, the nozzle pressure being 6 lb. Around the top of the tank is a louvre fence forming a "saucer" or "bowl" that catches the dropping spray and allows a circulation of air between the spacings in the fence. From the tank the aerated water descends by gravity to the mixing chambers within the settling tanks. A mixture of milk of lime and chloride of lime solution is fed by gravity near the entrance to the mixing chambers. The lime dose is regulated so as to remove the last traces of CO_2. A trace of phenolphthalein alkalinity (normal carbonate) is maintained in the settled water. Chloride of lime serves a triple rôle and a trace of available chlorine is maintained in the settled water. The chlorine serves as an oxidizer of any reducing compounds or ferrous iron that may escape oxidization during aeration. It oxidizes organic compounds, reducing odors and at the same time maintains a sterile water through the plant.



PLANT FOR REMOVING CO_2, ODOR AND IRON FROM WELL WATER AT VIRGINIA BEACH, VA.

Raw water passes through spray nozzle aerator where it receives lime treatment. Goes thence to mixing and settling tanks, then to filter and finally to covered clear water basin.

Mixing Chamber and Settling Tanks—At the center bottom of the two circular wooden settling tanks (in parallel) and extending to the flow line is a box mixing chamber. Treated water entering at the bottom passes upward around the horizontal baffles in the mixing box and is distributed at the water level in the tanks. A solid partition in the tank causes the flow to take a

course of 360 deg. to the opposite side of this baffle wall where it leaves to enter the filter tub. The distribution of flow is made uniform by a stilling wall of 1 x 10-in. boards with 1-in. spacing. The stilling wall is 120 deg. from the influent side of the baffle and 240 deg. from the effluent side. Though the water enters the tanks at the surface, because it is always colder than the water in the tanks it has a tendency to take a downward course, mixing with the underlying water. The stilling wall, however, causes a very satisfactory uniformity of tank displacement with no short-circuiting, surface currents or under-currents.

The Filter—This is an ordinary wood tub-filter with the rakes removed and a bisecting gutter placed across the center to reduce the longitudinal distance between edges of wash troughs. Virginia Beach (local) sand was employed. The effective size is about 0.4 m.m. and the uniformity coefficient 1.5. The rate is set by hand

RESULTS OF WATER TREATMENT AT VIRGINIA BEACH

(Parts per 1,000,000)

(1) Aeration—No Lime Added—Chloride of Lime, Settled and Filtered.

	CO_2	Iron	Carbonate Alkalinity	Total Alkalinity	Odor
Raw	125	2.2			Putrid
Aerated	20	1.4			None
Settled	19	1.1*			None
Filtered	15	0.05			None
Service Tap	...	0.15			None

(2) Aeration—Lime and Chloride of Lime—Settled and Filtered

Raw	100	2.1	0	80	Putrid
Aerated	10	1.7	0	80	None
Mixed	0		6	94	None
Settled	0	0.40*	3	92	None
Filtered	0	trace	trace	90	None
Service Tap	2	trace	0	..	None

*Iron in settled water present as hydrate.

(3) Per Cent Removal: Chloride of Lime but no Hydrate of Lime

By aeration	84	....
By settling tank	0	50
By filter	4	48
Total	88	98

(4) Per Cent Removal: Treating 12,000 Gal. per Hr. with 0.3 lb. Chloride of Lime and 1 lb. Hydrated Lime

(Available chlorine dose = 0.9 p.p.m. Lime = 0.85 grains per gal.)

By aerator	90	
By lime	100	
By settling tank	...	81
By filter	...	18
Total	100	99

control and since the raw water pump cannot supply water in excess of the sanitary rating the operator holds the size of the effluent stream to correspond as nearly as possible to the raw water pumpage. This, with a little experience, offers no particular difficulty. The filter is washed from the elevated service tank at the plant. Control of wash water is regulated by observing a pressure gage on the wash line. The rate of wash is a rise of 18 in. per minute with 9 lb. pressure on the manifold. With the sand level 20 in. below the top of the gutters, this rate is very satisfactory. An additional sewer outlet had to be put in the filter to take off this volume of wash water, however.

Clear Water Tank—This consists of an old filter tub buried in the ground for three-fourths of its depth and covered with tight cover and composition roofing.

Plant Efficiency—The average results obtained through the plant under different conditions are shown by the accompanying table. It is apparent that the iron is just as effectively removed by the plant as a whole where lime is omitted as where it is used. In such case, however, a greater load is placed on the filter and a higher percentage of wash water is required.

The OH ions combining with the ferrous or ferric carbonate tends to form a larger and more feathery floc, which is ready for prompt settling upon emergence from the mixing chamber box. Such a floc, possessing a greater absorption quality and a tendency to more pronounced settling, removes a greater portion of dissolved organic and finely divided matters in suspension during retention in the settling tanks than is the case where lime is omitted. The portion of floc which flows onto the filter forms a highly satisfactory "blanket" which is more gelatinous and has less tendency to be sucked into the sand surface than when lime is omitted.

The greatest value from lime addition, however, is found in the carbon dioxide removal. When lime is omitted the filter builds up loss of head rapidly and finally becomes air-bound. With an increase of a CO_2 atmosphere under pressure in the filter, however, the CO_2 content gradually increases in the filter effluent. This is very undesirable in that under such conditions the water is increased in "aggressiveness" with attendant corrosion of mains and an objectionable iron content returned to the water before it reaches the consumer. As a general rule therefore it was decided to add lime at all times to the aerated water and maintain thereby in the settled water a CO_2 content of less than 2 p.p.m.

Bacteria Removal—Bacteria removal was not the end sought. The wells are so located as to be practically free of any danger of pollution. Due to the fact that these wells were being drawn on at a heavy rate, and also realizing the attendant pollution around construction jobs, it was thought advisable to add the chloride of lime. It later developed that this was warranted as some seepage was discovered entering the wood tub clear well before the swelling of the staves had made it entirely tight. Although the raw water has never shown B. Coli present, samples from the aerator and other points through the plant showed B. Coli present when, during the tuning up of the plant, the chlorine dose was allowed to become somewhat lower than desired and again when through accident some of the sludge in the settling tank was disturbed and became mixed with the supernatant water. All samples examined since July 26, 1921, show absence of B. Coli in raw and treated water, with the total count at the service tap varying between 5 and 50 per c.c. on agar at 37½ deg. As the chlorine aids in iron and odor removal the treatment is kept up.

Effect of Improved Supply on the Consumers—Since August, 1921, the improved supply has been universally used, replacing the necessity of using cisterns as laundry water supplies and bottled spring waters for the table. No complaint has been heard of further objectionable colors or odors at the hot water services.

The investigation, preliminary designs for plant and chemical tests were made by Messrs. Wagner and Enslow and the installation by William H. Taylor, Jr., director of public works, Norfolk, and his assistant, David A. Decker.

U. S. Topographical Survey Not Yet Half Done

In summarizing the work of the Interior Department between Mar. 4, 1921 and Mar. 4, 1922, Secretary Fall reports that during that period the Geological Survey covered 14,000 sq. mi. with surveys for the topographic map of the United States. This work has been in progress for forty years and if it is to be completed within the present generation, Secretary Fall declares that the survey must have sufficient funds to cover several times this area annually. At present it is less than half done.

Operation and Tuning up of the Cleveland Filters

Comparative Uniformity of Results Obtained for Four Years—New Effluent Pipes—Baffling Reduced 75 Per Cent—Chemical Apparatus Revamped

By J. W. Ellms
Engineer of Water Purification, Water Department, Cleveland, Ohio

During the strenuous tuning-up period of the Cleveland water-filtration plant a remarkably even average set of results was obtained. The major changes made, aside from the reconstruction of the filtered-water basin in 1917, consisted in materially reducing the number of baffles in the mixers, discarding certain of the lime-handling machinery, installing a dust filter for reducing the lime-dust nuisance when unloading cars and substituting water ejectors for motor-driven pumps for feeding the various chemical solutions. On account of foundation difficulties, which caused serious settlements in various parts of the plant, portions of the plant could not be operated. It was for this reason that new effluent pipes were built to replace the original galleries and conduits provided. Practically speaking,



INTERIOR OF ONE WING OF FILTER HOUSE
Filter operating stands are shown on either hand.

operation did not begin until April 1, 1918, awaiting the reconstruction of the filtered water basin. A few filters were operated as early as Nov. 1, 1917. A brief description of the plant is here given, followed by operating results for four years and by brief mention of the early difficulties and changes. The original layout was described in *Engineering News*, Oct. 19, 1916, p. 732.

The plant, located on Division Ave. adjoining the pumping station at the intersection of this avenue and W. 45th St., was constructed in 1914-16. It is of the rapid-filter type and was built with the idea of softening the water, as well as purifying it from a sanitary standpoint. On account of unforeseen difficulties, it has not yet been possible to carry out the softening process. The filtration processes have, however, been conducted practically as was originally intended. The nominal capacity of the plant is 150 m.g.d., but as it is not possible to operate it in its entirety at present, its approximate actual capacity is 130,000,000 gal. daily.

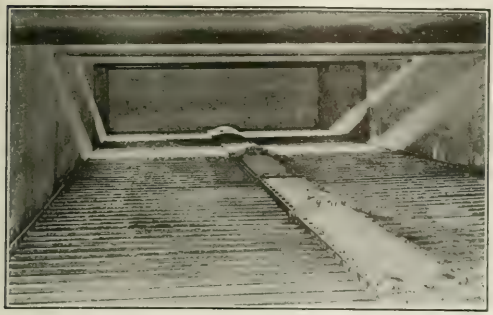
General Design and Operation Procedure—The raw lake water, lifted by the low-service steam turbine-driven centrifugal pumps in the pumping station just west of the filtration plant, flows through a riveted-steel pipe line 72 in. in diameter directly to the mixing chambers. This pipe line passes through the chemical house. In the pipe line is a Venturi meter which measures the rate of discharge, and which furnishes the necessary data for estimating the amount of chemicals to be applied. The prepared chemical solutions are pumped or ejected into the raw water in this 72-in. pipe line as it passes through the chemical-house building.

The chemical house contains large concrete storage bins, crushing and elevating machinery, weighing machines for measuring out the chemicals, slaking tanks and storage solution tanks for the lime solution, and storage tanks for the sulphate of iron, together with the necessary pumps, ejectors, heaters and ventilating fans for properly preparing the chemical solutions and for injecting them into the water.

Mixing Chambers—In the mixing chambers, where the water at the rated capacity of the plant as designed remains for 0.6 hr. and moves forward at the rate of 60 ft. per minute, the thorough mixing of the raw water with the chemicals applied is effected. These chambers are of the over-and-under baffle type and are built in four sections, each having six channels. Each section has been made entirely independent of adjoining sections by replacing the original wooden stop-planks with concrete cut-off walls. Owing to the excessive loss of head which would have resulted in attempting to use the channels fully baffled, it was necessary to remove 108 of the 144 over-and-under wooden baffles originally installed. Plugs were also provided for the underdrain openings, and relief pressure gates in the channel walls were fastened in place. The present travel at full capacity is 20 ft. per minute, against 60 ft. as originally planned. The loss of head at present is less than 3 ft. when operation is at the rated capacity. It was impossible to operate the mixing chambers with all the baffles in place as originally designed, and, in consequence, it is not known what the original loss of head would have been.

Settling Basins—From the covered mixing chambers the water passes out through an effluent conduit to the six settling basins located between the mixing chambers and the filter-tank building. Each basin is 227 ft. long, 141 ft. wide and 20 ft. deep. Two around-the-end baffles divide each basin into three parts. The water leaves each basin over a skimming weir through a channel connected by pipe lines with the main effluent conduit. This conduit extends along the north ends of the six basins, and is connected by four pipe lines with the main influent pipe line in the pipe gallery between the filter tanks in the filter building. Only five of the six basins are used; the remaining basin will probably require reconstruction before it can be used with safety.

Filter Tanks and Accessories—Each of the 36 filter tanks is supplied through a separate pipe line. The filter tanks, which are rectangular in shape, have a capacity of 4½ m.g.d. when operated at the usual rate of 125 m.g.d. per acre. All filter valves are operated by hydraulic pressure. A Venturi type of rate controller is used. A master rate controller has been provided so



PERFORATED-PIPE MANIFOLD IN 4 M.G.D. UNIT
Collecting and reverse flow wash pipes lead to central conduit.

that the filters may be operated at a variable rate if desired. The usual loss-of-head and rate-of-flow gages are provided. The perforated-pipe underdrain system is covered by about 22 in. of gravel and 27 in. of sand. The tanks are covered for about three-fourths of their length, but the operator is able to see the entire length of the water surface from the operating table by means of lights placed in the roof of the tank. The lateral gutters are U-shaped and are made of steel plate, but the central collecting gutter is of reinforced concrete. The filters are washed by the "high-velocity" method.

Clear Water Basins and Conduits—The filtered water is conveyed away from the plant by two effluent pipe lines, each serving 18 filters. These pipe lines connect with the filtered-water basin through a twin concrete conduit. The filtered water basin holds approximately 20 m.g.d. and is located on the west side of the plant beyond the Division Ave. pumping station. From this reservoir the water flows by gravity through two 60-in. cast-iron pipe lines to the suction header of the high-service distribution pumps in the pumping station. The filtered water is disinfected with chlorine at its entrance to the filtered water basin in a gate chamber on the north side of the basin.

Operation and Analytical Data—The most striking feature of the results of operation and analytical data is their general uniformity, which is due largely to the rather even quality of Lake Erie water for the larger portion of the year. However, averages are somewhat misleading when they cover such long periods of time. The Lake water is, in reality, subject at times to sudden pollution, arising chiefly from high winds and storms that carry the polluted water from the mouth of the Cuyahoga River and the outfalls of the large sewers to the intakes. Fortunately, these periods of pollution are usually comparatively short, the water returning rather quickly to its usual uniform quality. The filter plant serves as an effective barrier to this sudden influx of polluted water.

Diatoms and Algae—For the larger part of the year the water of the lake is infested with diatoms and algae. These organisms have a marked effect upon operating conditions, principally in shortening the periods of service of the filters during the spring and summer months. Diatoms are apparently more effective in clogging the filter beds than the algae proper. No real remedy has been found to meet this trouble, since "breaking" of the filters with the coarse sand (effective size 0.45 to 0.50 m.m.) now in the filter beds has not proved satisfactory.

TABLE I. PRINCIPAL OPERATION DATA FOR 1918-21

	1918*	1919	1920	1921
Quantities of Water in Millions Gallons				
Treated	22,880	31,576	30,170	30,955
Filtered	21,988	31,495	29,711	30,324
Pumped	21,974	31,495	29,712	30,324
Used for washing filters	615	447	416	550
Filter Operation				
Total No. of filtering hours	118,126	170,254	159,953	169,146
Ave. period of service hours	19.19	28.02	25.84	25.33
Total number of washings	6,574	6,063	6,163	8,128
Ave. time to wash filters (Minutes)	3.60	3.05	3.06	3.00
Per cent of wash water used	2.79	1.44	1.40	1.79
Quantities of Chemicals Used				
Lime, av. gr. per gal.	0.61	0.62	0.54	0.59
Lime, av. p.p.m.	10	11	9	10.
Sulphate of iron (av. gr. per gal.)	0.80	0.76	0.84	0.81
Sulphate of iron (Av. p.p.m.)	14	13	14.	14
Sulphate of alumina (Av. gr. per gal.)		0.75	0.95	0.86
Sulphate of alumina, (Av. p.p.m.		13	16	15
Chlorine lb. per mill.	1.2	1.04	0.98	1.52

* The 1918 results are for 9 months, April 1 to Dec. 31



LIME SLAKERS AND LOWER PART OF LIME-FEEDING MACHINE
The lime pump in the right foreground has been removed to show rejectors

Changes in the Plant—The reconstruction of the filtered-water basin was completed in the latter part of the year 1917, and the two large filtered-water effluent pipe lines underneath the filter building were finished April 1, 1918. These pipe lines were required, as previously noted, to convey the water from the filters to the twin conduits leading to the filtered-water basin, since the effluent galleries, into which each filter was designed to discharge, had to be abandoned on account of foundation difficulties. The most westerly settling basin has never been used, nor has a portion of the effluent conduit of the settling basins which is located opposite this basin.

The hydraulic valves in the filter building gave more or less trouble from sticking or from moving too slowly. It was found that a pressure of at least 90 lb. per sq.in. at the valve was necessary. This pressure could not be maintained in the low-pressure system from which pressure was supplied, and in consequence the supply pipe was connected with the high-pressure system through a reducing pressure valve.

Rate controllers on the filters have been found to "hunt" to a marked degree. Just how serious this effect is upon the bacterial efficiency of the filters, it is impossible to say. Thus far the cause for the "hunting"

has not been definitely ascertained. The oversensitiveness of the pilot valve controlling the butterfly valve of the controller, or certain hydraulic conditions in the effluent pipe lines, may be the cause for the trouble. By placing a needle valve on the pressure pipe line leading to the pilot valve, the movement of the latter was retarded and in consequence, the rapid "hunting" of the controller valve was diminished.

Sand-Grain Incrustation—The use of lime in conjunction with sulphate of iron merely for coagulation purposes has been found to produce a rapid incrustation on the sand grains in the sand beds of the filters. During the year 1919 the average effective size of the sand increased 43 per cent from this cause or from 0.45 m.m. to 0.65 m.m. A sample of the top 6 in. of sand lost, when treated with hydrochloric acid, 41.2 per cent of its weight and 56 per cent of its volume. During 1920 the sand beds increased 9 in. in depth due to the accumulated incrustation of lime. The use of alum for a sufficient period will remove the incrustation and has been resorted to in attempting to remedy this trouble.

TABLE II. CHEMICAL AND BACTERIAL RESULTS DURING FIRST FOUR YEARS' OPERATION

	1918		1919		1920		191	
Turbidity, p.p.m.	Ave.	Max.	Ave.	Max.	Ave.	Max.	Ave.	Max.
Lake water	20	180	24	180	20	160	18	135
Mixing chambers, effluent	25	145	24	140	27	140	20	174
Settling basin, effluent	6	22	6	24	6	35	3	12
Filtered water	0	0	0	0	0	0	0	0
Turbidity, Removed, Percentage								
By coagulation (increase)	25	....	0	....	35	.....	11	.....
By sedimentation (decrease)	70	..	75	.....	70	.....	83	.....
By filtration (decrease)	30	..	25	..	30	..	17	.....
Alkalinity, p.p.m.								
Lake water	91	99	92	100	91	98	92	100
Treated water	96	108	95	106	94	103	91	104
Settled water	93	101	94	104	92	103	90	104
Filtered water	89	100	91	102	90	100	93	102
Permanent Hardness, p.p.m.								
Lake water	17	30	18	28	18	22	20	30
Filtered water	23	34	22	30	23	28	25	38
Total Hardness, p.p.m.								
Lake water	108	120	110	124	109	118	112	124
Filtered water	112	130	113	125	113	125	118	135
Chlorine, p.p.m.								
Lake water	13	22	12	14	13	16	11	14
Oxygen consumed, p.p.m.								
Lake water	1.8	3.9	1.7	3.9	1.9	3.4	1.7	3.4
Filtered water	1.2	2.1	1.1	2.7	1.3	2.6	1.0	1.8
Bacteria per c.c., 37 deg. C. on Agar Media								
Lake water	285	4,800	278	7,500	421	8,295	399	11,900
Settling basins, effluent	91	1,850	117	2,560	248	4,990	169	6,070
Filtered water	45	930	29	480	72	1,310	60	1,630
Disinfected water	21	360	7	265	13	640	5	275
Percentage removal	92.6	.....	97.5	...	97.0	.....	98.7	...
B. Coli Index per c.c.								
Lake water	0.840	10,000	1 666	10,000	1.597	10,000	3.079	10,000
Effluent settling basins	0.205	10,000	0.277	10,000	0.528	10,000	1.792	10,000
Filtered water	0.066	1,000	0.087	1,000	0.110	1,000	0.439	10,000
Disinfected water	0.017	1,000	0.009	1,000	0.021	1,000	0.019	1,000
Percentage removal	97.98	..	99.46	....	98 60	...	99.38	...

Loss of Head Conditions—Since the changes in the mixing chambers, noted previously, were made, the loss-of-head conditions obtained have been entirely satisfactory. Coagulation as a rule is well developed at the end of the second of the six channels, indicating that a shorter period of mixing would be sufficient under the present method of operation. However, it must be remembered that these chambers were designed to care for a heavily limed water, and that softening of the supply was to be the result. This latter method of treatment has not been possible for a number of reasons, chief of which would have been the increased cost for chemicals and maintenance of equipment, and the inadequacy of the plant as designed to care for handling larger amounts of lime suspensions and lime sludges.

Chemical House Changes—Changes in the chemical house have been found necessary in order to handle the chemicals required to coagulate the water. The lime, crushed by a swing-hammer crusher, is broken up rather fine. The bucket elevator used to lift the lime from the discharging chute of the crusher permitted a considerable portion of the lime to drop back through the elevator boot after elevating it to the top of the chemical house. This leakage not only choked the crusher, but would finally stop the bucket elevator. In addition, a tremendous quantity of dust was produced which made it difficult for men to work in the car being unloaded. By installing a suction fan system, including a dust filter, this nuisance has been largely reduced. The elevator and crusher troubles are due primarily to the type of apparatus, which is not adapted to handling finely-crushed lime.

There has been no trouble in elevating the sulphate of iron or sulphate of alumina to the bins but there has been the usual and inevitable difficulty of cementation of "sugar" sulphate of iron, when stored in deep bins. Attempts to break through hardened crusts of this sulphate of iron, which form in these deep bins, have proved difficult and dangerous to the workmen employed.

Lime Difficulties—The preparation of milk-of-lime suspensions was found to be particularly troublesome until important changes were made. The slaking tanks discharged the hot milk of lime into a dilution tank below the floor level. In this tank was a high-speed stirrer driven by a gear from a Pelton waterwheel. The discharge from the wheel was used to dilute the milk of lime. The wheel also operated a centrifugal pump, which lifted the milk of lime from the tank and discharged it into the raw-water pipe line. The stirrer in the dilution tank was found to be too small and to be operated at too high speed. Constant trouble with bearings was encountered from the start. The pump impeller blades were worn out in about a year's time.

The imperfect stirring action in the dilution tank caused a permanent deposit of a large amount of lime sludge which had to be removed by men going down into the tank and digging it out, since it was considered more than probable that it would soon clog all of the drains if it were washed out to the sewer. The sludge had to be deposited on the ground outside the building, making an unsightly appearance.

To avoid these difficulties, water ejectors were installed to suck the milk of lime directly from the slaking tank and to discharge it into the raw-water pipe line. The results have been decidedly satisfactory, since the sludge problem has been practically eliminated, the use of motors, stirrers and pumps avoided, and the actual consumption of water reduced by about one-half. Ejectors have also been installed in place of motors and pumps to carry the sulphate-of-iron solution, and the sulphate-of-aluminum solution, when the latter is used, to the raw-water pipe line.

Automatic Weighing Machines of the type used have given fair satisfaction, but the gate on the lime weighing scales was found to be of incorrect shape to hold back lime containing so much fine dust. Lumps in "sugar" sulphate of iron have also proved trouble-

some at times in the "iron" scales. The latter have been operated, as a rule, automatically through a clock; the lime scales, however, had to be operated by hand, as only one clock was ever installed, and also because of the difficulty in holding back the fine lime when filling the weighing hopper from the bin supplying the scales.

A Direct Motor Drive for the lime-bucket elevator and screw conveyors has been substituted for a belt drive through a jackshaft. This has been of great advantage, since the frequent slipping off of this belt stopped the elevator and conveyors and necessitated opening the boot at the foot of the elevator and shoveling out the lime before the machinery could again be started, an extremely disagreeable operation for the workmen.

The Apron Conveyors onto which it was expected to shovel the chemicals for delivery to the crushers were found to be impracticable, since, in the case of the lime, they soon became so clogged that they could not be operated. The lime spilling from the sides of the conveyor filled the pit, and as it swelled with water which could not be kept out of the pit, the machinery could not be moved. These apron conveyors were finally removed and the pits filled with earth.

Automatic Level Gages in various parts of the plant gave considerable trouble from time to time due to clogging of pipes and to freezing of water in the connecting tubes. In consequence they have been removed and gage boards substituted.

Many other changes and improvements have been made from time to time in order to bring the plant up to its maximum efficiency, and to maintain it in the best condition. Constant vigilance and care are required to do this, as every conscientious operator knows. No two plants are exactly alike or require the same degree or kind of "tuning up."

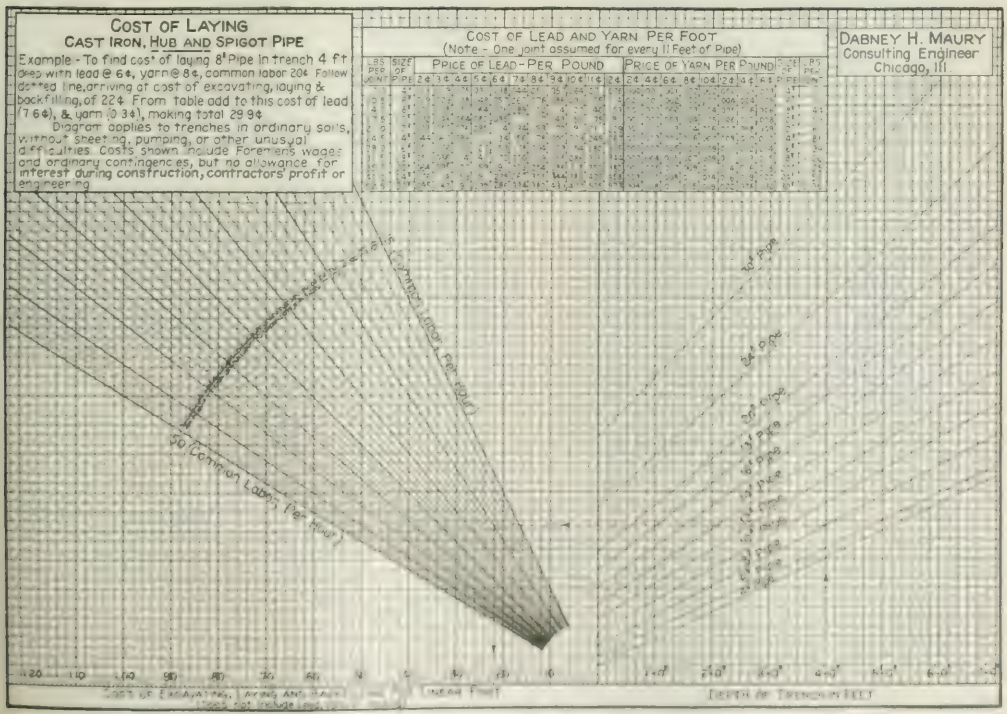
The writer wishes to acknowledge the cordial cooperation given him by Thomas S. Farrell, director of public utilities, J. T. Martin, commissioner of water, W. C. Lawrence, chemical engineer, and to the technical and operating staff in immediate charge in bringing this plant into operating condition.

Diagram Showing the Cost of Laying Cast-Iron Pipe

COMPILATIONS from actual costs of laying cast-iron pipe in 10 water-works plants have been combined in the accompanying diagram. The information was obtained in making appraisals for five water companies and five municipalities by Dabney H. Maury, consulting engineer, Chicago. F. G. Gordon, his principal assistant, prepared the diagram.

Since preparation the figures shown on the diagram have been compared with costs in a number of other cities and found on the average to check closely where conditions were not abnormal.

To use the diagram follow the direction arrows from trench depth to size of pipe, thence to common labor cost and cost per foot. Add to this figure the cost of lead and yarn per foot from the table which is made up with the quantity of lead assumed as 1¼ lb. to 1 in. of diameter of pipe.



COST OF CAST-IRON PIPE LAID IN THE GROUND

Making 30-Inch Flexible Joint Cast-Iron Pipe

Spherical-Shaped Bell and Spigot on Each Length Machined to Give Flexibility at Every Joint—Foundry Practice

By William G. Hammerstrom
Chief Engineer, Lynchburg (Va.) Foundry Co.

A GREAT variety of designs of flexible joints for water pipe are on record, each differing but little from the original Ward joint patented by John F. Ward in 1863. A number of such lines have been laid in various parts of the country, the longest perhaps

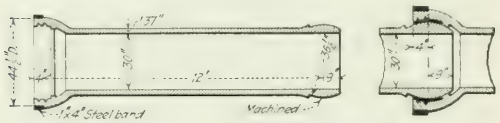


FIG. 1. PIPE WITH INTEGRAL CAST FLEXIBLE JOINT

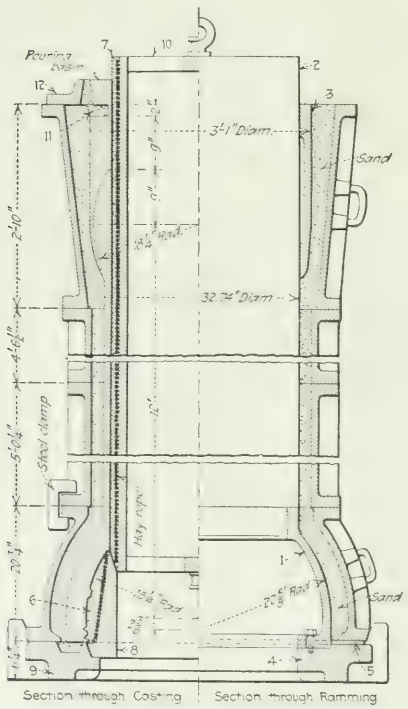


FIG. 2. PATTERN AND CORE EQUIPMENT

being the 24-in. Lake Champlain crossing about 15,000 ft. in length and, more recently and larger, the 36-in. line conveying New York City's Catskill water supply from Brooklyn underneath the Narrows to Staten Island. The 30-in. pipe selected by the City of Norfolk, Va., for use at the Nansemond and Elizabeth River crossings of its new 20-mile supply main is provided with a modified type of the Ward joint (Fig. 1). The spigot end is made to form a perfect bell with a radius of 18¾ in. and carefully machined to gage. A shoulder cast integrally provides a definite stop at maximum deflection of the pipe without injury to the lead at the face of the bell. The inside of the bell is provided with a ring which serves the purpose of holding the lead and of centering the pipe to insure a uniform lead space. This ring is also carefully machined to the same radius as the spigot. On the outside of the bell is shrunk a 1 x 4-in. steel band to protect the bell from breakage in handling and transportation. The pipe corresponds to Class D of the American Water Works Association standard. It was made by the Lnychburg Foundry Co., of Lynchburg, Va.

Fig. 2 illustrates by two half sections the manufacturing process. The iron flasks in which the pipe is molded and cast are made up of four carefully machined main sections—the bottom and top bell pieces and two straight body sections. Each one of these is made in two halves and held together by means of heavy steel clamps tightly secured by steel wedges. The body sections are hinged to facilitate the removal of the pipe from the flask. Since these flasks are subjected to much rough handling they are designed very heavily to prevent costly renewals due to breakage. To facilitate lifting the flasks out of the pit they are provided with heavy integrally-cast steel-hook eyelets reinforced by heavy bosses.

The pattern equipment for making a pipe consists of a head pattern (1, Fig. 2), forming the outside of the bell, the pipe body pattern (2) which makes the outside diameter of the pipe and the spigot pattern (3) forming the spigot end of the pipe. The head pattern is secured to the ramming steel (4) by means of screws. Prior to ramming up a mold the lifting ring (5) is placed in position over the head pattern on to the ramming stool with the bell mouth sections of the flask clamped together and secured to the ramming stool by means of clamps. A proper sand space is thus formed between the outside diameter of the head pattern and the inside of the bell mouth section and into this space the sand is tightly rammed. The straight sections of the flask are then fastened to the bell mouth and the body pattern fitted into the head pattern. The resulting space is filled with sand and rammed by means of long steel rod hand rammers. In a similar manner is the top bell piece rammed up with the spigot pattern in place, fitting snugly over the body pattern. After the ramming is completed the spigot pattern is first drawn vertically up out of the sand and the body pattern is drawn out in like manner. This removal of the pattern is accomplished by means of an overhead traveling crane. To remove the head pattern the lifting ring is clamped to the bell mouth section and the clamps fastening this section to the ramming stool removed. The entire flask is then lifted vertically, leaving the head pattern with the ramming stool. After these parts have been thus separated the lifting ring is also removed. This ring simply serves to prevent the sand from falling out in the process of removing the head pattern. After the usual "slicking up" and blacking, the mold is ready to be set on the casting stool for drying.

The cores consist of a head core (6) which forms the inside of the bell and a body core (7) forming the inside diameter of the pipe. The head core is made on a socket iron (8) which fits into the castings stool (9) and which also supports the body core (7).

The processes of making the head core is shown by Fig. 3 and its sub-title.

In making the straight body core the cast-iron core barrel (10, Fig. 2) is furnished at both ends with steel spindles which fit into bearings on the core strike to provide an easy turning of the barrel in the making of the core. An air motor installed at the upper end furnishes the power for revolving the barrel. An even layer of ½-in. hay rope is first wrapped around the barrel, after which the first coating is applied. This coating consists mainly of clay which after drying cracks and provides the vent which is necessary for the escape of gases in the casting of the pipe. The barrel



FIG. 3. MAKING THE HEAD CORE FOR BELL END

On the outside of the socket iron a layer of 1-in. hay rope is wrapped. The part is then placed inside of a core box and sand rammed in the usual manner. The lower section of this core box is made in two halves to enable its removal after forming the ring for the lead stop and the double head grooves. The upper section of the core box is made to conform with the curvature of the inside of the bell where it joins the body core. After the core is completed it is placed in the casting stool ready for drying. The complete core is shown at the right, the head pattern with lifting and ramming stool at left.



FIG. 4. POURING CENTRAL OF THREE PIPE FLASKS

The flask is not moved from the time it is poured for cooling until it is ready to knock out.

containing the first coating is placed on an iron car with racks, each car holding three cores. The car is placed in the drying oven where after about an hour the cores are taken out and a second coat, consisting of sharp sand and loam, is applied. This is followed by a thin coating of anthracite blacking. After drying for three to four hours the core is ready for use. Care is, of course, taken that the core is absolutely straight and made to an exact outside diameter, allowance having been made for shrinkage, etc. To allow for a free vent the core barrel is perforated with a number of ⅜-in. diameter drilled holes. A third and smaller core is a centering core (11, Fig. 2) placed at the top of the mold. This core is circular and about 2 in. thick, with an inside diameter large enough to allow an easy fit over the body core. A tapper on the outside diameter permits a bearing for the core on the mold which is thus held in place. On the inside diameter are rectangular slots made or cut out to permit the entrance of the molten metal in pouring the pipe. On top of the bell mouth section is placed a cast-iron circular runner (12, Fig. 2) the inside of which is sand lined. This forms a basin into which the metal is poured and from which it feeds through the slots of the head core and into the pipe.

After the mold has been made the complete flask is clamped to the casting stool carrying the head core

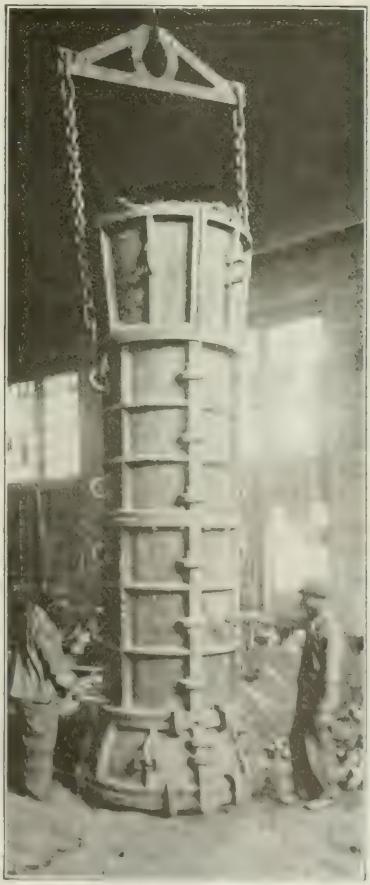


FIG. 5. READY TO TAKE PIPE FROM FLASK

(Fig. 2) and the entire unit placed in a 12-ft. deep pit on top of fire boxes for drying. The drying of the mold and head core is done simultaneously, usually over night. The body and the centering cores are made of dry sand and are dried separately in ovens. Prior to the pouring the body core is lowered into the mold,

the lower end of the core fitting into the tapered top section of socket iron and is thus supported in a vertical position. The centering core is then placed into position and after the runner has been secured and the basin formed the pipe is ready for pouring.

Fig. 4 shows the pouring of one pipe. Since the finished pipe weighs about 7,400 lb. it is necessary to use a ladle of five tons capacity to allow for shrinkhead, runners, gates, etc. About an hour after the flask has been poured the core barrel is drawn out and the pipe permitted to remain in the flask from five to six hours to cool off, when the flask is hoisted out of the pit and steps are taken to remove the pipe. Fig. 5 shows the flask immediately after removal from the pit.

The next steps are to place the pipe on skids for cleaning and chipping. The dry sand cores are cut out by means of long steel rods, sharpened at the end. The riser, or extra length of pipe beyond the spigot end into which foreign matters rise to ensure a sound spigot, is cut off in a lathe. The pipe is then coated and tested under hydraulic pressure and otherwise, as called for by the specifications of American Water Works Association. Finally, the pipe is transferred to the machine shop for the accurate finishing of its bell and spigot ends in special lathes, and for shrinking on the steel band. When the machinery has been completed the pipe is once more transferred and the steel band shrunk, making the pipe ready for shipment.

Maintenance Cost of Drainage Works

Drainage works for the removal of seepage and excess water are provided on a number of the irrigation projects of the U. S. Reclamation Service, and a tabulation of the cost of maintenance of both open ditches and tile drains is given in the January number of the

MAINTENANCE COSTS OF DRAINAGE DITCHES

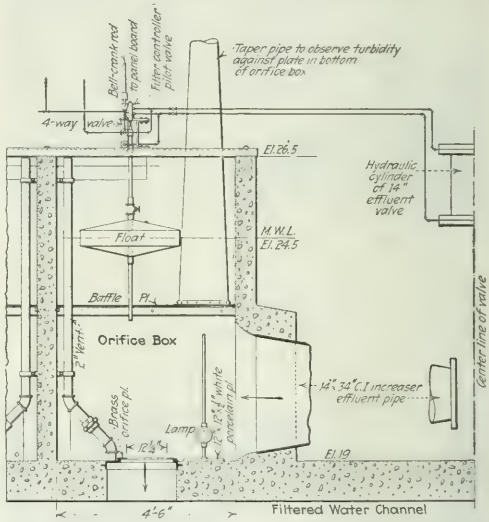
	Minimum Cost Per Mile-Year $	Minimum Per Cent	Maximum Cost Per Mile-Year $	Maximum Per Cent	Average Cost Per Mile-Year $	Average Per Cent
Drainage Ditches						
Patrolling	0 90	3.26	13.03	6.6	6.10	8.5
Clearing weeds and debris	8 35	20.20	17.71	9.0	17.96	25.0
Clearing silt and slips	1.58	5.50	22.55	11.5	16.32	22.7
Repairs to structures	12 36	43.30	89.05	45.4	11.63	16.2
Minor expenses, plant and equipment	1.18	4.1	14.53	7.4	3 90	5.4
Miscellaneous	0 26	0.9			0 96	1.3
Unit field cost per mile-year	24.65		156.89		56 87	
Overhead	3 91	13.70	39.38	20.0	14 76	20 6
Total unit cost per mile-year	28.56		196.27		71.63	
Tile Drains						
Patrolling					.53	0 9
Clearing tile and trap boxes	5.96	68.8	24.24	24.3	14.72	25.0
Repairs to tile and trap boxes	.36	4.2	37.56	37.6	31.00	52.6
Minor expenses, and plant and equipment charges			1.24	1.3	2.54	4.3
Replacement of drains					2.15	3.6
Hydrometry					0.01	
Unit field cost per mile-year	6.32		63.05		50.95	
Overhead	2.33	27.0	36.76	36.8	7.98	13.5
Total unit cost per mile-year	8.65		99.82		58.93	

Reclamation Record by C. E. Lounsberry, assistant to the drainage engineer, U. S. Reclamation Service. A summary of his table is given above. It appears evident that these irrigation drainage works receive much greater attention than those of ordinary land drainage, the neglect of the latter being notorious and occasionally involving heavy reconstruction costs. Patrolling, in particular, is practiced generally on the government projects but rarely on private projects, although a patrol system for the latter was noted in *Engineering News-Record* of Jan. 26, 1922, p. 141. Mr. Lounsberry points out that the cost herewith are for periods averaging 4.37 years on ditches and 3.56 years on tile drains.

Operation Control Panels for the Sacramento Filters

Upright Panels—Air Rate-of-Filtration and Loss-of-Head Gages—Colored Water Valve—Opening Indicators

UNIQUE filter control panels and novel methods of handling the filter operation are included in the design of the filtration plant now under construction at Sacramento, Cal. The panels are upright, the valve-opening indicators are colored liquids in glass tubes, the loss-of-head gages and rate-of-filtration gages are air gages, and the wash-water rate is indicated directly from a Pitot tube in the wash-water line. As designed, the Sacramento filters will all automatically respond at the same rate to the draft upon the filtered-water basin.

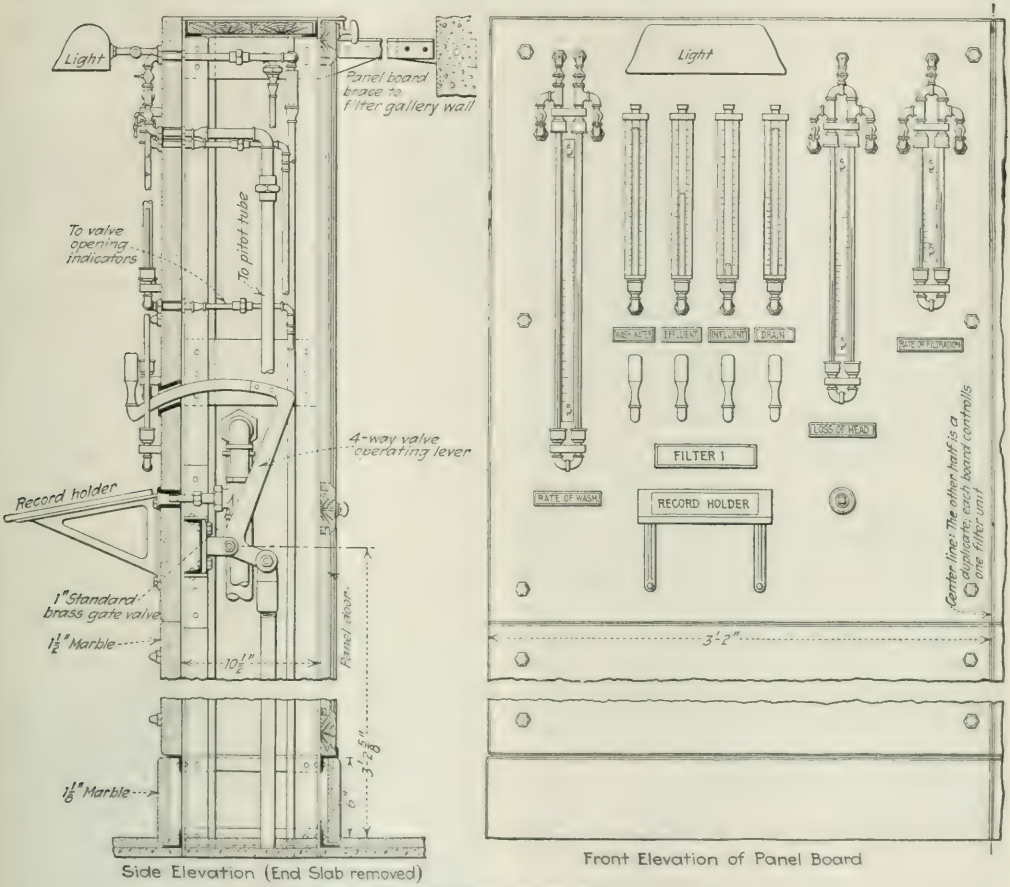


EFFLUENT ORIFICE BOX AND EFFLUENT VIEW-PIPE

The condition of the water yielded by each filter may be seen through a view-pipe, which tapers outward from the floor downward to give a 20-in. field of vision over a 12-in. white porcelain plate at the bottom of the orifice box.

They will accordingly respond to the pumps and the demand made upon them by the consumption or draft upon the distributing pipe system.

The controllers are of the Harrisburg type but will be improved over the early design. The discharge will be through fixed, horizontal, circular orifices, 12¾ in. in diameter. The normal depth of water over the orifices will be 5.5 ft., but this depth can be increased to 6.5 ft. if desired. This means that the filters will not come into full operation until the filtered-water basin is drawn down to that depth below the high-water mark at which the water-level control float is set. At the high-water mark the filters will automatically stop filtering. Such a condition can never exist inasmuch as the minimum rate of draft is fully 10 m.g.d. The eight filters are designed to yield 4 m.g.d. each, at the 125-m.g.d. per acre rate. Their maximum rate of yield is at present fixed at 6 m.g.d. each, or 48 m.g.d. with eight units in operation at a rate of 187.5 m.g.d. per acre. When the filtered water basin is drawn down to give the full static head on the orifice plates in the bottom



FILTER-CONTROL PANEL BOARD FOR SACRAMENTO

Valve-opening indicators are colored liquids in glass tubes; loss-of-head and rate-of-filtration gages are air gages; wash water rate is indicated directly from a Pitot tube

of the orifice boxes, this maximum rate will be reached by the filters, but it cannot be exceeded except by using larger orifices or by increasing the head on them to a limited extent. The filters have been designed for a maximum loss of head of 10 ft., which can be increased somewhat. Ten feet represents the difference in elevation between the water surface on the filters, as designed, and that in the orifice boxes.

The floats in the eight orifice boxes will all be set at the same level and all filters will operate at the same rate within expected small limits. Therefore there will be but one rate-of-filtration recorder and indicating dial for the entire plant. The recorder will be of the integrating type to give a straight-line diagram of rate; that is, all ordinates on the recorder will represent the same amount of water. There is thus no necessity of providing in each operating panel an expensive rate-of-filtration recorder.

The hydraulic valves controlling the operation of the filters are governed by 4-way piston pilot valves of the leakless, enclosed type. The spattering of water which occurs at the Harrisburg plant will thus be avoided. The 14-in. effluent control valve is a stop or shut-off valve, as at Harrisburg. Operation of the 4-way effluent valves from the panels will automatically cut out the operation of the pilot valves actuated by the floats, as is the case also at Harrisburg. The design is estimated to save $1,500 per filter unit on the controlling apparatus alone.

The usual 4-way rotary cocks will not be used but 4-way, leather-cup, piston-type valves, designed and manufactured for 500-lb. per square inch pressure, will be installed. This type of valve is exceedingly rugged and will not leak. The valves will be set down in the pipe gallery on the back wall of each filter orifice box and directly beneath the corresponding operating panel, from which they will be operated by lever handles and standard bell-crank connections.

In usual operation these handles will all be pushed back against the panel. Therefore, if any handle is out, one can tell at a glance that either the filter is being washed, or else some valve has been tampered with. A master control-valve will prevent any harm being done by such tampering. It is opened when washing is begun and closed when the filter is returned to normal operation. The control valve shuts off the supply to all

but the float-operated 4-way valves, and will be turned by a special key which the operators only will have.

All strings or wires connecting valve stems to pointers have been done away with on valve-opening indicators on the panel board. Instead, colored liquid piped from miniature pumps actuated by the valve stems to glass tubes on the panel boards is to be used and the corresponding scales will show both the height of valve opening and the percentage of total waterway through which the water is passing. An outside-packed plunger rod, attached to the valve-stem extension above the hydraulic cylinder, will displace its own volume of liquid as the valve closes or opens. The movement of the plunger will make the colored liquid in the glass tubes rise or fall, corresponding to the motion of the valve. The scheme works equally well with the valve turned up, down or sideways at any angle.

The rate of washing will be instantaneously indicated by a differential gage on each filter-control panel, connected to a Pitot tube of special design in the wash-water line to each filter.

The loss of head on each filter will be shown by a differential gage with terminals connected to the water surface above the sand and the effluent pipe on the filter side of the control valve. This gage will be an air gage on the principle, but not the design, of the "Pneumercator."

A rate-of-filtration indicating gage will be provided on each panel. Like the loss-of-head gage, it will be of the differential, air type, with terminals connected to the upstream and downstream sides of the filter-orifice plate. Thus in reality the head on the orifice will be indicated, but the scale on the gage will be calibrated to show the corresponding discharge through the orifice in millions of gallons per day.

At the end of each operating panel is a filtered-water view-pipe through which one can look down through the 5.5-ft. depth of water in each orifice box. Above the filter-gallery floor the view-pipe is 4 in. in diameter, but from this floor downward it is tapered to give such an angle of vision as will permit the observer to look at the water over the area of a 20-in. diameter circle. At the bottom of the orifice box below each pipe a white porcelain plate will be placed. Just above this plate will be an electric bulb in a marine-glass fixture which is adjustable or removable through an opening in the side of the tapered view-pipe. A push-button type of electric switch will be placed at the side of each view-pipe and must be held down while one is making an observation of the character of the filtered water. This arrangement will prolong the life of the electric lights.

Each panel will be illuminated at night by a panel light. Each panel also carries its own shelf for 8½ x 11-in. record sheets for operation data, the loose-leaf system being employed. The provision of such a shelf is intended to imply that the records of each filter are an immediate, inseparable and integral part of its operation.

Within easy reach of the panel boards will be switches to lights which will illuminate the filter surfaces for night working, and also submerged lights to determine the turbidity of the wash water so that the end point in washing can be studied or watched at night.

The panels will have angle-iron steel frames supporting selected marble fronts and ends. The interior of each panel board is made entirely accessible through the removal of two light, paneled doors which form the back of the panels. All apparatus and piping requiring oiling or adjustment are at a convenient height above the filter-gallery operating floor.

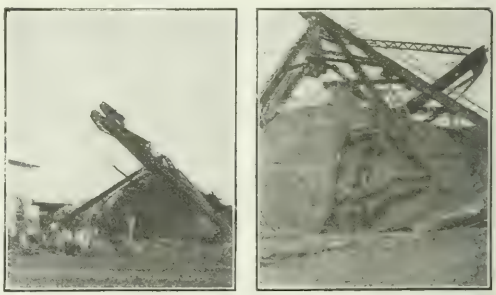
The designs for the Sacramento filters are being carried out under the general direction of Prof. Charles Gilman Hyde, consulting engineer. C. G. Gillespie is resident engineer, K. B. Foster is assistant hydraulic and filtration engineer and Harry N. Jenks special assistant engineer on design. Frank C. Miller is city engineer.

Rusted Columns of Tank Tower Buckle

By W. F. Heath
Assistant Engineer, Cameron County Water Improvement District No. 2, San Benito, Tex.

A WATER tank failed in this city recently, by simple collapse under vertical load, as the result of weakening by severe rusting and neglect. There was no wind. The tank did not fall to one side, but just sat down, as the two views herewith show. Fortunately, no one was injured, although the structure was within 20 ft. of one of the principal streets and close to the pumping station.

This tank was of 40,000 gal. capacity and was supported on an 80-ft. tower, of standard four-column construction. It was built about 1910. With proper care it should have lasted forty years. About two years ago it was painted, but at that time none of the old



COLLAPSE OF TANK TOWER DUE TO RUSTING

paint or rust was removed before putting on the new paint. The lattice bars of the columns had rusted in two in many places, and rust had also attacked the main channel members of the columns.

Six months ago the San Benito Water Co., which owned the tank, was advised by W. E. Anderson, chief engineer for the Cameron County Water Improvement District No. 2, that the tank should be taken down as soon as possible. At that time all the lattice bars of the upper panel of one column had rusted out. A few months later this column section bent to a noticeable curve outward, and he advised taking the tank down immediately. Nothing was done, however, except to drain the water from the tank.

It is said that on the morning of the failure the plant engineer sent a man to open a valve leading to a main. Instead, he opened the valve leading to the tank, and the tank filled to the point where it collapsed.

The intensity of rust action in this coast countr is hard to believe by anyone who has not lived here. I have seen "flivvers" not more than a year old with holes rusted in the fenders.

Motor Trucks Collect and Deliver Garbage to Farmers for Pay

By W. F. Bates
Town Engineer, Montclair, N. J.

MOTOR trucks heavily manned are being used by the town of Montclair, N. J., to collect garbage and to deliver it outside the town to farmers for rates of compensation fixed by obtaining bids. For collection during the seven months from Nov. 1 to June 1, when only two collections a week are made, three motor trucks are used. For the other five months of the year when the collections per week number three, an extra truck will be required.

There are now in use three 2½-ton Packard trucks with Van Dorn hoists and special 4-cu.yd. garbage bodies with flare tail gate. Each truck is manned with a chauffeur and either three or four collectors according to the season. The fourth collector is employed during extreme cold weather when the garbage is frozen and hard to remove from the receptacles or when there is snow on the ground. The trucks are loaded a little under levelful, giving about 3½ cu.yd. per load. The average haul of the loaded truck is 5 miles per load and an average of two loads a day is made.

Specifications—Bids were received under specifications calling for the number of loads each bidder would take and the price that he would pay per load. The invitation for bids stated that the contract would be awarded to the bidder offering the highest price per load and that where two or more bidders offered the same unit price the bids would be accepted that offered the nearest dumping grounds. The town reserves the right to limit the amount delivered within 5 miles of a point on the western boundary of the town to 60 per cent of all garbage collected in the town and to limit to 40 per cent likewise the garbage going out of town on the north boundary.

The specifications provided that the dumping grounds offered must be so located that they could be "reached over hard-surfaced roads and the route over the bidder's premises leading from the public road to the dumping place must be kept in a condition suitable for the use of the town's auto trucks."

The town reserves the right to cancel any agreement made with any bidder in case "any proper authority outside of Montclair stops the hauling of the garbage through its territory or requires the same to be hauled over roads other than those provided with a hard surface, and further that no claim for damages would be made by reason of such cancellation." Bidders were also required to hold the town and its agents "free from any claims for damages that may arise because of the condition in which the dumping ground is maintained, or because of any garbage there dumped."

Bids and Awards—Eight bids were received for quantities ranging from 1 to 24 loads a week, but only one bidder offered to take more than 6 loads a week. There were two bids at $1.25 a load, five at $1 a load and one at $0.75. The bidder who proposed to take 24 loads a week offered to pay $1 a load.

At the time the bids were received only 35 loads a week were being collected. The highest bidders were given the number of loads they bid for and the remainder was apportioned among the other bidders, taking into account the length of haul. An attempt is made to furnish some garbage to each bidder so as to hold all the bidders as customers for the summer collection, estimated at 50 loads.

Previous Methods—In May, 1918, when the writer took charge of the Engineering Department of the town, and for a number of years previous to that time garbage was collected by horse drawn steel carts and dumped into a hopper on a farm situated about two miles from the center of the town and less than one-fourth of a mile from a residential section. The garbage was disposed of by the owner of the property, a portion by sale to farmers for hog feeding and the balance piled or spread on the land for fertilizer. The cost to the town for rent and maintenance of the dump was $770 per year. Records show that this dump had been a constant source of complaint for a number of years.

Soon after the writer took charge an investigation showed that farmers from surrounding towns, without permission, were coming into town and collecting ahead of our men. There existed such a demand for the garbage on account of the high cost of feed that it was decided to make use of these farmers and save expense to the department.

Farmer Collection Regulated—With the assistance of the police and the health officer all the farmers were notified that in order to continue the collection they would have to work under our direction. Arrangements were made by which the farmers were to furnish the teams, with drivers, and the town the collectors, the farmers to receive the garbage free of charge in exchange for the use of the teams. Enough farmers agreed to this arrangement so that for eighteen months all the garbage was removed from the town, at an average saving of $20 per day for teams. This method caused a few complaints, as sanitary carts being too heavy for the long hauls could not be used to advantage by the farmers, but the writer considered that the small amount of leakage from the carts caused much less nuisance than that from garbage stored at the dump.

Early in 1920 the decrease in prices made it unprofitable for the farmers to continue and a number gave up the collection, while with others we were obliged to pay the driver. This made it necessary to use the dump again, which on account of being leased land could not be satisfactorily controlled and complaints became numerous from the residents in that vicinity. The nuisance at the dump became so acute that some other method of disposal was imperative.

Incineration Proposed But Given Up—Thorough investigation of different methods of disposal was made and preliminary plans for disposal by incineration considered, but on account of the present state of incineration, with vast differences of opinion among experts, and the opposition which developed to the erection of an incinerator in every section where a site was available, the matter was indefinitely postponed and the present system adopted. This system is working very satisfactorily from the sanitary standpoint, and at less expense than for incineration, and should continue to serve our needs for a number of years, or until the surrounding country is more thickly settled and feeding places become a nuisance.

The work as now conducted is under the general direction of Dr. James T. Hanan, commissioner of streets and public improvements of Montclair, with the writer in direct charge.

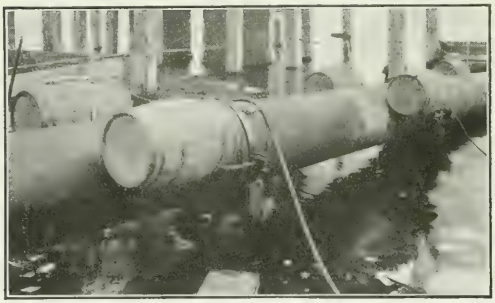
Submerged Intake For 24-in. Pipe Placed Without Diver

Concrete Anchor Block Cast on Shore, Floated to Place and Sunk Simultaneously With 250-Ft. Bell-and-Spigot Pipe

By George W. Pracy
Superintendent, Spring Valley Water Co.

THE SPRING VALLEY WATER CO., which serves the City of San Francisco, recently renewed the intake of Lake Merced pumping station after it had been in service twenty years. This station, which has a capacity of 7½ m.g.d., had been taking water from the lake through a 24-in. suction line supported on a wood pile trestle. The trestle had decayed, the joints in the suction line were giving trouble by admitting air and it was found that a new and shorter route to deep water could be used. The old pipe sections were used in laying the new line which was placed directly on the ground and on the lake bottom.

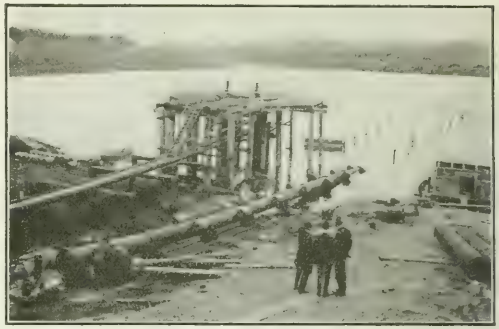
A combined concrete anchor block and screen support was cast on shore, floated to position, and, before being sunk, was attached to the portion of the pipe line to be



SECTIONS OF 24-IN. PIPE READY FOR LAUNCHING
Note clamps and bolts to prevent joints from opening. Pipe trigger for tripping wire sling is on far side of pipe. Manila rope attaching bolster to pipe was cut before launching.

submerged which had been floated into position separately. When the connection of floating parts had been made, pipe line and anchorage were successfully sunk at the same time. Advantages of this plan of construction were that it was carried out by the company's regular gang and without the use of a diver, the cost was about one-quarter that of replacing the old line on a trestle, joint maintenance was eliminated on the submerged section and the shorter suction line reduced the friction head. With the new intake the lake can be drawn down 5 ft. lower than before.

The shore where the new intake is located has a gentle slope reaching the lake's maximum depth of 14 ft. at the present water stage, about 250 ft. from the shore. In the preparation for laying the new intake the surface of the ground between the pumping station and the water's edge was smoothed to an easy vertical curve and pieces of 2 x 6-in. timber 4 ft. long taken from the old wharf were laid on this slope like railroad ties. Longitudinal runs of 2 x 4-in. timbers were then spiked on to form the rails of a 24-in. gage track. In addition to the track built down to the water's edge, a 20-ft. section was put together on land, floated into place and sunk so that its outer end was in 3 ft. of water.

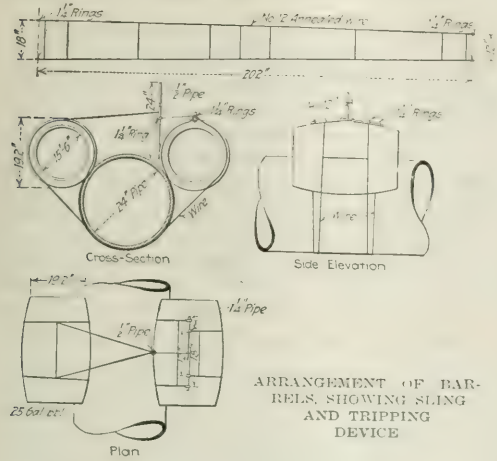


GENERAL VIEW OF INTAKE LINE, FIRST SECTION ENTERING WATER
Abandoned intake structure in center, concrete crib at right.

The old suction line consisted of 12-ft. sections of cast-iron pipe ⅜ in. thick, weighing 3,025 lb. per section. Twenty-two of these sections were taken up, cleaned, and sledded over to the site of the new work where they were mounted on a four-wheel, 24-in. gage truck on the wooden track. Each section rested on a wooden bolster cut to fit the pipe circumference and bolted to the truck. The second section of pipe, after being attached to the truck, was lowered down the track until its spigot entered the bell of the first section, the same as though the pipe were being laid in the ditch. Four pieces were put together this way and then the lead joints were run and calked. The pipe had only the ordinary standard bell. After the joints were calked iron bands were clamped around each section, just above the spigot and below the bell of each joint. The bands on either side of a joint were connected by a pair of bolts, one being placed opposite each end of the horizontal diameter of the pipe. These bolts, while preventing actual separation of the pipe



VIEW TAKEN JUST AS THE CRIB AND PIPE SUBMERGED
Note simultaneous appearance of pairs of barrels.



ARRANGEMENT OF BARRELS, SHOWING SLING AND TRIPPING DEVICE

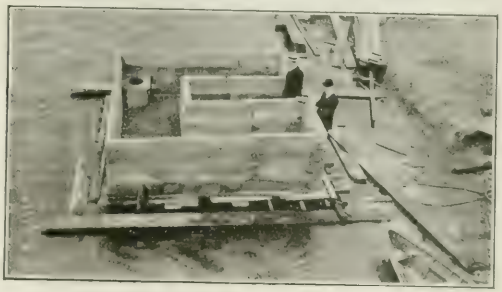
sections, would allow a certain amount of play or articulation in case any tensile strain should be put on the line in the process of floating and sinking it. As the assembly and jointing of each four-length section was completed, a rope was fastened around the upper bell and by means of block and tackle the line was let down the track to make room for the next four pieces. The front end of the first pipe was sealed with a 24-in. wooden plug calked in with oakum to make it watertight. Just before each length of the pipe went into the water two 25-gal. barrels were fastened to it by means of a wire bridle arranged so that both barrels could be released simultaneously by a tripping device.

The means for supporting the pipe from the barrels consisted of a sling of 12-gage annealed wire whose ends terminated in 1½-in. iron rings slipped over short lengths of ½-in. pipe. Two runs of the wire encircled each pair of barrels and passed beneath the pipe. The sling was so arranged that the rings would be free to slip off the short pipe when a vertical pipe, acting as a lever, was tripped by a horizontal pull. The levers projected above the barrels and were connected by a rope to shore. Until the morning of the sinking the sling releases were wired up as a precaution against accidental release. When the time for sinking came, the release was wholly successful, all the barrels being freed instantaneously when the trigger-line was pulled. The sling arrangement was developed by O. G. Goldman of the company's engineering staff.

It was believed that the lead-calked joints of the pipe line would permit of sufficient movement to allow the line to straighten out as it entered the water and later to conform to the slight curve of the bottom. This they did. The empty line, with the aid of the barrels, floated just at the surface of the lake. A rope was tied to each truck as it went into the water and as the pipe floated, the truck was hauled ashore and re-used. Only ten trucks were required, the operations being repeated until the desired length of pipe was floating.

The pipe joints were expected to be tight enough to keep water out while the pipe floated so the buoyancy of the line full of air could be utilized. This they did effectively and although a 1-in. pipe was run down inside the sections as the line was floated, the leakage was so small that it was pumped out only once. To prevent danger to the floating pipe line from wind, two rows of piles were put in on either side of the proposed intake location. These were not used, as no wind strong enough to interfere came up during the work.

While the pipe was being run out into the lake, a concrete box or crib was constructed at the water's edge to serve as anchor block and screen support combined. This crib is 12 x 13 ft. in plan and 4 ft. deep. It contained a recess or re-entrant niche for the end of the cast-iron pipe and was balanced by an extra yardage in other parts so as to float on an even keel. Bolts were set in the recess so that an iron S trap could be placed around the pipe to secure it to the crib just before sinking. In the four corners of the crib were concrete blocks with cylindrical chambers to take 14-in. pipes which were to serve as the posts of the superstructure. Brass bolts to which the screen could be fastened were imbedded in the tops of the concrete wall around the recess for the intake pipe and a temporary wooden bulkhead was put in the recess at the point where the intake pipe was to terminate. This



CONCRETE CRIB READY FOR LAUNCHING

bulkhead formed the fourth side of a well 2½ x 3 ft. in plan at the inner end of the recess and approximately in the center of the crib.

When the intake line had been floated to place the crib was launched. This was done by placing timbers against it and jacking it out into the water. While still near shore the 14-in. vertical pipes were put in place ready for filling with concrete. Reinforcing steel had been left projecting into the chambers provided in the four corners of the crib for the vertical pipe, and this steel extended above the tops of the chambers. A reinforcing steel "cage" was made up to slip down inside each pipe and after these were placed the pipes were raised enough to enable workmen to wire the steel of the cages to that projecting from the bottoms of the chambers. When pipes and steel were in place and had been braced together with timber struts and tie wires, asphalt was poured into the recesses around the bottom of the pipes to avoid filling with water as the crib sunk.

The crib was then towed out to place and backed in so that the outer end of the intake pipe entered the recess and was butted up against the timber bulkhead of the central well. The pipe was strapped to the crib to hold it in place and concrete was poured around the end of the intake pipe so that it was imbedded in a solid concrete block filling the space in the recess

around the pipe but leaving the tops of the walls of the central well free as a base for the screen.

After allowing the concrete to set for one day, the wooden bulkhead which had served as a form was cut out and the wooden plug was removed from the end of the line, leaving the intake ready for sinking. Two 3-in. pipes had been cast in the bottom of the crib. These pipes were capped but care was taken to see that the caps made an easy fit. When ready for sinking the caps were removed and as the crib began to submerge, the barrels were released so that the whole line would sink at the same time. The sinking operation was a complete success. The shore end of the pipe had been left on the trucks so that it could move if any strain was put on it. This was a needless precaution, however, as the pipe did not move at all.

With the anchor block on the bottom of the lake the 14-in. pipes extending upward from it were trued up and filled with concrete, the stay wires were drawn taut and a timber superstructure was built up with a platform level about 12 ft. above the tops of the piles. Working from this platform four guide rods for the cylindrical screen were "fished" into place. These rods or bolts, which are 20 ft. long and 2 in. in diameter, have threads tapped into the lower ends to fit over the ¾-in. brass bolts left projecting from the concrete of the central well walls. These rods were readily screwed into place and when the screen was being lowered, fitted into notches cut in the flanges of the screen and guided it accurately to the desired seat over the central intake well.

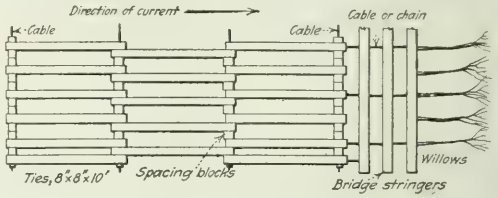
As a final operation, the crib was filled with sand to increase its weight and stability. The sand was brought out on a scow and shoveled into a 14-in. pipe used as a tremie.

Zoning Ordinance for Atlanta, Ga.

The zoning ordinance passed by the City Council of Atlanta, Ga., on April 11 by nearly unanimous vote, establishes four use and three height districts and has lot area requirements in addition. The use districts are for dwelling houses, apartment houses, business and industrial purposes. The building height limit for the three districts are 50, 100, and 150 ft. The basis for lot area requirements is the number of housekeeping units for which the residence building is designed. For much of the dwelling house area 5,000 sq.ft. of lot area per family is required and for sections suited to double or two-family houses, 2,500 sq.ft. per family is required. In apartment house sections, only 625 sq.ft. per family is made necessary, and in the limited hotel and elevator apartment sections there is no minimum lot area requirements, but side, rear and front yards are necessary. The zoning plan and ordinance was prepared for the City Plan Commission of Atlanta by Robert Whitten, city planner, Cleveland, Ohio. Mr. Whitten started his zoning studies in May, 1921, and the zoning ordinance became effective in April, 1922. During this period, Mr. Whitten states, "The initial indifference or opposition of the public was overcome by an intensive educational campaign in which newspaper articles, editorials and cartoons played an important part." In addition, 5,000 copies of a tentative zoning map, together with a descriptive illustrated pamphlet, with the reasons for zoning stated, were circulated.

Missouri River Bank Erosion Checked by Rafts of Bridge Ties

EMERGENCY current retards consisting of rafts of bridge ties, with willow screens below the downstream side to cause the deposit of silt, were employed to check erosion on the east bank of the Missouri River, in 1920, when erosion threatened the Chicago, Burlington & Quincy R. R. near Folsom, Iowa. This construction was a modification of the retards composed of anchored trees, as used elsewhere on the river and described in *Engineering News-Record* Oct. 5, 1921. The raft system was adopted in this case owing to the scarcity of trees in the neighborhood and the urgent necessity of providing immediate protection. Mattress work placed along the bank had proved ineffective owing to undermining of the toe.



RAFT TO CHECK RIVER BANK EROSION

Three rafts were used, 200 to 400 ft. long and about 1,250 ft. apart, extending out from the shallower water along the bank. Each was about 27½ ft. wide, being composed of three rows of 10-ft. ties, 8 x 8-in., having a hole bored near each end so that they could be strung on four ¾-in. wide cables, as shown in the accompanying drawing. The ties were spaced 24 in. c. to c. by means of blocks, which also were bored for the cables. Diagonal lines of cable laid across the raft and stapled to the ties maintained the raft in its rectangular form. Each raft was anchored by cables to concrete piles about 100 ft. upstream and spaced about 110 ft. apart, these piles being sunk till their heads were below the river bed.

To the downstream end of the retard were attached three rows of bridge stringers about 2½ ft. c. to c. and having willows attached to the outer stringer, as shown. As these willows soon began to hang down in the water, due to the sand accumulating on their leaves and boughs, they caused rapid silting beneath the floating retard or raft. A willow fence was built across a strip of low marsh land between high ground and the shore end of the retard in order to prevent water, backed up by the retard, from finding a course across this low land. The fence, formed by two rows of willows about 2 ft. apart, was buried during the first year, the depth of filling amounting to about 4 or 5 ft.

This shore protection proved successful and the fill, which is 6 or 8 ft. above normal water level, was utilized for farming during 1921. Work is to be continued for about three miles downstream in 1922. Portions of the rafts were salvaged in 1921, for use elsewhere, if necessary, but the remaining parts were so buried in the silt that it was impracticable to remove them.

Retards of the tree type are considered generally preferable to the rafts on account of ice conditions in the river. Ice floes would probably break or carry away

rafts, in spite of anchorages. But with trees pointing downstream and having their trunks anchored to the bottom and partly buried in silt, the ice floats over the boughs at the surface. Further, the trees practically fill the space from the river bed to water surface and thus cause more extended silting than the surface raft with willow screen. Both the raft and tree retards mentioned were designed and built by the Woods Brothers Construction Co., Lincoln, Neb., of which Wayne Pringle is chief engineer. The work was done under the direction of A. W. Newton, chief engineer of the Chicago, Burlington & Quincy R. R., and C. L. Persons, assistant chief engineer.

Causeway Succeeds Lynn Floating Bridge

DURING the past year the old "floating bridge" over Glenmere Lake on the line of Western Ave., Lynn, Mass., formerly the Salem Turnpike, was replaced by a new structure. Both the floating bridge and its successor are interesting in type. Notes on their construction are given below, from an account of the county engineer, R. R. Evans, of Salem, in his 1921 annual report, just published.

Dating back to the early part of the past century, the floating bridge, whose final stage of development produced the typical cross-section shown in Fig. 1, "was the solution by the early builders of the problems confronting them at the beginning of the nineteenth century in laying out the Salem Turnpike from Salem to Chelsea Bridge." It crosses the small lake, about 500 ft. wide, although a deviation of 1,000 ft. would have taken the road around the lake. The lake is nowhere more than 10 or 12 ft. deep, but its bottom is mud to a maximum depth of 30 ft. Probably for this reason the bridge was originally built as a floating structure. In recent years only the upper part floated, it is believed.

Mr. Evans considers that probably the two courses of logs at the bottom, the 6 x 6-in. longitudinals and the

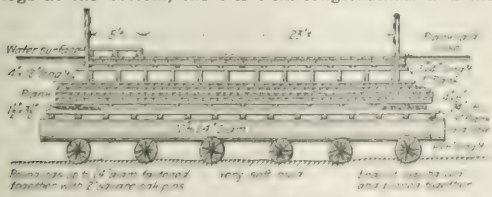


FIG. 1. CROSS-SECTION OF "FLOATING BRIDGE" OVER GLENMERE LAKE, LYNN

3-in. transverse planks constituted the original bridge, and that the timber above this point was added later, from time to time. The depth of the structure as it existed in recent years would bring the bottom just about to the mud line at the deepest part of the lake, while near the shore the logs were undoubtedly buried in the mud. It is believed that only a few of the upper layers of the structure floated in recent years. That some of the structure floated was indicated by undulations in the bridge whenever loads crossed, the water coming up onto the roadway around the load. But in the removal most of the logs of the lower part would not float, while the whole top portion of the bridge could be removed intact and floated off.

For the new bridge a masonry-walled solid-fill on submerged timber trestle was adopted (see Fig. 2). The substructure has bents 7 ft. apart, the piles being cut off and capped with 12 x 14-in. caps. The deck over these consists of 6-in. longitudinal timbering, edged on each side by two heavier timbers notched into the cap to hold the sidewalls more securely. The side walls, 6 ft. high, or 4 ft. above normal water level, have a construction joint at each bent.

It is believed, says Mr. Evans, that this type of structure is best adapted to the conditions encountered, since it should be permanent, is probably less expensive than an earth fill, and avoids settlement as well as heaving of the bottom.

For the work of removing the old bridge and building the new, the lake was pumped down 5 ft., bringing it

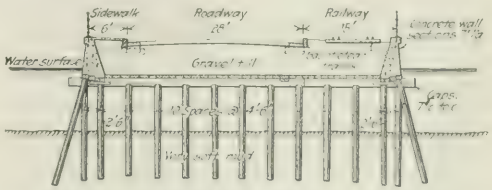


FIG. 2. SECTION OF NEW GLENMERE LAKE CAUSEWAY

about 2 ft. below the deck of the new structure. The old structure was removed by taking out the upper parts of the timber work by a derrick working from each end, and blasting out the lower part by dynamite placed in the holes drilled in rows across the bridge. Only so much material was removed as would interfere with the new structure.

The cost of the work was about $105,000, of which nearly $20,000 was paid by the trolley company for whose use the westerly 18-ft. width was provided. T. Stuart & Sons Co. were contractors.

New York Highway Types

There are only two general types of pavement—concrete and bituminous macadam—which are being constructed in New York State in any considerable amounts, according to the 1921 annual report of Herbert S. Sisson, state highway commissioner. Of all highways constructed this year 56 per cent have been of the concrete type and 44 per cent of the bituminous macadam type. Before a determination was made on any contract as to type a study was made of the local available material, general traffic conditions, relative importance of the highway, soil and frost conditions affecting a rigid pavement, and character of the country through which the highway passed. Comparative estimates in each case were prepared in connection with other data at hand before making a determination. Generally speaking, where satisfactory local stone was not available, the concrete type was adopted on account of the smaller amounts of material to be imported. Where local stone was available in ample quantities on routes of secondary character, bituminous macadam was usually selected of a thickness of approximately two and one-half times that of the concrete.

A Challenge to Accepted Theories of Highway Finance

Fifty-Year Bonds Advocated on Assumption that Roadbed Is Permanent and that Maintenance Includes Resurfacing

By Robert Murray Haig, Ph.D.

Professor, School of Business, Columbia University; Secretary, Special Joint Committee on Taxation and Retrenchment of the Legislature of the State of New York

THE demand for more and better highways arising from the great increase in motorized traffic during the past few years has resulted in a financial problem so great as to make imperative a critical re-examination of the accepted theories of highway finance. Few realize that our states and localities are now spending most of their money for two purposes—roads and schools. There seems to be almost no limit to the need for additional funds for these two purposes alone. Our theory of finance with respect to roads must be developed and refined if the necessary road support is to be secured and if serious consequences to the motor vehicle industry, to the taxpayers and to the community as a whole, are to be avoided.

Many leaders are beginning to appreciate the truth of these statements and the importance of the situation. During the past few weeks an attempt has been made to secure from students of the problem a sharper definition of the questions which must be answered. Various highway engineers, tax experts and others have been consulting as to the possibility of securing a correct analysis of the problem and a sane program of finance. It is the purpose of this article to set forth some of the questions which have been raised and some of the tentative conclusions which have been reached in the hope that discussion may be stimulated and progress made toward a revised and more scientific theory of highway finance.

There appear to be two fundamental questions. The first relates to the division of the cost of supplying highway facilities as between present taxpayers and future generations. To what extent shall the roads be paid for by taxes and to what extent by bonds? The second relates to the division of the cost as between users of the road and taxpayers in general. To what extent shall the roads be paid for by motor car fees or gasoline taxes and to what extent by the general tax levy?

If it is possible to arrive at the correct answers to these two questions the problem is solved. But the correct answers involve a combination of engineering knowledge and sound economic analysis.

1. *Cost Division Between Present and Future Generations*—Certainly the present taxpayers want good roads. They want and they deserve as many good roads as are economically justifiable. But how much of the cost of a good road may fairly be charged to the present generation and how much to the future? If the present generation pays the entire cost of all the roads built it is obvious that fewer roads can be built than if a portion of the cost were met by the proceeds of bonds. But just how much of the cost may be bonded in a sound and defensible financial program for roads?

The general answer is simple enough. Any debt which the present generation passes on to the next must be adequately covered by sound assets passed on to that generation. That is the theoretically correct answer. In general each generation should pay its way. This is axiomatic.

However, when one examines the current applications of this axiom, he finds much bungling because of inadequate analysis of the facts. Consider what the chief of the U. S. Bureau of Public Roads, Thomas H. MacDonald, says regarding one such case of bungled application:

"We have had it imposed upon us almost as a commandment that *'Thou shalt not build a road which will not last longer than the life of the bond.'* Granted. But is the life of the road merely the life of the surface? Because a highway surface goes to pieces are we to conclude that the entire investment in the highway has been lost? To take a specific case:

"The State of New York has issued road bonds for about $100,000,000 and I have seen within very recent times articles written in which it is said that the roads are going to pieces so badly that they will be gone before the bonds have been paid. Probably the road surfaces built with the proceeds of those particular bonds will be gone before the bonds are paid. But it is a fact that this year in New York State we (the Bureau of Public Roads) in co-operation with the state are widening those old macadam roads with 18 ft. of concrete, leaving a strip of the old macadam in the middle. This work has only just begun but successfully so, and the result is a 24-ft. surfaced roadway in place of the old 12- or 14-ft. macadam surface on the same roadbed that was built with the bond money and at a cost which is enough less than the average cost of the new construction of concrete 18 ft. wide to absorb the first cost that the state has invested.

"In other words, so far as I can see it, New York State by the investment of $100,000,000, and by building cheap roads when her needs were for cheap roads, has been having the service of those roads all these years at not to exceed the interest cost and has all the investment left.

"So it is apparent that we must learn to differentiate between the permanent and transient features of the road. In fact, while we expect the surfacing to wear with use, we have perhaps overlooked an actual increment in value in the permanent investment as the years go by. In other words, the subgrade is better as it becomes compact, the bridges are improved, the hills are cut, the safety factors are strengthened and railroad grades eliminated. Use of the road may deteriorate the surface; it only enhances these other factors. It is because of this attention to the subgrade that the old roads of Rome and France are still in use today."

Mr. MacDonald's conclusion that "we must learn to differentiate between the permanent and transient features of the road," based as it is upon the extensive surveys of the Bureau of Public Roads in New York, California and elsewhere, gives a dependable engineer-

ing answer to the economist's query regarding the soundness of the asset which may properly be passed on to the next generation. It holds forth a hope of determining in a fairly definite and precise way what each generation must pay if it is to "pay its own way."

New Definition of Maintenance—It is suggested (The writer desires to disclaim any personal credit for this suggestion but wishes to register his belief in its soundness. It is the result of much discussion to which the writer contributed far less than many others.) that a good method of meeting the problem of differentiating "between the permanent and transient features of the road" would be to establish a new and broader definition of maintenance. If maintenance, to be cared for by the present generation, were so defined as to include not merely day-to-day and year-to-year expense of keeping the highway in serviceable condition but also the replacement of the surfacing when needed, the road would never wear out, but would be turned over to the next generation with its value unimpaired. A road once built to a given standard would be "maintained" for all time to that standard, each generation assuming responsibility for preserving the soundness of the asset during the period it used it. It would appear reasonable to classify as "permanent features" such items as grade reduction, new drainage structures, new alignment and the excess cost of replacing an inferior surface with a superior type. However, if a hard surface be replaced by a new hard surface of the same class the entire cost of replacement would be charged to maintenance or current expense as a transient feature.

Such a definition of maintenance of course destroys the foundation of the standard argument against long-term bonds for highway construction. The life of the road is indefinitely long.

The argument thus far, however, ignores the possibility that, in the far-distant future, roads may not be so useful to society as they appear to be to the present generation. Consequently caution dictates the amortization of the entire road cost over a reasonably long period—perhaps 50 years.

It appears, then, that by the adoption of a definition of maintenance such as that suggested above, the entire original cost of a road might conceivably be bonded on a basis of perhaps 50 years. The theoretical minimum which might fairly be charged against the present generation would then be the sum of (1) an adequate maintenance allowance, (2) interest on the bonds and (3) an amortization item sufficient to retire the bonds in 50 years. The theoretical maximum which could properly be passed on to the next generation would be the bonded indebtedness, reduced by the amount of the accumulated amortization items, against which would exist the roads themselves in a condition as good as when originally constructed.

It must be borne in mind that the above analysis deals with a theoretical maximum and minimum. If space permitted it would be pertinent to discuss the advantages of departing from those limits in rich communities as compared with poor communities and in communities with a bright outlook compared with communities whose "futures lie in their past."

2. *Cost Division Between Road Users and General Taxpayers*—Irrespective of whether the above analysis or some other is finally accepted as the proper one for determining the portion of road costs which shall be absorbed by the present generation, the question remains as to how the cost to be currently absorbed shall be distributed as betwween the user of the road and the general taxpayer. The analysis given above is very suggestive, however, in the search for a solution of the second question.

Motor vehicles as a test of general taxpaying ability have obvious disadvantages and although many states continue to tax them as personal property the trend is definitely away from this practice. Motor vehicle taxes are coming more and more to be pure efforts to measure the use of the roads.

It is also true that while motor vehicles are not the sole users of the road they are usually the only users to be subjected to a special tax. There is some justification for the practice of confining the taxes to the motor vehicles in the fact that the additional road costs which are the occasion of the present difficulties are demanded by the users of motor vehicles alone.

The recent report of the New York State Special Joint Committee on Taxation and Retrenchment contains the following clear analysis of the theoretical problem involved in determining these additional costs. (Report submitted March 1, 1922, pages 132-134. Copies of this report can be secured by addressing Senator Frederick M. Davenport, State Capitol, Albany, New York.)

"The question arises as to whether the whole cost or only a part, and, if only a part, precisely what part, of the costs should be borne by the user.

"Some of the enthusiasts for heavy motor fees seem to forget that roads and streets were considered necessary before the advent of the automobile and the truck and that the public's interest in these roads and streets was often considered sufficient to justify their construction and maintenance as a general public charge. In the case of city streets, of course, it has been a general practice to charge a portion of these costs to the land immediately served, in the form of special assessments. . . .

"On the other hand, some of the representatives of the motor vehicle interests go to the other extreme, asserting that the public builds roads for itself, free for all to use as they choose, and that it is unfair to charge any part of the cost to any particular group of users.

"It seems to the committee that the true view is one which lies between these extremes. That there is a general public interest in the streets and highways is true, but it is equally true, that when these streets and highways cost more than they otherwise would because of the necessity of supplying accommodations to a particular group of users, such additional cost may be properly chargeable to those particular groups. The problem is to draw the line.

"In cases where the roads are used for business the term 'user of the road' must be understood to be the person for whom the service is rendered. . . . A charge on the user of the road would under the present system be imposed, of course, upon the truck, but it will appear as a business expense of the truck owner, who must pass it on in higher prices to the consumer. . . . If the true costs of truck-borne eggs [for example] including the cost of supplying any additional road facilities involved in the use of the truck, is not charged to the buyer of that egg, the egg carried by the railroad is discriminated against, for it must cer-

tainly be sold at a price which covers the entire cost of its transportation. . . .

"The conclusion is that only by charging to the user of the road the community costs involved in supplying him the additional road facilities required by him in his use of the roads can the motor truck competition with the railroad be placed on a basis which will insure an economically sound decision in the struggle between the motor truck and the railroad. This is the only way to keep the account straight, so that an industry whose proper development means so much to the solution of the transportation problem may be neither repressed or unconsciously subsidized."

Charges on the user of the road rest on the benefit principle of taxation. They attempt to apportion the costs as accurately as possible and to ask the person who desires the direct benefit to meet the cost which his use of the road entails. The advantage from the point of view of persuading taxpayers to support a program of road improvement in times of financial pressure like these lies entirely with the plan of imposing charges on the benefit principle rather than on the principle of 'ability to pay' which is depended upon to justify general taxation. Under the benefit principle the man pays directly for what he gets and can readily compare the cost he pays out and the benefit received.

The recent traffic counts indicate that the main roads in many sections are being almost monopolized by motor vehicles. This raises the question as to *whether the entire cost of maintenance as above defined might not be fairly charged to the user.*

The portion of the interest and amortization charges which the user should assume constitute the nub of the tax problem in this field. Much can be said in defense of the assumption that the roadbed would be necessary irrespective of motor traffic and that *the maximum part of the capital charges which may be fairly imposed upon the user would be the portion which the cost of the special surface bears to the entire cost of the road.* This figure could be readily determined.

Conclusion—The above discussion is far from exhaustive. However, it is hoped that even though the constructive suggestions do not win general assent, the analysis may stimulate discussion which will lead to a more rational system of highway finance—one which will build roads as quickly as economically desirable—and not more quickly—one which will not unfairly repress nor yet subsidize the automotive industry—and one which will distribute the tax burden fairly.

Large Railway Gasoline Motor Car

A LARGE steel double-truck gasoline motor car for railway service has been built recently to provide greater accommodation than the small cars now in operation on several railways, and to meet a preference of railway officers for cars mounted in the usual way.

An entirely new design was made for this car, which is not a converted motor truck. It is 42½ ft. long over all, 8 ft. 4 in. wide and 10 ft. 8 in. high over the ventilators, with a weight of about 13 tons. Steel is used for the framing, with ⅜-in. side plates up to the level of the windows. A rear vestibule forms the entrance to the main compartment, which has seats for 38 passengers; drop seats in the baggage room increase the seating capacity to 46. A 60-hp. engine drives both axles of the leading truck. In trial runs on the Cleveland, Cincinnati, Chicago & St. Louis Ry. between Wabash and Milford, Ind., a round trip of 92 miles, the normal speed is 37 m.p.h., with a maximum of 48 m.p.h. The car will make about 30 m.p.h. on a grade of 1 per cent. During these runs the car has averaged 5.3 miles per gallon of gasoline.



DOUBLE-TRUCK GASOLINE CAR FOR RAILWAY WORK

This new car, built by the Service Motor Truck Co., Wabash, Ind., is a development from a four-wheel 32-passenger car which was built by the same company and has had a year of successful operation on the Winchester & Western R.R. (see *Engineering News-Record* of April 14, 1921, p. 648). The smaller car, with a daily run of 90 miles, has an operating cost of about 10c. per mile, according to C. H. Sencindiver, general manager of the railroad. The daily cost is as follows: Crew, $5.80; gasoline, $2.40; oil, 15c.; repairs, etc., 50c.; total, $8.85. A light trailer is hauled for carrying express. The line has 4 per cent grades and 16 degree curves. The schedule speed is 25 to 28 miles per hour.

Ten Tests of an Efficient Assistant

Engineers in executive positions who may have occasion to sum up in concise form the qualities they seek and value in subordinates will be interested in the following list on which British Civil Service employees are rated for promotion: 1. Knowledge of department (or branch). 2. Personality and force of character. 3. Judgment. 4. Power of taking responsibility. 5. Initiative. 6. Accuracy. 7. Address and tact. 8. Power of supervising staff. 9. Zeal. 10. Official conduct.

Diesel Engines To Furnish Power For Water-Works

New Station at Gloucester, N. J., To Be Equipped with Motorized Pumps and High-Economy, Oil-Engine-Driven Generators

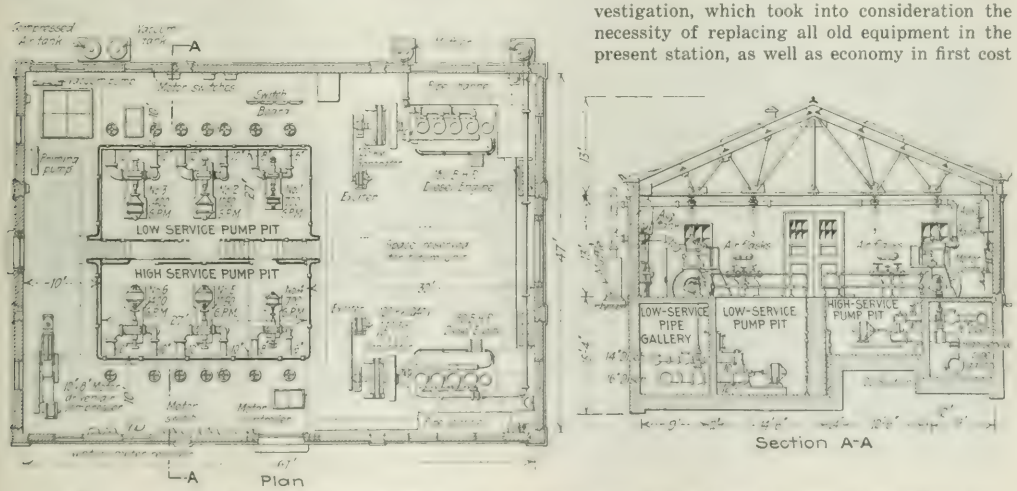
By W. DeWitt Vosbury
Of Remington & Vosbury, Consulting Engineers, Camden, N. J.

DIESEL-ENGINE-DRIVEN generators will be used to furnish power for the electrically-operated pumping station now under construction at Gloucester, N. J. The present plant was built in 1883. It is steam-driven and has for its source of supply a number of wells varying in depth from 100 to 500 ft. Water is raised from the wells by an air-lift system and conveyed to a small receiving basin, from which it is pumped by low-service, direct-acting pumps to two elevated settling tanks. After settling, the water flows by gravity through rapid sand filters to a large clear-water reservoir, from which it is pumped by two 2-m g.d. horizontal, crank-and-fly-wheel pumping engines into the distribution system. Sedimentation, followed by filtration, is necessary to remove the iron with which the water is impregnated.

Some two years ago it became evident that radical alterations and improvements were imperative. Most of the equipment was badly in need of repair or replacement and the water supply was inadequate. In addition, the operating expenses were excessive, due to the fact that all water was pumped three times: (1) by air-lift from the wells to the receiving basins; (2) from the receiving basins by low-lift pumps to the settling tanks and filters; (3) from the clear-water reservoir to the distribution system. It was clear that any general scheme of improvement should first recognize the necessity of an ample supply of water, and second, the elimination of at least one of the three pumpings and a reduction in operating expenses.

The water supply was first investigated by the construction of four 8-in. wells, by a method not previously employed at this particular well field. The results obtained were so successful that the 18 original wells were abandoned and the four new wells only continued in service. Furthermore, it was determined by a series of careful tests, that, with six to eight wells of the new type, it would be entirely feasible to pump all water required for years to come by direct suction at a maximum draft of not to exceed 30 ft. below the present engine room floor.

It was decided to lift the water directly from the wells to the filter plant by pumps, installed in a suitable pit, thereby eliminating one of the three pumpings and at the same time the use of compressed air. Owing to the depth of the pit required, it was desirable to keep the pit as small as possible, to avoid excessive construction costs. For this reason, the use of steam-turbine-driven centrifugal pumps was first contemplated, but later abandoned, as it was found that, owing to the low power requirements of the pumps, it was not practicable to run the turbines with condensers and they would, therefore, be inefficient. Further investigation, which took into consideration the necessity of replacing all old equipment in the present station, as well as economy in first cost and efficiency in operation, led to the decision to construct a new station using electrically-driven pumps.



ELECTRIC-DRIVEN PUMPS AT GLOUCESTER, N. J., WITH GENERATORS DRIVEN BY DIESEL OIL ENGINES

The new station will have two sets of motor-driven centrifugal pumps, one for low service from the wells to the filter plant and the other for high service from the clear-water reservoir to the distribution system. Each set consists of three pumps, having capacities of 700, 1,050 and 1,400 g.p.m., respectively. The various combinations of these capacities will give pumping rates of from 1 to 4.5 m.g.d. at intervals of 0.5 m.g.d.

Both sets of pumps have been placed in the pit, which is 27 ft. square in plan and of two depths, the deeper half being occupied by the low-service pumps. On each side of the pit is a pipe gallery of sufficient space to accommodate and conceal the rather complicated piping required by the fact that the two larger units of each set are interconnected so that they may be operated in series as well as in tandem.

As previously stated, the current for operating the pumps will be furnished by either of two generating sets. Each unit will consist of a 120-kw., 240-v., 3-phase, 60-cycle generator, direct-connected to a

180-hp. vertical, four-cylinder, Busch-Sulzer, 300-r.p.m. diesel oil engine.

Current from the main panel board will be distributed through concealed conduits in the pipe galleries to the pump, motors and controllers. The latter will be attached to the walls on the ground floor, directly opposite the pumping units which they control. In starting or stopping the pumps it will not be necessary for the operator to descend into the pit.

In all ground waters there is more or less entrained air, which is released as soon as the pressure is relieved. Since the action of centrifugal pumps is particularly sensitive to the presence of air, even in small quantities, provision has been made for the trapping and removal of the air before the water reaches the pumps. At the point where the suction main enters the pipe gallery will be located a large, vertical, steel tank, through which all water from the wells must pass. This tank, with the aid of suitable baffles, will serve as an air trap. Located on the outside of the building and connected to the trap will be a large air receiver in which a constant vacuum will be maintained by an automatically-controlled, motor-driven, vacuum pump. Besides the vacuum system, there will be a special priming pump capable of exhausting the air rapidly from the pumps and suction mains whenever required. Provision for priming by water under pressure will also be made

In addition to the equipment already mentioned, a 10 x 8-in. single-stage, motor-driven, air compressor will be used to furnish air under pressure for cleaning the wells. For the purpose of keeping complete daily operating records of the station, suitable instruments will be installed to record the quantity of fuel oil consumed by the engine, the current used, suction lift, discharge pressure and gallons pumped.

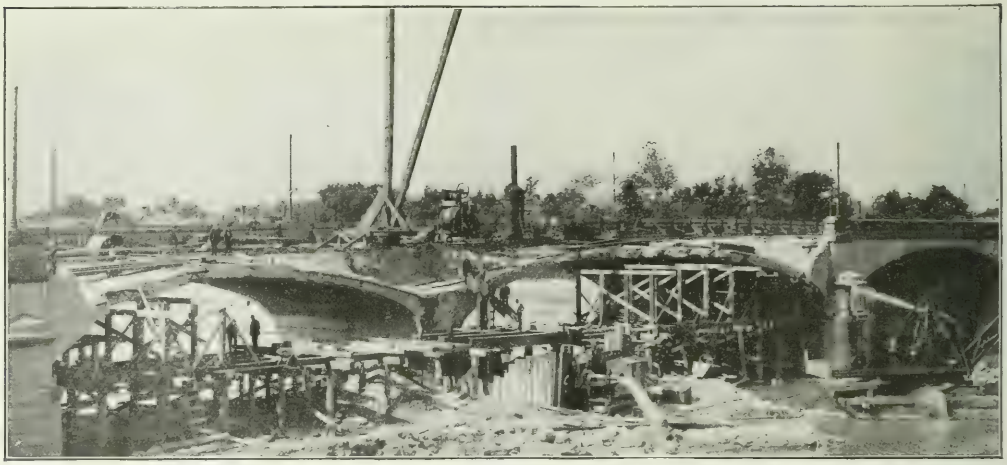
Upon completion of the new station, the equipment in the old building will be removed and a new, rapid sand filter plant installed.

The old station is now operating at the rate of approximately 2,000,000 m.g.d. In 1921 the cost of operation, including fuel, labor, repairs and miscellaneous items of expense, was $0.0577 per 1,000 gal. of water delivered to the distributing system. Based upon the guaranteed fuel oil consumption of 0.48 lb. per b.hp. hour and 0.6 gal. of lubricating oil per 1,000 rated hp.-hours, with liberal allowances for labor, repairs, supplies and miscellaneous items of operating expense, the estimated cost is $0.0290 per 1,000 gal of water pumped, or an expected saving of fifty per cent.

Timber Struts Under Compression Take Arch Thrust During Bridge Repair

By Fred M. Hall
Dayton, Ohio

A NOVEL method of counteracting the thrust of spans adjacent to the area to be repaired was employed during the reconstruction of the Third Street bridge in Dayton, Ohio, which failed in an unusual manner in February, 1921. Details concerning the failure and the proposed repair were contained in *Engineering News-Record* Feb. 10, 1921, p. 264, and March 24, 1921, p. 511.



A DETAIL IN THE RECONSTRUCTION OF THE THIRD STREET BRIDGE, DAYTON, OHIO

Four lines of timber struts, placed under 75 tons compression by hydraulic jacks, were built to relieve the damaged spans of the arch thrust of adjacent spans.

The method of repair planned by the consulting engineers consisted in unloading the spans at either side of the two which failed down to the arch rings in the upstream section, to cut the remaining portions of the arch rings in the spans that failed and to remove from the river channel a part of the pier that had broken off and all of the collapsed portion of the arch barrels. The plans also called for a new pier to be set 3 ft. deeper than the old one.

To carry out these plans a steel sheetpile cofferdam was sunk, enclosing the broken-off pier with the south wall, following the line of fracture. This south wall of the cofferdam acted as a cutoff wall between the part of the pier that had broken off and the good part which remained. The wall was sunk as the excavation in the cofferdam progressed and was left in place when the new pier footing was poured, the top part only being cut off.

In order to take the thrust of spans 1 and 4 (the spans at either side of those two that failed) against piers 1

and 3 (see accompanying photograph), four lines of struts 200 ft. long and extending from the springing line of pier 1 to the springing line of pier 3, were placed, with 75 tons compression in each line of struts. Piers 1 and 3 were first unloaded of pavement and spandrel filling down to the arch rings. The four lines of 12-in. x 12-in. timbers were constructed on falsework bents 10 ft. apart, bolted in perfect alignment and painted. The 75 tons pressure was secured by hydraulic jacks.

At a given point in each line of struts a 3-ft. section was left out and heavy cast-steel shoes were placed on the ends of the struts facing each other. These shoes extended beyond the strut on each side to provide bearings for the jacks. Two 60-ton hydraulic jacks were then inserted and when a pressure of 75 tons was reached, a 12-in. x 12-in. hardwood strut was sawed the required length and driven in between the shoes in alignment with the struts. The jacks were then released and moved over to the next line of struts and the operation was repeated.

The struts extended across pier 2 above the cofferdam. They were boxed in and concrete was poured around them during the pouring of the pier shaft. After the arch barrels had set, the struts were removed and the holes through the pier shaft were filled with concrete. Care was exercised during construction to protect the struts from falling material or from any jar which might affect their alignment.

The work was in charge of George F. Baker, city engineer, and the writer was resident engineer. Glen M. Wiley, Tippecanoe City, Ohio, the contractor, personally supervised the reconstruction.

Advocates Four-Inch Brick Walls

Four-inch brick walls for both bearing and non-bearing partitions were advocated by William Carver, architect of the Common Brick Manufacturers Association, in a paper read at the Building Officials Conference, Indianapolis, on April 25. Mr. Carver said that such walls are considered standard construction in Europe, that in England more than 90 per cent of all houses erected are built with 4-in. interior bearing partitions, and that 2½-in. partitions, built of brick laid on edge, are extensively used there for non-bearing purposes. Tests made by an English building materials research committee were quoted to show the strength of such construction. They were made on 4-in. and 2⅝-in. walls, and included tests of pillars 14 in. wide and 42-in. lengths of wall, both 8½ ft. high, the pillars being tested under vertical load only and the wider sections under a combination of vertical load and horizontal pull at mid-height. The ultimate strength of the 14-in. pillars was found to be about two-thirds of the crushing strength of 9 x 9-in. cubes, ranging from 330 to 1,040 lb. per square inch for the pillars as compared with 720 to 1,530 lb. per square inch for the cubes. In the case of the 42-in. walls under a load generally of 3½ tons, a horizontal pull of 375 to 895 lb. at mid-height was required to break the wall. The low result in each case was found for a 4½-in. wall laid up in lime mortar. The 2⅝-in. wall, laid up in 1:3 cement mortar, gave results barely inferior to those found for a 4½-in. wall, namely, 1,040 lb. per square inch crushing strength on the 14-in. pillar, and 553 lb. horizontal pull required to break the 42-in. section of wall under 3½ tons load. All the tests were made at about one month age.

Germans Learn Lessons from First Concrete Building Fire

Combustible Contents Destroyed Because of Poor Fire Protection—Concrete Structure Stands Up Well

IN THE complete destruction of the contents of the factory buildings of the Sarotti Co. in Berlin, Germany, last January and the severe damage to the concrete structures German engineers have had their first experience with a severe fire in a large reinforced-concrete building. As a result they have learned a number of lessons regarding the necessities of fire protection in what has been assumed to be a completely fireproof structure and have had confirmed their faith in the fire resistance of well made reinforced concrete.

The building in which the fire took place was five stories high, a beam-and-girder reinforced-concrete



OPENING ON INTERIOR COURT AFTER FIRE

building of an outside plan area of 255 x 180 ft. with an interior court about 50 x 70 ft. Each of the five floors was open and all were connected by staircases on the interior court, well protected against the floor itself but with only plain glass windows opening on the court. A basement under the whole structure had skylights opening into this same court.

The building was filled with highly combustible materials, in the basement wood shavings and packing materials, and in the rest of the building mostly chocolate and cocoa beans. The fire broke out in the basement and rapidly spread over its entire area breaking through the skylight into the open court, which formed a chimney carrying the flames up to the exposed windows on each floor. These windows were soon broken through and every floor completely gutted of its contents. So confident were the owners of the fire-resisting qualities of the factory that the workmen were not even called out of the upper floors when the fire was first discovered in the basement, and due to the exposure through the open glass, the fire-escape stairway became impassable and many workmen had to be rescued by the fire department through outside windows.



ONE OF THE FLOORS AFTER THE FIRE
Spiral columns exposed in background; expansion joint open in ceiling.

It is reported that an inspector after the fire found that every single piece of material that could possibly burn in the building had been consumed and that only the reinforced-concrete structure itself remains and this badly damaged in places. The principal damage is of the type shown in some of the views, that is the crumbling off of the outer layers of concrete and the exposure of the steel. So far as has been learned, no complete failure occurred except in one staircase in the basement exposed to the direct play of the flames in the initial fire. It is stated that the columns were in practically every case exposed down to the spiral reinforcement, that the girders more frequently had only a surface spalling, and that the floor itself was quite well protected. The greatest damage was in the top floor which was chiefly occupied by bunkers for storing the cocoa and cocoa beans. Here the concrete was very seriously damaged so that it will probably have to be replaced.



DESTRUCTION ON ONE OF THE FLOORS
Surface spalling apparently only damage here.

A curious phenomenon in regard to an expansion joint is reported by the German engineers. It is stated that there was such a joint across the whole width of the building, about ¾ in. wide and filled with wood. Great alarm was taken during the fire from the fact that contrary to all expectations this joint instead of closing widened, showing an opening of nearly 8 in. running crosswise of the whole building. When this happened the firemen were recalled for fear that the whole building would come down. This contrary behavior of the expansion joint is still a puzzle to all the experts. The wood filling was completely burned out. Many theories have been formed in explanation, the most feasible of which is based on the fact that the butt ends of the joint in the lower floors showed signs which would indicate that the joint there had first closed under pressure. It is being pointed out that the heat in the concrete structure was at first not uniform, spreading from the interior toward the outside and from the lower stories upward. The expansion would, therefore, greatly differ. While a certain warping of the floors may have occurred laterally, it is considered most likely that the expansion joint closed at the lower stories under the first effects of the fire and the expansion allowed thereby being insufficient the direction of the forces was reversed with a tendency to open up the joint in the upper stories.

Registration Urged by Architects

Reporting on an investigation of the collapse of the Knickerbocker Theater roof in Washington, a committee of the local chapter of the American Institute of Architects has recommended compulsory inspection of construction work by the owner and his architect, and followed this by presenting a strong plea for registration of architects. The report is published in the April *Journal* of the institute.

On the former point, it proposes that the building regulations of the District of Columbia be amended to make it imperative for the owner to employ a competent "clerk of the works" constantly on the building during its construction, this clerk acting under the direction of the architect. His duties would be to check all materials delivered against the drawings and specifications, and to check the quality of the workmanship. It remarks that "the office of the Building Inspector should not be required to maintain a force of inspectors sufficiently large to provide proper inspection of all building operations in the district. This is an entirely unnecessary expense, which expense is not borne by those receiving the benefits." It also comments on the division of responsibility between builder and contractor by stating that the contractor "should not be held responsible for any architectural or structural feature of the design" but should be responsible only for proper execution of the contract requirements.

On the subject of registration, the report says: "Architects without adequate training, draftsmen without any training at all, should not be permitted to practice. The public is paying continually for improper and inadequate advice from men without proper training and experience. The chapter should press with vigor the measure now before Congress providing for the registration of architects. Why should an architect be permitted to practice without proper education any more than a doctor or lawyer."

Anomalous Results in Venturi Flume and Meter Tests

A Discussion of the Peculiar Variations of Venturi Coefficients of Discharge—Wave Formation, Air and Other Theories

By William J. Walker
University College, Dundee, Scotland

THE paradoxical results which frequently occur in hydraulic work, particularly under low rates of flow, are illustrated by the data obtained in the tests of a Venturi flume given in the article by P. S. Wilson and C. A. Wright, in *Engineering News-Record*, Sept. 2, 1920, p. 452. Before attempting to throw some light on questions raised by the article cited a portion of it will first be abstracted from the article mentioned.

H	H_t	C
0.178	0.025	0.983
.112	.010	1.000
.063	.002	1.036
.038	—.002	1.112
.025	—.003	1.211
.017	—.004	1.320
.014	—.004	1.384
.010	———	1.411
.0105	———	1.678
.007	———	1.800

Fig. 1 shows the peculiar and perfectly definite nature of the change which is taking place in the recorded results, the value of C, the coefficient of discharge, being obtained by the application of the orthodox equation

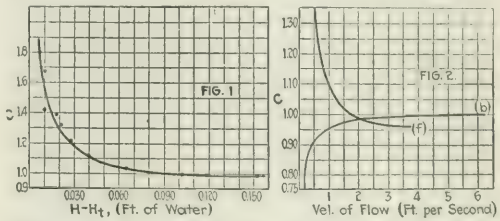
$$C = \frac{v}{\sqrt{2gh/m^2 - 1}} \quad \ldots\ldots\ldots\ldots (1)$$

where v = velocity of water in feet per second and h = pressure difference in feet of water between entrance and throat $= H - H_t$.

A paper by Prof. A. H. Gibson (Proc. Inst. C. E., Vol. VXCIX, p. 392) gives a series of the same type of curves as the above, but for Venturi meter flow. Some of these curves (Fig. 2) show that in certain cases, the results are similar to those of Fig. 1, while the remainder show the exactly opposite tendency, namely a decrease in C with a decrease in velocity of flow. The difficulty of explaining such conflicting results is at once apparent, since any explanation applying to one type of curve obviously cannot account also for the other type. The writer has obtained similar results for many experiments on Venturi meter flow, the type of curve in which the coefficient of discharge, C, increases as the rate of flow diminishes being, for his own experiments, by far the most common.

Several arguments have been advanced by different experimenters to account for such results but no satisfactory explanation has yet been advanced, so that, perhaps, the writer may be pardoned for introducing subject-matter here, which while not professing to solve the problem, may at least offer a clue to its solution.

The anomalous results, as given above, were assumed by the writers of the article in question to be due to wave formation. This, although the evidence of eye witnesses, does not appear very convincing, since at such low rates of flow at which the paradoxical results are obtained, the wave formation set up, if any, would not be very likely to have the effect of increasing the coefficient of discharge, C, as the velocity of flow is diminished. From the brevity with which the difficulty is dismissed, however, it may have been considered that the matter was of little moment so far as the main object of the tests was concerned, and so received little consideration. It is important to note, however, that the results of such flume tests entirely negative an explanation which is commonly advanced with regard to similar Venturi meter results. The explanation in question is based on the fact that meters which give abnormally high values of C at low velocities are invariably working under negative throat pressures. This then, it is claimed, results in the liberation of air at the throat, thus increasing the throat gage reading and so giving a fictitiously high value to C. According to the arrangement of the flume experiments



VENTURI FLUME AND VENTURI METER CURVES

no such explanation is valid, since the throat of the flume is open to the atmosphere.

In the most recent development of the mathematical treatment of fluid motion it is now generally agreed that, based on the application of the principle of dynamical similarity, the resistance to fluid motion may be written (Advisory Committee for Aeronautics (London) 1909-10. "Note on Dynamical Similarity," Rayleigh) in the form:

$$R = \rho v^2 f\left(\frac{m}{vl}\right) \quad \ldots\ldots\ldots\ldots (2)$$

and the general form which is usually given to the function f is such that for any system of fixed dimensions

$$R = Av + Bv^2 \quad \ldots\ldots\ldots\ldots (3)$$

where A and B are constants. Results, however, are frequently obtained which are not amenable to the use of this formula unless the sign of the constant, A, may be allowed to be negative. (Advs. Comtee. 1910-11. See also "Motion of Liquids," p. 178, Villamil.) If such is the case, the only admissable formula which may be applied is

$$R = K + Av + Bv^2 \quad \ldots\ldots\ldots\ldots (4)$$

where A may be positive or negative.

The term K must, of course, be very small but it does not appear to be difficult to imagine it as a resistance force independent of velocity and due to the surface tension and adhesive forces of the fluid at the boundary surfaces. It is not so easy, however, to account for results for which A has a negative value. This constant is usually spoken of as the viscosity constant, and by the definition of viscosity, it cannot have a negative value. To define a property of matter, however, does not necessarily mean that its entire significance has been grasped. The writer is one of those who, although constantly applying the definition to his own experimental results, does so with a feeling of its incompleteness. The object of the present article,

however, is to draw attention to, and emphasize the fact that, granted the reliability of experiments which have given negative values of A, the analytical curves derived from (4), when A is given positive and negative values respectively, are exactly similar to the Venturi meter and flume curves illustrated in Figs. 1 and 2. This analysis is given by the writer in two short papers published in the *Philosophical Magazine* for February and July, 1921.

It will be observed, of course, that fluids behaving according to an equation of type (4) cannot be strictly amenable to Bernouilli's theorem, although under ordinary conditions they may appear to be so amenable. It will be only under certain conditions, such as say, rapid convergence of boundary walls or low velocity of flow, in which the application of Bernoulli's theorem will give the anomalous results so often observed.

Attention is here drawn to a fairly common explanation of these anomalous results, which appears to be based on a misapplication of Bernoulli's theorem. The argument is adopted that for streamline flow the kinetic energy across a section is $\frac{v^2}{g}$ per lb. of water (where v is the average velocity of flow across a section) and not $2g$ as usually applied in the fundamental equation. If, then, it is assumed that there is streamline flow throughout the meter or flume, and the kinetic energy be written $\frac{v^2}{g}$ instead of $\frac{v^2}{2g}$, a value of C is obtained which is in the neighborhood of 0.7, and it is claimed that this accounts for the low values sometimes obtained. The flaw in the reasoning lies in the neglect of any averaging of the pressure energy values also over a cross-section. Bernoulli's theorem is strictly applicable to a single streamline. If it is applied to a series of contiguous streamlines, the kinetic energy of these as carried out above, by averaging the velocities squared, gives a value which is certainly half that of the same number of streamlines of common velocity, v. It cannot be assumed, however, as is implicitly done in the above explanation, that the pressures along the lines would be the same in both cases. If such were so then the only logical conclusion is, that the theorem applies to the fluid in bulk, but does not apply to the streamlines themselves. It certainly cannot apply to both, if v is considered as the average velocity in each case.

In the same way by the assumption that there may be, in certain cases, critical velocity at the throat with streamline motion at the entrance to meter or flume, it can be shown that C may have values slightly greater than unity, although not nearly so high as those which are frequently obtained.

To account for the latter high values, an ingenious, though in the writer's opinion untenable, explanation is given in an article entitled "A New Hydraulic Paradox," published in London *Engineering*, May 27, 1921. In this, these high values of C are attributed to the assumed reversal of the radial velocities of the water particles as they strike the orifice of the pressure-measuring devices used. As such reversal will normally give rise to twice the pressure which would be obtained if the radial velocity of each particle were simply annulled at the wall, then at the throat of a meter, where higher velocities prevail, higher pressure reading discrepancies will occur, and these will result in abnormally high values of C. The objection to this explanation is that water particles, moving in bulk at least, do not behave so that they assume equal and opposite reversal of velocity on impact against a solid surface. Even under turbulent motion conditions, when a high velocity jet of water strikes a flat plate at right angles to the stream, the bulk of the water travels over the surface of the plate and does not rebound (even where the splashing effect is considerable) with anything like equal and opposite reversal of velocity. In the case of the pressure-measuring device, the possibility of reversal of the radial velocity of the particles on the open end of such devices (the impact of water particles on a water surface) would appear to be even less probable.

The writer's own view after deducing the analytical curves based on (4), which curves turned out to be similar to those so frequently obtained, was that the stationary film (if any) of fluid next to the boundary walls might be in some state of fluctuating strain due to periodic breakdown of the film during flow, the action of this film being presumably the hitherto neglected factor in analysis. He has since, however, carried out experiments involving the passage of polarized light both along and at right angles to the line of flow in glass and metal tubes but has detected no state of strain or change of strain, in either case, in the boundary layers. It may be that the effect was too feeble to be observed under the conditions of these experiments. In any case, although this view has, so far, been apparently negatived, the important fact remains that the representation, graphically, of C against head or velocity of flow, as deduced from (4), gives curves similar to those obtained in practice, whereas other theoretical explanations account only for single definitely high or low values of C, and not for values which vary continuously from normal to abnormally high or low values. Although the action which is taking place has by no means been made clear it is hoped that the foregoing treatment of the subject may lead to some further elucidation of the difficulty.

Highway Construction in Britain

(London Correspondence)

It is probable that the outlay on British road construction for the year ending March 31 will exceed £50,000,000, as compared with £20,000,000 in the year 1913-1914. On the 23 road schemes originated with the idea of alleviating unemployment the road fund of the Ministry of Transport had provided £1,200,000 in grants and £623,000 in loans. An important feature of these road schemes, both in urban and rural areas, is the width provided. On the majority of these new roads the width between fences is 100 ft. and in some cases it is 120 ft. Says the Ministry of Transport: "The necessity for the creation of many of the by-pass roads now under construction has arisen from the lack of foresight on the part of former generations, who have allowed the roads to be throttled by the erection of buildings unprovided with forecourts and insufficiently set back. This is an ever-present danger and can only be guarded against by the introduction of legislation giving general powers for the prescription along main roads of such building lines as will provide ample scope for future widenings without the prohibitive cost involved in the demolition of buildings."

Largest Storage Reservoirs in the United States in Use in 1920

Compiled by Allen Hazen, Civil Engineer, New York City, for The Committee on Water Supply of Engineering Council

Capacities include only the available capacity ordinarily and easily used and do not include water below the outlet and not available; nor water held above the flow-line by flash-boards unless the flash-boards are a part of the regular equipment and are normally used each year; nor temporary storage at times of high flood.

The information was first secured and verified by a well informed hydraulic engineer in each state selected for this purpose by the council. Figures for several states from which returns were not received have been supplied from any other source believed by the committee to be trustworthy.

As Engineering Council was abolished the work of this committee was terminated while it was still in an incomplete state, and this table represents this particular work as far as it had been then carried.

Name of Reservoir	Year Began To Fill	Area Acres	Cap'y Billion Gal.	Depth of —Water, Ft.— Max.	Aver	Used For
Elephant Butte, N. M.	1915	40,680	863	193	65	Irr.
Roosevelt, Ariz	1908	.....	425	220		Irr.
L. Winnibigoshish, Minn.	1884	103,040	338		10	Irr
Pathfinder, Wyo	1909	.....	327	200		Nav.
Jackson Lake, Ida.	1916	25,530	254	.....	30 7	Irr
Leech Lake, Minn.	1884	149,760	247		5	Nav.
Moosehead Lake, Me.	.....	74,900	177		7 3	Pow.
Ripogenus, Me.	1916	28,800	157		22	Pow.
Clear L., Kla., Ore.	.....	.....	150			Irr
Shoshone, Ida.	1909	6,604	148		69	Irr
Ashokan, N. Y.	1913	8,180	132	190	50	W. S
Twin Lakes, Me.	.....	.....	123			Pow.
Medina, Tex.	1913		98	156		Irr.
Big Meadows, Cal.	.....	15,500	96		20	Pow.
Bridgewater, N. C.	1919	6,510	94		44	Pow.
Lahonton, Nev.	1914	12,000	94	112	24	Irr.
Arrowrock, Ida.	1915	2,860	91		98	Irr.
Sevier Bridge, Utah	1908	10,120	82		26	Irr.
Strawberry, Utah	.....	.....	81			Irr.
Sebago Lake, Me.	.....	28,672	77		8 2	Pow
Salmon, Ida.	1911	3,500	74	120	65	Irr
Aziscohos, Me.	1913	.....	71	60		Pow.
Lake Kachess, Wash.	.....		68			Irr.
Magic, Ida.	1911	3,800	65	.....	52.5	Irr.
Belle Fourche, S. D.	1910	8,000	65	100	25	Irr
Moosehookmaguntic L., Me.	.....	16,608	64		11 9	Pow.
Spednic Lake, Me.		14,618	64	.....	13.5	Pow.
Wachusett, Mass.	1905	4,200	63	150	46	W. S
Deer Flat, Ida.	1908	9,250	60	.....	20 1	Irr
Sawyer Lake, Me.	.....	6,720	60	.....	27 3	Pow.
Salmon River, Ida.	1911	3,500	58		53	Irr
Pine River, Minn.	1886	562	58	.....	3	Nav.
Blewett Falls, N. C.	1912	2,500	57	.....	74	Pow.
Warm Spring, Ore.	1919	4,200	55	.....	43	
L. Winnepisaukee, N. H.	1850	45,400	52	.....	4	Pow.
L. Keechelus, Wash.			49			
Badin, N. C.	1917	6,500	46		23	Pow.
Croton, N. Y.	1906	3,360	45	157	41	W. S
Richardson Lakes, Me.		8,371	42		15 5	
Grand Lake, Me.		15,155	39		8 05	
Burton Lake, Ga.	1920	2,200	35		58	
Tahoe Lake, Cal., Nev.		120,000	39		1	Irr & P
Pakegama, Minn.	1884	660	39		19	Nav.
Kensico, N. Y.	1916	2,218	38	155	52	W. S
Grand Lake, Me.		15,034	34		7 0	
Indian River, N. Y.	1898	5,053	33	46	20	
Stanley Lake, Col.	1910		32	108		Irr
Lake Walcott, Ida.		11,350	31		8 4	Irr
Chamberlain L., Me.	.....	11,264	30		8 4	Pow.
St. Marys Lake, O.	1841	13,440	30		7	Nav.
Keuka Lake, N. Y.		11,200	30		9	Nav.
Spaulding, Cal.	1914	805	30		83	Pow.
Cimarron, N. M.	1918		26			
Hinckley, N. Y.	1915	2,850	26		29	
Lake Cheesman, Colo.	1901	874	26	222	88	W. S
Schoenmosk Lake, Me.			25			
Sebec Lake, Me.		7,000	25		11 1	
Twin Falls, Ida.	1912	800	24	137	90	Irr
Oakley, Ida.	1913	1,290	24		57 8	Irr
Crystal Springs, Cal.	1888	1,500	23		48	W. S
Cassie Lake, Minn.	1895	421	23		18	Nav.
Umbagog Lake, Me.		10,112	23		7 15	
Gull Lake, Minn.	1913	22,720	23		3	
Lake George, N. Y.		28,000	22		3	Pow.
L. Minatare, Neb.			20			Irr
Hayes, Cal.	1911	2,100	21	60	30	W. S
Delta, N. Y.	1912	3,070	21	70	23	Nav.
Square Lake, Me.		9,344	20		6 7	
Dresser, Ore.	1912	4,540	20		14	
Somerset, Vt.	1913	1,690	20		41	Pow.
Fort Worth, Tex.	1914		20	36		W. S
Payne, Utah	1908	2,300	19		28	
1st Connecticut Lake, N. H.	1916	2,960	19		21	
Cranberry Lake, N. Y.	1867	6,700	19		9	
Great Pond, Me.		8,198	19		7 1	
Pushaw Lake, Me.		10,496	18		5 43	
Middle Dead L., Me.		8,928	18		6 3	
Moosehead L., Me.		7,940	18		7 0	
Otter Creek, Utah	1897		17			
Big Creek, Cal.	1914	1,554	17	110	34	Pow.
Big Lake, Me.		10,419	17		5 0	
Ithaca, N. Y.	1913	3,000	17		18	
East Park, Cal.			16			Irr
Sysladobsis L., Me.		6,310	16		7 95	
L. Medicine, N. M.	1893	5,500	16		10	
Lapa, Lake, Me.		6,400	16		7 75	
Long Lake, Me.		6,117	14		8 0	
Coal spring, Ore.	1908	1,590	15	76	30	Irr
Gobeon, Ore.	1919	1,220	15		40	
Croton Falls, N. Y.	1910	1,600	15		20	W. S
Moreno, Cal.	1911	1,170	15	142	34	W. S
Crane Valley, Cal.	1910	1,200	14	68	38	Irr
Nicaragua Lake, Me.		5,574	14		6 17	
Santa Maria, Cal.	1912	636	14	85	73	Irr
Rio Grande, Col.	1913		14			Irr
Grand L. & Second L., Me.		4,243	14		10 6	

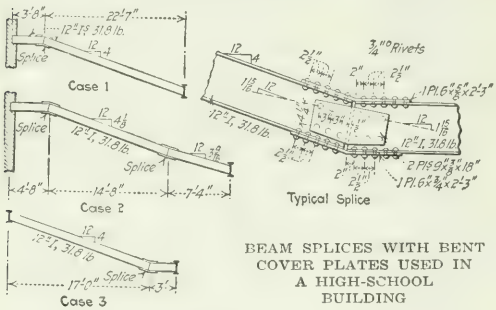
Name of Reservoir	Year Began To Fill	Area Acres	Cap'y Billion Gal	Depth of —Water, Max.	Ft.— Aver.	Used For
Damariscotta L., Me.		4,345	14		10.3	
Bear Valley, Cal.	1884		14	49		Irr.
Lower Otay, Cal.	1896	869	14	120	48	W. S
Rice Storage, Wis.	1911	4,384	13		10	
Owasco Lake, N. Y.	1850	6,657	13		6	
Tomhannock, N. Y.			12			W. S
Cold Stream Pond, Me.		4,723	12		8 1	
Johnstown, Penna.	1911	900	12	80	42	W. S
Bumping Lake, Wash.			11			Irr
Sherburne, Mont.			11			Irr
Mathias, Ga.	1914	834	10		41	
Allagash Lake, Me.		4,864	10		6.65	
Eagle & Churchill Lakes, Me.		11,136	10		2.9	
Caucomgomoc L., Me.		4,480	10		6.95	
Seboeis Lake, Me.		4,090	10		7 6	
Carmel, N. Y.	1895	998	10	55	31	W. S
Cross River, N. Y.	1908	850	10	106	36	W. S
Milton, Ohio	1913	1,700	10		19	
Mattawamkeag L., Me.	1862	3,853	10		7.78	
Nepaug, Conn.	1916	851	9 560	97	33	W. S
Licking, O.	1836	2,700	9 150		11	Nav.
Schoodic Lake, Me.		6,989	9 000		3.97	
China Lake, Me.		3,853	8 760		7.04	
Gardner Lake, Me.		5,376	8 720		5.00	
Nelson, Mont.			8 700			Irr.
Grass Valley, Utah.	1911	975	8 700		29	
Long Lake, Me.		2,816	8 680		9 5	
Boonton, N. J.	1904	900	8 600	100	25	W. S
Kennebago Lake, Me.		1,754	8 360		14 8	
Rocky Ford, Utah.	1914	1,129	8 340		24	
1st Kokadjo L., Me.		3,053	8 170		8 2	
St. Froid Lake, Me.		3,328	8 020		7.43	
Decatur Dam, Ill.	1920	3,500	8 000		7.04	W. S
Rangeley Lake, Me.		6,246	7 900		3 9	
Sudbury, Mass.	1896	1,220	7 900		21	W. S
Moose Lake, Me.		3,520	7 830		6 9	
Harvey Lake, Pa.		659	7 733		38	
Amawalk, N. Y.	1897	600	7 680		20	W. S
Rest Lake, Wis.		4,000	7 584		6	
2nd Conn. Lake, N. H.	1916	2,160	7 500		11	Pow.
San Fernando, Cal.	1914	410	7 500		56	W. S
Las Vegas, N. M.	1917	1,100	7 500	70	21	
Lake Clealum, Wash.			7 400			Irr
Titicus, N. Y.	1894	707	7 167	105	31	W. S
Thompson Lake, Me.		4,365	7 110		5 05	
Junior Lake, Me.		3,635	7 100		6 05	
Telos & Telosinis Lakes, Me.		2,752	7 100		7.95	
Long & Mud Lakes, Me.		9,344	7 100		2 33	
Cobbosseecontee L., Me.		5,440	7 090		4.0	
Stillwater, N. Y.	1903	2,750	6 750		8	
Sebasticook Lake, Me.		4,160	6 780		5.0	
Great East Pond, Me.		1,690	6 700		12.2	
Messalonskee L., Me.		3,424	6 700		6 9	
Cathance Lake, Me.		3,437	6 700		6 0	
Otis, Mass.	1885	1 065	6 600		20	Pow.
Eagle Gap, O.	1915	1,518	6 540		14	
Turnpike, Ore.	1914	1,100	6 540		19	
Spectacle Lake, Me.		1,150	6 500		13 3	
San Andreas, Cal.	1874	549	6 500	90	36	W. S
Ossipee Lake, Me.		3,885	6 450		5 1	
Rose Lake, Me.		3,776	6 430		5 27	
Little Sebago L., Me.		1 882	6 400		10.4	
Cross Lake, Me.		3 136	6 130		6 05	
Deadwood, Ida.	1908	818	6 000	30	22	W. S
Sweetwater, Cal.	1887	722	5 882	70	25	Irr.
Fulton Chain, N. Y.	1881	3,835	5 850		7	
Great Thunk Pond, Me.		1,394	5 700		10 4	
Sebattis Pond, Me.		2,918	5 700		6 0	
Willow Creek, Mont.			5 400			Irr
Mooselookmeguntic L., Me.		1,664	5 310		9 85	
Mooselookmeguntic L., Me.		1,734	5 270		9 4	
Lagunitas, Cal.	1884	2,000	5 240		8	Nav.
Portage Lake, Me.		3,968	5 160		4 0	
Crawford Lake, Me.		1,715	5 010		9 0	
Lucas, Me.		2,182	4 980		7 05	
Castilla Ck., N. M.	1917		4 890	90		
Scituate, R. I.	1890	575	4 845	72	26	W. S
Moosehead, Me.	1890	7 214	4 660		2	
Pleasant Pond, Me.		1 299	4 730		11 2	
Long Pond, Me.		2 382	4 670		4 8	
Long Pond, Me.		1 648	4 640		9 1	
Lawrence Reservoir, Wis.		6 982	4 170		2	
Hemenway, Conn.	1913	700	4 000	80	25	W. S
Wachusett Reservoir, Wis.	1870	4,781	4 500		3	
Moosehead Lake, Me.		2	4 490		4 9	
Sebec Lake, Me.		11	4 440		4 0	
Lake Hopatcong, N. J.	1875	711	4 423	100	40	W. S
Cobbosseecontee, Me.	1799	4,600	4 370	60	28	Irr.
Cachuma, Cal.	1918		4 360			W. S
Lake Cheesman, Colo.	1903	280	4 160	100	46	Irr.
Big Pond, N. Y.	1890	410	4 145	54	31	W. S
Quabbin Reservoir, N. H.	1919	655	4 040		20	Pow.
Mohansic Reservoir, N. Y.	1878	432	4 000		34	W. S
Grand Lake, Me.		2,835	4 000		4 35	
Long Pond		1,434	3 990		8 1	

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Balcony Beam Splice Questioned

Sir—Quite a lot of discussion developed a few months ago over the detail shown in the sketch attached, representing balcony beams in a high school. The question was the value of the splice in bending, and also its safety in a public building. The writer designed, under protest, the splice as represented, except that he used more rivets in the web plates, which was changed by the chief draftsman. The beams were fabricated and erected as per detail shown



BEAM SPLICES WITH BENT COVER PLATES USED IN A HIGH-SCHOOL BUILDING

and are apparently standing the test, but the writer nevertheless doubts the wisdom of such practice. It seems to the writer that the construction, of which three cases are shown, involves possible arch action (Case 1) or suspension action (Case 3), as well as a tendency of the bent cover plates to straighten out (lower plate in Case 1). The writer would like to see further discussion of the design. No doubt full-size tests would be of great value.

Richmond, April, 24. R. W. BOWMAN.

For Better Engineering in Buildings

Sir—The writer wishes to second the views expressed by John A. Ferguson in your issue of April 20, p. 665. The Association of General Contractors and the American Association of Engineers are to be congratulated on their initiative and results in investigating and reporting on the collapse of the Knickerbocker Theater. Every serious collapse should be investigated in a similar manner, for the benefit of the engineering profession and incidently the public at large. Unless this is done, too little attention may be given to such important matters. Usually individual investigations and reports are made in behalf of those vitally concerned by one or more experts, whose reports are used entirely for the benefit of the client and consequently may or may not be given publicity. Indictments are expected to follow disasters of this kind and each client is naturally concerned in his own interests. The expert therefore submits a report to his client's attorneys and governs himself accordingly. It may thus happen, as it frequently does, that the real cause of the disaster is never made public, if indeed it is found at all.

A very important lesson to be emphasized is that the engineer of a structure is held to be directly responsible for its safety. This being established, it should be given wide publicity to architects and owners, for the purpose of impressing upon them the fact that this responsibility can only be safely entrusted to competent and experienced men, whose compensation therefore must be made entirely adequate.

It behooves owners and architects to select an engineer as carefully as they would an attorney, by his specific qualifications for the work to be done, and expect to compensate him in a similar manner. High-grade attorneys handling responsible work are well paid for their services and so should engineers, doing equally responsible work, be well paid. The writer mentions this because frequently the client engages less expensive services because he does not fully realize the importance and value of the services required.

The general public, including owners and a certain class of architects does not seem to realize the true value of engineering services. On this account it frequently happens that inexperienced and inexpensive engineers are engaged to do work which they are not able to do. Too much stress cannot be laid on this point. Engineers in general owe it to themselves as well as to the engineering profession to undertake to enlighten clients in particular and the public in general on this subject. This is one of the most important features in engineering practice and is one of the features which has been greatly neglected.

In order to improve the standing of engineers with the public at large it is necessary that all possible publicity be given to them and their work. It would seem to be both proper and ethical to do this if it is carried through in the right direction. Engineers have a tendency to give their work publicity within professional circles, not outside of the profession. Such publicity would be beneficial not only to the engineer but also to those to whom the publicity is given. It would be for their protection and their benefit that the engineer would be striving.

That the foundation of building construction is engineering was demonstrated by recent collapses. If a structure is made structurally sound there can be no failure. It must be made not only structurally sound but economically sound as well. Consequently every effort should be made to impress upon those requiring engineering services that they should employ only those who are thoroughly competent to undertake the work and that they must expect to pay for these services at a rate commensurate with the importance of the work to be done.

H. ROBINS BURROUGHS.

New York, April 25.

Detail of Scissors Roof Truss

Sir—Two recent fatal building failures caused by faulty details lead me to comment on the scissors roof truss of which you published a description in your issue of Feb. 23, p. 309. The detail in the joint of the bottom members at the middle is faulty, in the writer's opinion, as eccentricity will increase the stress in the material beyond a safe point.

If good appearance is the prime consideration, make the most of it; halve the timbers and fit the central crotches with knees, preferably natural-growth knees, properly let into the beams. No bolts would be required, as the truss rods will perform their function, but if desired a few spikes, lagscrews, treenails, or the like might be used. Cast side plates may also be used.

A construction all of wood will look better, I believe, and will also be preferable from the constructional standpoint. Not over 25 per cent of the gross area of the timber will be lost. J. M. S.

Brooklyn, Feb. 27.

[The author of the original article on the scissors truss with special joint replies as follows.]

Sir—I should have covered the matter of eccentricity in my original description of the truss detail. The eccentricity amounts to 2.7 in., and the total stress is 24,000 lb., making a bending moment of about 69,000 in.-lb. The upper end of the member is held against lateral movement, however, which prevents bending of the back of the hook. The lateral force against the end of the stick required for this action is 69,000 ÷ 78 in., or 900 lb. The top chord alone is not capable of carrying this lateral force, but the roof planking will transmit it to the end support and to the peak, where it is neutralized by an equal and opposite force from the other rafter. If one wished to be very precise, and could be sure of proper inspection, he might call for the

trusses half one hand and half opposite hand, in which case the 900-lb. thrust would be taken care of even more directly.

As to detailing the joint with knees, it seems to me as if the upper knee would have to do most of the work of transmitting the tension in one member to side bearing on the other, and that most of the tension would be bound to go through the halved joint. This joint is reduced in bearing by the hole for the vertical rod to, say, 7¾ x 2¾ in., or less than in my design. DAVID C. COYLE.

New York, March 31.

Map Scales and the Metric System

Sir—In your issue of April 6, 1922, the question is put up to the readers: Shall map scales be decimal, or inch-to-the-mile? The writer agrees with Mr. Bonner that there is hardly any excuse for using much longer the present scale of 1:62,500. The adoption of this scale was most probably a rather unfortunate compromise between the decimal and the inch-to-the-mile scale. However, as a decimal scale it cannot very well be made use of to great advantage because the proportion of 1:62,500 is very cumbersome for calculations, and as inch-to-the-mile scale the unit length on the map differs from one inch just enough to prohibit the use of the inch scale for most purposes. On the other hand, the difference is so slight that this is a constant source of error and misinterpretation.

The fundamental requirement for a map scale which is best suitable for general purposes is such a scale which permits taking off distances directly with such *measuring scales as are used in everyday life.* At the present time, therefore, it would appear that the inch-to-the-mile scale and its multiples were the logical ones to use.

However, in the United States as well as in England, recent tendencies favor strongly the general introduction of the metric system. In fact, the requirements of international trade will sooner or later force all countries with considerable export trade to adopt the decimal system wherever competition is keen enough to make a difference of a few percent the margin between success and failure.

Whoever has had occasion to compare the relative efficiencies in calculation with dollars and cents in the United States and pounds, shillings and pence in England will fully appreciate the enormous advantage of the decimal system. About the same relation in efficiency exists when calculating with metric units of measures and weights as compared to the so-called English units. These conditions are accentuated by the growing general use of calculating machines and other devices, which all tend to increase the relative efficiency of the decimal system.

The United States and England will therefore hardly be able to escape much longer the necessity of adopting the metric system, whatever the cost and the inconvenience during the period of transformation from the old to the new system may be. For this reason the writer would suggest caution in spending money and time now for a change in the present map scales, however desirable a change to the inch-to-the-mile scale may appear to be. The adoption of the metric system in the United States is bound to come, and the experience of the war and after-war period no doubt has increased the desire for early action in this matter.

There is another reason which argues against the change of the 1:62,500 scale to the inch-to-the-mile scale. The difference between the two scales is so small that, unless particular attention is being paid when working alternately on maps of either scale, a constant source of error and most annoying misinterpretations would be created. By adopting either immediately or in the near future the metric system of 1:50,000, 1:100,000, etc., the chances of error are greatly diminished, and the maps would be drawn to a scale admirably suitable after the general introduction of the metric system, which is bound to come some day.

FRED A. NOETZLI,
San Francisco. Chief Engineer,
April 25. Beckman & Linden Engineering Corp.

Sir—I have noted with interest the article on map scales. A number of the new maps compiled, engraved and published by the United States Geological Survey using the scale 1:1,000,000 are now available. It is obvious that 1 mm. on these maps represents 1 km. in actual distance. The convenience of this hardly needs comment. Then, too, this is practically identical with the scale 1 inch to 16 miles, which relationship will be of use until the metric system has come into general use. On these maps heights and depths are noted in meters. This scale has been adopted by the United States, Great Britain and practically all other nations for the new maps of the world. HOWARD RICHARDS,

New York. Secretary American Metric Association.
April 18.

Behavior of Low Earth Dam

Sir—In connection with George C. Love's letter in your issue of April 6, p. 579, on the behavior of a low earth dam, it would be interesting to know in what relation the present water surface stands to the lines between the old and new work after raising the dam "twice by adding material to the crest and lower slope."

The crest and slopes shown are certainly ample and the resulting sections generous, but the dam's behavior is disconcerting. I would suggest that the water found its way along the junction between the old and new work, first along the level top of the older portion and then down the old

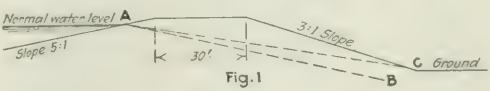


Fig. 1

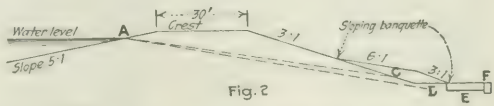


Fig. 2

EARTH DAM SATURATION, SLIDING AND REPAIRS

Reproduced from *Engineering News-Record*, April 6, 1922, p. 580.

slope, making the line of saturation to appear as a reverse curve and finally causing movement of the added fill on the downstream face.

In a homogeneous material the line of saturation drops sharply at the upper end, due to surface resistance to entrance, and is further modified by the selected material in the center of the dam.

The ditch and laterals at the toe of the dam were good medicine and effective in spite of the clay "banquette." The latter should have been rock or gravel or else omitted. Should the drains become clogged, the clay will hold the water in the toe until it rises above and is forced out over the clay, still further saturating the structure.

Many earth dams have been built in the West and in recent years a number of high earth dams have been built in the East and others are in process of construction. The design and execution of some of these structures has been given careful study, as described in Trans. Am. Soc. C. E., Vol. LXXXIII, p. 1713, Vol. LXXXIV, p. 331 and in the Proceedings for March, 1922, p. 453. J. ALBERT HOLMES.

Decatur, Ill.

War Material for Highways Totals $126,000,000

Up to Feb. 1, 1922, the value of surplus war material distributed to the states for highway work by the U. S. Bureau of Public Roads amounted to $126,000,000, of which $90,000,000 represented the value of motor vehicles and parts. Recently an inventory was taken of about $40,000,000 worth of material at Camp Grant, Rockford, Ill., part of which will be retained by the War Department and all of the remainder suitable for road work will soon be available for distribution. The work is being rushed so that the material may be used for road work early in the season.

NEWS OF THE WEEK

New York, May 11, 1922

Defense Wins Strong Point in Cement Trial

Second Count of Indictment Charging Specific Contract to Restrain Trade Is Dismissed

Hearing of the motion made by the defense that the indictment, under which cement manufacturers of the Eastern district are being tried before a federal jury and Judge Knox in New York City, be quashed resulted in the dismissal, May 8, of the second of the two counts on which the defendants are being tried. After two days of argument Judge Knox sustained the contention of the defense that the second count, charging a specific making of a contract to engage in interstate trade in violation of the Sherman law, should be dismissed because it was barred by the statute of limitations. The court, however, found that enough evidence had been adduced by the prosecution to allow the case to proceed on the first count of the indictment which charges, generally, that the defendants unlawfully engaged in a combination to restrain trade by restricting competition.

The facts surrounding the dismissal of the second count were essentially as follows:

The government charged that when the Cement Manufacturers Protective Association was formed the defendants adopted "the Eddy plan of open competition" by the operation of which all the defendants subscribing thereto automatically entered into a contract to restrain interstate commerce by restricting competition, fixing prices, etc. However, the Cement Manufacturers Protective Association was formed Jan. 2, 1916, whereas the indictment against the defendants was not returned until August of 1921.

CONTENTION OF GOVERNMENT

It was the government's contention that the formation of the association, the entering into it of the defendants and the active participation in its proceedings by the defendants constituted a continuing contract and that inasmuch as all of the defendants had either attended or had otherwise exhibited interest in meetings within the three-year period before which the statute of limitations operates, they were all liable. The defense held that the actual entering into by the defendants of the alleged contract for trade restraint (the formation of the Cement Manufacturers Protective Association) happened more than three years before the indictment was returned and was therefore barred by the statute of limitations. The defense cited one U. S. Supreme Court case in which a distinction had been made between the signing of a specific contract and the continuance of a combination. It was upon this case that Judge Knox instructed the jury to return a not guilty verdict on the second count.

(Continued on p. 806)

Hoover and Roosevelt To Lead Construction Council

Secretary Hoover has accepted the chairmanship of the formal organization meeting of the American Construction Council to be held in Washington June 19, and Franklin D. Roosevelt of New York, formerly Assistant Secretary of the Navy, has agreed to accept the first presidency of the organization.

These two important matters settled, the committee of secretaries which has the organization details at hand, is proceeding rapidly to secure the adherence of the various organizations in the industry. Formal invitation together with supporting arguments are now going to the 250 national organizations.

The committee, which is acting under the chairmanship of Gen. R. C. Marshall, Jr., reports that responses, thus far, are very encouraging. Commendation of the movement and promises of support are universal.

Wilgus Resigns as Consulting Engineer on Narrows Tunnel

Following the abandonment by the City of New York of the Narrows tunnel project for a trunk-line terminal railroad system and the adoption of a new plan for a local development based on the tunnel (*Engineering News-Record*, April 13, 1922, p. 626), Col. William J. Wilgus has resigned as consulting engineer to the Board of Estimate and Apportionment. It is understood that in carrying out the new project the board contemplates calling from time to time for the advice of specialists in the various problems involved instead of maintaining a staff of consulting engineers on a permanent basis.

Lawsuit to Prevent Bayonne from Building Ramapo Reservoir

A writ of *certiorari* calling for a review of the action of the New Jersey Department of Conservation and Development in granting the city of Bayonne a permit to build a 50-m.g. impounding reservoir on the Ramapo River has been granted by a New Jersey court. The applicant for the writ is a resident of Bayonne and owner of one of a number of large estates that it is alleged would be flooded by the reservoir. Other litigation designed to thwart Bayonne's Ramapo project has been threatened by municipalities and private interests. The granting of the permit was opposed by the North Jersey District Water Supply Commission, which is building a storage dam on the Wanaque River for Newark.

Further Report on Palm Beach Bridge

Outside Investigation of Collapse of Structure on Dec. 29 Now Probable

An investigation by an outside engineer is to be made of the bridge collapse at Palm Beach, Fla., Dec. 29, according to action taken last week by the county commissioners. Several consulting engineers are under consideration for the investigation.

It is understood that the incentive for this step came from representatives of bond holders.

A supplementary report by Harrington, Howard & Ash, designing engineers of the bridge, has been made public in the Palm Beach *Post*. This report, supplementing a preliminary report made shortly after the collapse (see *Engineering News-Record*, Jan. 26, p. 150), states that serious defects of construction were found in the bases of the east abutment and piers 13, 11, 8 and 7. Pier 12 had the forms still in place and therefore could not be examined, while piers 10 and 9 were concealed by sand and debris, making examination impossible, but the engineers express the belief that defects of construction in these pier bases would be found similar to those in the ones reported upon. They report that in every joint between pourings of concrete (the pier concrete was largely placed under water) there exist "large amounts of soft and defective material, laitance and scum, which is not concrete, contains little or no stone and is not capable of supporting loads. In some places this material adjacent to the exposed surfaces has fallen out, washed out or otherwise been displaced, leaving holes extending well into the bases and varying in width from an inch or so to a foot."

SPECIFICATIONS

The work was done under specifications which provided that the concrete of the pier bases might be deposited in open cofferdams or cribs after pumping out, or might be deposited entirely under water; actually the concrete was placed under water in two to five pourings for each pier base. It was specified that before one pouring of concrete is placed on another, scum and laitance should be removed from the surface, but the engineers report that this requirement was ignored. Some of the upper concrete, which was required to be placed after pumping out, was also poured in water. The engineers further say, "These operations of the contractor, contrary to the specifications and contrary to the plans, were carried on with the knowledge of our inspector and evidently with only mild objections on his part, although clearly contrary not only to the plans and specifications, but to the special instructions written to him."

(Continued on p. 806)

Wheeling Votes $2,000,000 for Water Treatment Plant

After delays extending through many years and much agitation over the various plans for an improved water supply for Wheeling, W. Va., the voters of that city recently approved a $2,000,000 bond issue for building a water-treatment plant. Chester & Fleming, Pittsburgh, are engineers for the improvement. C. H. Dowler is city manager.

St. Louis Committee Passing on $73,000,000 Bond Proposal

City bond issues totalling $73,000,000 are being considered by a special committee of 200 members chosen to pass on the advisability of submitting them to popular vote at an election to be held in the fall. The total includes $12,000,000 for water-works recommended by Edward E. Wall, water commissioner of St. Louis (see *Engineering News-Record*, March 16, p. 437).

San Francisco Awards Contracts on Hetch Hetchy Power Units

The San Francisco Board of Public Works on April 28 awarded contracts for equipment to be used in the Moccasin Creek power plant on the Hetch Hetchy water-supply project. It is the present intention to sell power from this plant to one of the large power companies. Deliveries on the units for which contracts have just been awarded are limited by agreement to the period between April 15, 1923, and Aug. 31, 1923.

Contracts awarded were as follows: Pelton Water Wheel Co., four 25,000-hp. double-overhung impulse units, $248,000; General Electric Co., four 20,000-kva. generators with exciters and one spare exciter set, $260,285; and the Coffin Valve Co., eight 36-in. valves, $37,586. The electrical units involve a departure from standard practice in that they have direct-connected overhung exciters.

To Announce Plans for Extensions of New York Transit System

Comprehensive plans for rapid transit subway extensions in New York will be announced by the Transit Commission some time this week. Advance information indicates that the complete program will involve the expenditure of $250,000,000 and will include the following items:

1. A 4-track subway the length of Manhattan Island following the line of Eighth and Amsterdam Aves. 2. Extension of Seventh Ave. subway up Central Park West and Eighth Ave. to the Harlem River. 3. Brooklyn cross-town line running from Queensboro Bridge Plaza to connect with existing lines in central Brooklyn. 4. Extension of the Fourth Ave. subway in Brooklyn under the narrows to Staten Island. 5. Extension of the Queens-Corona line from Corona to Flushing. 6. Moving platform on 42nd St. to replace existing shuttle service between east-side and west-side subways.

Construction of any of these lines will be subject to approval and appropriation of funds by the Board of Estimate and Apportionment of New York City.

The Engineer in Public Life

While engineers, as a class, have been charged with neglect of public responsibilities, individual members of the profession have engaged in public service of a non-engineering character. "Engineering News-Record" desires to record their activities in a series of biographical sketches, of which this is the first. Readers can aid in making the series complete by sending to the editor the names of any engineers who should be included.—EDITOR.

CHARLES SAVILLE

For nearly two years an engineer has been serving as the executive head of the Chamber of Commerce of Dallas, Texas. Starting his association with that organization in 1918 as secretary, Charles Saville, a specialist in the field of municipal and sanitary engineering since his graduation from the Massachusetts Institute of Technology in 1905, became its general manager in September, 1920. Mr. Saville was born in Brookline, Mass., in 1883, and after completing his university training and spending ten months herding sheep in Montana, he served for six years as sanitary engineer and special investigator for the Massachusetts State Department of Health.



After a European trip of fifteen months beginning in 1910, devoted to a study of foreign sanitary engineering practice, he went to New York in 1911 and became a member of the firm of Hering & Gregory, hydraulic and sanitary engineers. He moved to Dallas, Texas, in 1914, opened a consulting office and the following year was appointed director of sanitation and public health of Dallas. As secretary of the Committee on Sanitation of the Texas State Council of Defense during the war he organized and directed public health activities throughout the state, having charge of 110 community councils in school districts of Dallas County. He served also as consulting engineer and sanitarian for the U. S. Army on sewage disposal and malaria control in camps at Fort Worth and at Dallas and at shipbuilding yards at Orange. Due largely to his efforts as executive secretary the drive for the fourth Liberty Loan in Dallas reached its quota of $10,250,000 in three days.

After service as vice-chairman of the Texas Public Health Commission, appointed by Governor Hobby as a war measure, Mr. Saville became in October, 1918, director of industrial development and later secretary of the Dallas Chamber of Commerce. Here his activities included such matters as city planning, housing, open shop agreements, fire-insurance protection, the Boy Scouts of America and the Dallas Art Association. He assisted also in organizing chambers of commerce in several other Texas cities.

Will Not Buy Out Superior Water, Light & Power Co. Now

At a recent popular election the voters of Superior, Wis., rejected the offer of the Superior Water, Light & Power Co., to sell its property to the city for $3,115,000 plus certain additional allowances. Condemnation proceedings were started by the city several years ago. A few months ago the company offered to sell out on the terms stated above. W. C. Lounsbury, general manager of the company, informs *Engineering News-Record* that "the whole question is involved and this action by the voters may or may not mean that the agitation for municipal ownership is over."

Trips to Water and Sewage Works for Civil Engineers

In connection with the annual convention of the American Society of Civil Engineers to be held at Portsmouth, N. H., June 21-22, trips of inspection to New England water-works and sewage-treatment plants are being arranged by Harrison P. Eddy, of Metcalf & Eddy, consulting engineers, Boston. These trips will be by automobile and are planned to take place prior to the convention on June 19 and 20 without interfering with the convention program. Members of the society are requested to inform Mr. Eddy of their desire to visit any or all of the following works: Sewage-treatment plants at Worcester, Marlborough, Clinton, Fitchburg and Boston, and water works at Boston, Cambridge and Lowell.

New Jersey To Study Trans-Hudson Passenger Situation

An unpaid commission of seven members to report on a comprehensive plan of "rapid passenger transit between the several communities in the counties of Bergen, Essex, Hudson, Middlesex, Morris, Passaic and Union, as well as between such communities and the City of New York," has been appointed by the Governor of New Jersey in accordance with an act of the 1922 legislature of that state. The commission has selected as chairman Bertram H. Saunders, who is also chairman of the Paterson City Plan Commission, and as secretary Herbert S. Swan of Glen Ridge, a city planning consultant with offices at 15 Park Row, New York City.

The creation of this commission is the outcome of the Bi-State Rapid Transit Conference held at Paterson on Dec. 15 (*Engineering News-Record*, Dec. 22, 1921, p. 1037) which led to the formation of the North Jersey Rapid Transit Committee, with Mr. Saunders as chairman and Mr. Swan as secretary. This committee drafted the act already mentioned—which was passed unanimously by both houses of the legislature.

The act authorizes the commission to "employ such professional skill and assistance as it may need for the effective working out of a comprehensive and adequate plan of rapid transit." The commissioners themselves are to serve without compensation. The act carries an appropriation of $5,000 to be paid out of any moneys in the state treasury not otherwise appropriated."

Illinois River Flood Highest on Record

Gage Readings Show Stages as Much as 5 ft. Higher Than Ever Before Known

Probably the biggest flood ever experienced on the Illinois River during modern times was that of April, 1922, which exceeded all previous flood heights. Numerous cities and great areas of agricultural lands were flooded.

In the accompanying table are shown the gage readings at several points, all exceeding those of any previous year in which readings were actually recorded. It will be noted that at Beardstown, the stage was 5.1 ft. higher than in 1904, while at Havana the excess was only 2.7 ft. This condition was caused by heavy and long continued rains on the drainage area of the Sangamon River. The tabulation was made by the Elliott & Harman Engineering Co., Peoria, Ill.

FLOOD DATA AT STATIONS ABOVE AND BELOW PEORIA, ILL., 1922 AND 1904

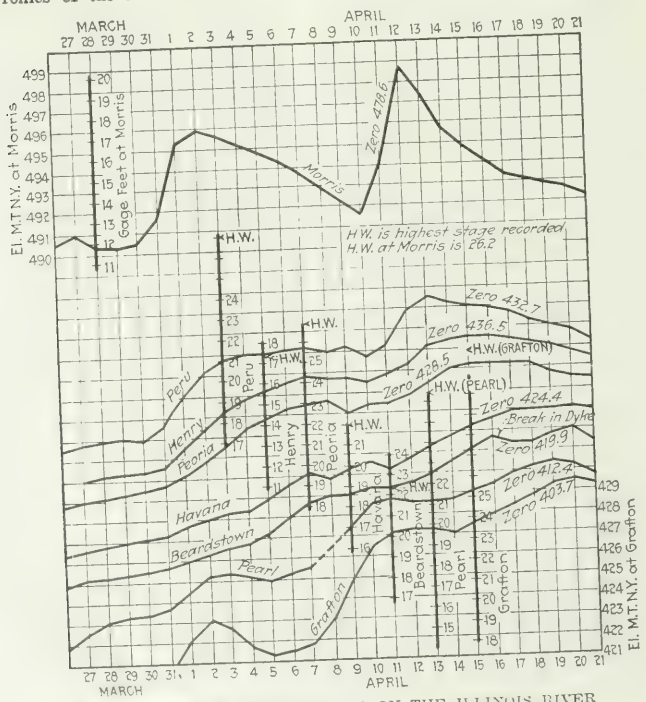
Station	1922 Crest* Ft.	1922 Date April	Condition on April 26 Ft.	1904 Crest Elev.** Ft.	"O" State Memphis Data Ft.
Peru	23.8	13	19	17.2	443.79
Henry	18.0	15 & 16	14.9	23.0	435.82
Peoria	24.8	15	22.6	19.9	431.67
Havana	22.6	20	21.7	20.0	427.25
Beardstown	25.1	20	24.1	(1903-20.7)	419.70
Pearl	22.8	20	21.4		

* These readings were on scratch tabulations, and there may have been slight variations between readings not shown in this report. Readings at Pearl were not secured on April 18 and 19. The crests at Havana, Beardstown and Pearl were affected by the breaking of levees along the river near those points.

** The 1919 and 1920 floods were slightly higher than 1904 flood in most places.

Profiles of the rise and fall of the flood at several points are given in the accompanying diagram furnished by M. G. Barnes, chief engineer of the State Waterway Division and based on the figures of the U. S. Geological Survey. A profile of the 1916 flood was given in *Engineering News*, March 23, 1916, p. 550.

Strenuous work was done in endeavoring to save the levees of the twenty-eight drainage districts along the river. But breaks occurred causing the flooding of twelve districts aggregating 72,800 acres, the estimated damage being $2,870,000. At the other districts the levees held, protecting 112,500 acres, but flood damages in these districts are estimated at $209,000. These figures are based on estimated losses of all crops for this season in the flooded districts. The Pekin-LaMarsh district of 3,500 acres was protected at the north by two railway embankments 400-ft. apart, but the outer and older one gave way as a result of seepage and the rush of water carried away the other bank.



FLOOD STAGES AT EIGHT POINTS ON THE ILLINOIS RIVER

State Sanitary Engineers Will Meet in Washington, D. C.

The third annual conference of state sanitary engineers will be held in Washington, D. C., at the Department of the Interior Building on May 17 and 18, concurrently with the annual conference of state and territorial health authorities with the United States Public Health Service. The program is made up largely of committee reports on water supply and water purification, control and limitation of chlorination, milk supply, sewage and stream pollution. Remarks of Imhoff tank patents are to be made by William F. Keohan, Washington representative of the Chemical Foundation. Clarence Marsh, New York City, is to speak on the electrolytic production of chlorine, and E. S. Tisdale, Charleston, W. Va., will talk on educational campaigns for better water supplies.

City Planning Conference to Be Held at Springfield, Mass.

The fourteenth National Conference on City Planning is to be held at Springfield, Mass., June 5-7, in conjunction with the annual convention of the Massachusetts Federation of Planning Boards. Among the subjects to be presented are "The Treatment of the River Front," one of the speakers on which will be Edward H. Bennett of Chicago; "City Planning in Relation to Transportation and Street Traffic," E. P. Goodrich of the Technical Advisory Corporation, New York City, and D. L. Turner, chief engineer, New York Transit Commission, and "Methods of Winning Public Support for a City Planning Program," S. C. Kingsley, director, Welfare Federation of Philadelphia and Dr. Samuel B. Woodward, chairman, City Plan Committee, Worcester.

Railroad Gets Time Extension on Branch-Line Construction

The Salt Lake & Denver R.R. has been granted an extension of two years in which to start construction of a line into the Uinta Basin, Utah. An order to this effect has just been made public by the Utah Public Utilities Commission. Objection to this extension was made by the commercial clubs of Vernal and Myton, Utah, but the commission, believing this to be the only hope this territory has of getting railroad facilities in the near future, and recognizing the efforts and time spent by the railroad to promote this particular line, have extended the time for starting construction to Feb. 25, 1924.

Rescind Bids for $3,000,000 Public Improvements in Florida

The Hillsborough County Commissioners at Tampa (Fla.) rescinded the proposed opening of bids April 24 on seventeen road projects, a bridge, a seawall and a fill all to total $3,000,000. Included in the work was the proposed Bayshore drive from Tampa to Ballast Point, similar to the Havana Malecon.

It is now proposed first to vote and sell the bonds and then readvertise, though the exact procedure is still indefinite. The bids had been requested "subject to the subsequent voting and sale of the bonds."

Give Transportation Act a Fair Trial, Say Railroad Men

From many angles the railroad problem was discussed authoritatively at an all-day meeting of the Academy of Political Science held in New York April 28. The opinion prevailed that the Transportation Act of 1920, including the establishment of the Railroad Labor Board, has not yet had a fair chance to prove its worth and that it should not be fundamentally changed at the present time.

At the luncheon session attended by nearly 600, Henry C Wallace, Secretary of Agriculture, declared that unless freight rates come down the country will be confronted by profound readjustments in its agricultural and industrial activities. Daniel Willard, president of the Baltimore and Ohio R.R., urged a five-year trial of the Transportation Act in its present form. He favored that portion of the act which provides that the government shall take over one-half of net operating income above 6 per cent and questioned the wisdom of any legislation to prohibit strikes by railroad employees. Walker D. Hines, former Director General of Railroads, endorsed Mr. Willard's plea on behalf of the Transportation Act.

At the morning session Prof. Frank H. Dixon, of Princeton University, explained the functions and policies of the Railroad Labor Board and W. N. Doak, vice-president of the Brotherhood of Railroad Trainmen, discussed them from the viewpoint of the employee. C. B. Heiserman, general counsel, Pennsylvania R.R., and Henry T. Hunt, former member of the board, discussed them from the railroad and public angles with special reference to the current controversy between the Pennsylvania R.R. and the shop crafts. At the afternoon session Charles R. Hook, vice-president and general manager of the American Rolling Mill Co., explained the effect of freight rates on the cost of steel making, and J. D. A. Morrow, vice-president of the National Coal Association, showed how much of the retail price of coal goes to pay for transportation. Prof. Wm. J. Cunningham, of Harvard University, indicated what the railroads might do to render maximum service while R. H. Aishton, president of the American Railway Association, told what they are now doing to increase economy and efficiency.

Samuel McCune Lindsay, president of the board of trustees of the Academy, presided at the luncheon session. Prof. Henry R. Seager of Columbia University at the morning session, and Albert Shaw, editor of the *Review of Reviews*, at the afternoon session. Information as to the published proceedings and future meetings of the Academy may be obtained from the Secretary, Academy of Political Science, Kent Hall, Columbia University, New York City.

French Line Starts To Electrify

A large program for electrification of about 2,000 miles of line on the Paris & Orleans Ry. is to be commenced this year by the construction of three power plants and the line equipment of the Paris-Vierzon division. Orders for 200 electric locomotives have been divided between three French firms. At 1914 prices the cost for the 2,000 miles was estimated at $94,000,000.

Municipal Improvements Convention Date Changed

The convention committee has changed the date of the 1922 convention of the American Society for Municipal Improvements to Oct. 1-6, 1922. It is to be held in Cleveland.

New Ohio River Bridge Built in 274 Days

Dedication of the new Ohio River highway bridge at Ironton, Ohio, connecting with Russell, Ky., marked the completion of construction in 274 days. Work on the foundations was begun by the Dravo Contracting Co. last July, and erection of the superstructure steel was begun in the fall by the Wisconsin Bridge & Iron Works, designers of and contractors for the bridge. The bridge has a main span of 725 ft., this being the central span of a cantilever structure 1,425 ft. long between anchor piers. (See "Engineering News-Record," Oct. 13, 1921, p. 613, for span diagram.)

The governors of Ohio, West Virginia and Kentucky, as well as United States senators and a large number of railway officials attended the dedication, which centered about the state line, here located along the low-water line on the north side of the river, as fixed at the time when the Northwest Territory was set off from Virginia.

The cost of the bridge was about $700,000. Money was raised locally, and 2,424 persons hold stock in the company. The bridge will be operated on a toll basis.

Reclamation Act Amended

The Senate on April 2 passed a bill already approved by the House amending the U. S. Reclamation Service Act so as to permit the federal and the state governments to take bonds of irrigation districts as a substitute for the securities of the individual entrymen heretofore required. The Senate amendment permits federal land banks to make loans on irrigation projects. This, if agreed to by the House, will remove the inhibition of the Farm Loan Act against loans secured by irrigation projects.

Court of Appeals Decision on Flat-Slab Patent

Justice Alschuler sitting with Justices Baker and Evans, United States Circuit Court of Appeals for the Seventh District, in January affirmed the decision of the District Court for the Northern District of Illinois, Eastern Division, that U. S. patent No. 1,005,756 on reinforced-concrete flat slab held by F. F. Sinks, was invalid in so far as it related to claims 2, 4, 6, and 7. This was in the case of the Concrete Co. against the Corrugated Bar Co., and means in effect that the upper court has held that the so-called Akme system is not patentable. The lower court decision was noted in *Engineering News-Record*, issue of May 1, 1919, p. [illegible].

Urge Three-Year Federal-Aid Road Program

Effort Will Be Made in Senate to Secure Yearly Appropriation of $75,000,000

(*Washington Correspondence*)

An effort will be made in the Senate to provide for a three-year road building program rather than the two-year program prescribed in the bill which just has come to the upper chamber after having passed the House. Thirty-four of the state legislatures meet next January and will not meet again until January, 1925. It is held to be essential in the prevention of economic loss in organization and in securing maximum efficiency that the legislatures know just what the federal government will contribute during a three-year period. Since the states during the past three years have put under contract an average of $82,000,000 federal funds per year, there is very strong sentiment in favor of amending a bill in the Senate so as to make it provide $75,000,000 per year for three years.

Section 4 of the bill as it passed the House is not satisfactory to the state highway officials and W. C. Markham, their representative in Washington, has submitted the following substitute to the Senate committee:

Sec. 4. That if any State, for a period of one year from the date on which the Secretary of Agriculture approves, or heretofore has approved, a project statement for the construction of any road project, shall have failed to commence actual building construction on such project or if contract for the construction of such project shall not have been entered into, the Secretary of Agriculture shall require such State to submit a project statement, or statements, for one or more other projects to replace such project; and if said State, for a period of 60 days from receipt of notice from the Secretary of Agriculture to submit such other project statement, or statements, shall not have submitted the same, then, and in that event, the Secretary of Agriculture shall immediately cancel such project and reapportion the Federal funds allotted thereto among all the states in the same manner and on the same basis as provided by the Federal Highway Act and all acts amendatory thereof or supplemental thereto.

For $20,000 a Mile

An effort also will be made to convince the Senate committee that the bill passed by the House should be amended so as to continue the $20,000 per mile maximum which may be contributed by the federal government. The House reduced the maximum from $20,000 per mile to $12,500 during the first year and $10,000 per mile thereafter. The state highway officials believe that no abuse is resulting from the $20,000 maximum, with the type of construction left to the judgment of the Secretary of Agriculture. They point out that the average federal aid per mile has been but $7,415.

Representative Begg, of Ohio, made strenuous objection, during the consideration of the bill in the House, to a maximum as high as $20,000 for federal aid. He suggested that a $4,000 maximum would be better. He opposes the whole system of federal aid, however, and declares the states have already surrendered 90 per cent of their police powers so that the highways, the railroads, the education and the health may be nationalized. He presented, somewhat newly garbed, the argument that a few of the states pay most of the taxes and, as a result, are being taxed out of all equity for road construction.

Temporary Sewage Treatment Plant for Los Angeles

The Los Angeles city council on April 24, in accordance with the recommendation of John A. Griffin, city engineer, appropriated $153,000 from the city's reserve fund with which to purchase 33 acres of land on Angeles Mesa and to build there, pending the construction of some means of permanent disposal, Imhoff tanks and filters to treat the raw sewage now discharged into Ballona Creek to relieve the ocean-outfall sewer. (See *Engineering News-Record*, Feb. 23, p. 366, March 2, p. 343, April 13, pp. 596 and 618.) The Los Angeles Community Development Association, with the unanimous approval of the city council, has decided to appoint a citizen's committee of fifteen to work independent of other agencies in gathering facts as to the need of increased sewage-disposal facilities and the relative merits and costs of the various methods of disposal which have been suggested. An endeavor is to be made to unify public opinion on a definite workable sewage-disposal program so that there will be whole-hearted support at the time when the voters are asked for the fourth time to vote bonds for additional and improved means of sewage disposal.

Defense Wins Strong Point in Cement Trial

(*Continued from p. 802*)

Judge Knox also instructed the jury to return a verdict in favor of the Allentown Portland Cement Co. of New Jersey, a defunct organization. The indictment named this company through error, the Pennsylvania company by the same name having been the company the indictment should have named. However, the Allentown company of Pennsylvania is still represented in the trial by one of its officers, who is an individual defendant.

Beside the motion to quash the indictment and to dismiss the first count because of lack of evidence and the second because the statute of limitations barred it, the defense sought to have striken from the records certain testimony of government witnesses. It sought to have stricken out all of the testimony of Mary Kavanagh, a former employee of the Atlas Portland Cement Co. However, the court ruled that only a minor part of her testimony be stricken out. The attempt of the defense to relieve certain defendants from the indictment because of their apparent lack of connection with any of the proceedings of the protective association was of no avail.

The government finished its case on Thursday of last week, having introduced exactly 800 exhibits. Testimony and documentary evidence introduced by the government consumed some 4,000 pages of printed record. The government's case occupied in time four weeks and one day.

The defense opened its case on Tuesday morning of this week by the exhibition of moving pictures, accompanied by a lecture, on the manufacture of portland cement. The lecture was given by H. Bruckman, president of the International Cement Co., who was the defense's first witness.

It is probable that the defense case will consume at least three weeks.

A.S.T.M. Program Announced

The American Society for Testing Materials has issued a provisional program for the twenty-fifth annual meeting which will take place at the Chalfonte-Haddon Hall, Atlantic City, N. J., June 26-30. By far the largest number of items ever included on one of its programs are noted, the number running up to eighty. There are to be twelve sessions, two of them in duplicate with simultaneous meetings on subjects which are assumed not to have interest to the same members.

Monday, June 26, is devoted to committee meetings, and the sessions open Tuesday morning. Following is the program: Tuesday morning, non-ferrous metals, metallography and corrosion; afternoon, wrought, cast and malleable iron; evening, presidential address, report of administrative committee, informal dance and smoker. Wednesday morning, steel; afternoon, committee meetings; evening, symposium on impact testing of materials. Thursday morning, fatigue of metals, methods of testing and nomenclature; afternoon, coal, coke, timber and shipping containers; evening, simultaneous sessions on (a) concrete aggregates, road materials and waterproofing; (b) preservative coatings. Friday morning, simultaneous sessions on (a) lime, gypsum, and ceramics; (b) petroleum products, insulating materials, textiles, and rubber; afternoon, recreation period, golf and tennis tournaments; evening, final session on cement and concrete. The secretary of the society is C. L. Warwick, 1315 Spruce St., Philadelphia.

Road Builders Meeting May 15

The annual meeting and election of officers of the American Road Builders Association will take place May 15 at the Automobile Club of America, New York City. The meeting of members of the association is scheduled for 3 p.m. following a meeting at 10 a.m. of the board of directors. At 6:30 p.m. the annual dinner will be held, after which the program provides for a report on the election results, and addresses by the retiring and the new presidents.

Further Report on Palm Beach Bridge

(*Continued from p. 802*)

Two of the arches, it is said in the report, are found considerably out of correct position. The concrete pushed the pier or skewback forms out of shape and out of position, and the arches then were poured apparently to fit the incorrect arches or skewbacks. In turn, the spandrel wall forms were built to fit the arches.

No grounds were found by the engineers for believing that any settlement of the bed rock under the piers had occurred. "The defects of the piers, together with the improper method of placing the spandrel filling would fully account for the accident which occurred. It is possible also that some of the fallen arches may have been constructed in improper positions." The engineers also report that they have verified the design, plans and specifications and found them adequate.

Engineering Societies

Calendar

Annual Meetings

NATIONAL FIRE PROTECTION ASSOCIATION, Boston, Mass.; Annual Meeting, Atlantic City, May 9-11.

NATIONAL HIGHWAY TRAFFIC ASSOCIATION, New York City; Annual Meeting, New York City, May 12.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, Philadelphia, May 15-19.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Annual Convention, Salt Lake City, Utah, June 5-7.

NATIONAL CONFERENCE ON CITY PLANNING, Boston, Mass.; Annual Meeting, Springfield, Mass., June 5-7.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Annual Convention, Portsmouth, N. H., June 21-22.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, University of Pittsburgh; Annual Convention, University of Illinois, June 20-23.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual Meeting, Atlantic City, N. J., June 26-30.

The Milwaukee Chapter, A.A.E., has elected officers as follows: President, Ralph M. Kibbe; vice-president, H. L. Foster; directors, John A. Harrington and J. A. B. Tompkins.

The Jamestown Engineering Society has elected the following officers: President, W. J. Knauer; vice-president, L. L. Graham; secretary, Archie W. Roberts; treasurer, Francis Irvine.

The St. Joseph Valley (Ind.) Chapter, A. A. E. has elected the following officers for the year: President, H C. Weaver; vice-president, J. L. Stevens; secretary-treasurer, E. R. Austin.

Personal Notes

W. N. RYERSON, for several years manager of the Great Northern Power Co. at Duluth, has resigned to become secretary of the Duluth Chamber of Commerce.

E. S. SMITH, superintendent of public works, department of highways, Ohio, has resigned because of ill health. His successor has not yet been appointed.

C. G. TROWBRIDGE, city engineer and superintendent of construction, Decatur, Ga., has resigned to engage in engineering work with the St. Simons Island Investment Co.

P. J. HURTGEN has been appointed city engineer of Kenosha, Wis., succeeding B. C. Brennan, resigned.

C. U. SMITH has been appointed district engineer of the Chicago, Milwaukee & St. Paul Ry., with headquarters at Milwaukee, Wis. He succeeds O. H. Frick, who has been promoted.

W. L. LOZIER, of Rochester, N. Y., has been appointed engineer in charge of public improvements, Seneca Falls, N. Y.

CHARLES MATER, resident engineer on the construction of the Pearl Street bridge, Grand Rapids, Mich., has resigned to accept another position. A. E. WHITLOCK, one of the staff of the Westcott Engineering Co., will succeed him.

C. E. RICE, city engineer, Wooster, Ohio, has resigned, effective May 1.

JAMES A. MORTLAND, bridge engineer for the Florida State Highway Department, has resigned to open a private office in Tallahassee, Fla., as a consulting engineer specializing in bridge design and construction.

JAMES E. SELLERS, assistant engineer of the Verde River Water Project, Phoenix, Ariz., has resigned and has gone to Chicago for special investigation work in connection with a report of the Colorado Flood Control which he is completing for Chicago interests. Before he assumed charge of the design and construction of the Verde River Project he was senior highway engineer with the Arizona State Highway Department.

A. W. GRAHAM, chief engineer of the Missouri State Highway Department, has resigned, effective May 1, and his assistant C. W. Brown is acting in his place until a permanent appointment can be made.

LESLIE H. BALKNAP, deputy state highway commissioner, Lansing, Mich., has resigned and will be succeeded by G. C. Dillman, an engineer in the department of maintenance.

E. A. VAN DEUSEN has resigned his position with the New England Power Co. to become assistant hydraulic and structural engineer with the United Hudson Electric Corp., Poughkeepsie, N. Y. He was at one time engineer with the Southern Power Co., N. C., and later with the Fargo Engineering Co., Jackson, Mich.

MAJOR WILLIAM A. MITCHELL, Corps of Engineers U. S. Army, has been confirmed by the Senate to be professor of civil and military engineering at the United States Military Academy, West Point, N. Y.

H. P. BORDEN, late member of the Board of Engineers of the Quebec Bridge, and former consulting engineer to the Department of Railways and Canals of the Canadian Government, has opened a consulting office in Ottawa. Mr. Borden will specialize in bridges and structures, both steel and concrete, and in reports, inspections, estimates and investigations. Mr. Borden has had wide experience in bridge engineering practice. After graduation from McGill University, he was assistant engineer in the bridge department fo the Canadian Pacific Ry. He then became assistant chief engineer in the structural department of the Montreal works of the American Locomotive Co. Later, he was made structural engineer of the Canadian Pacific Ry. In 1908, he became assistant engineer, Board of Engineers of the Quebec Bridge, being appointed a member of the board early in 1916 upon the death of C. C. Schneider.

BUSINESS NOTES

A. RENNOLDS, formerly with the Equipment Corporation of America, announces the organization of the RENNOLDS EQUIPMENT CO., with offices in the Lumber Exchange Bldg., Chicago. The Rennolds company will handle a complete line of contractors' equipment and will buy slightly-used machinery to rebuild, sell or rent.

The CONTRACTORS TRADING CO., New York, is to take over the sale of the building construction equipment of the LAKEWOOD ENGINEERING CO. only in the New York territory; roughly speaking the eastern half of the State of New York and the northern half of the State of New Jersey. It will not have charge of all the sales territory of the Lakewood company as might have been inferred from the note in the issue of May 4, p. 755.

EQUIPMENT AND MATERIALS

New Concrete Road Tamper

A concrete-road finishing machine which performs several operations simultaneously and finishes the slab by passing over it once has been developed and tried out by the Dunn Road Machinery Co., Conneaut, Ohio. Briefly the machine consists of a carriage which travels on the side forms and carries the power unit and operating mechanism. It is propelled by winding up a cable anchored ahead or to the rear. The operator rides on the machine.

An auxiliary strike-off pushes the surplus material ahead and smooths the slab off about 2-in. high. Behind comes the main strike-off or clearing tamper which has a slow vertical movement to press down the surface stone. Then come in order a spader, a tamper, and a finishing belt. In case reinforcement is used a sub-strike-off is attached ahead of the auxiliary strike-off. The clearing tamper, spader and finishing tamper have special purposes and action as follows:

The clearing tamper has a vertical movement, with a long stroke and runs at a comparatively slow speed, a ratio of 1:3 with the other tamping members. Its action is such that all large pieces of aggregate are pressed down a little below the finished surface, as its stroke is adjustable, but without variation when set; the distance below the surface that it will drive the large pieces can be predetermined. The result of this action is such that the concrete is pressed or squeezed into a dense mass, but without separating the coarse from the fine material.

The spader [illegible] is thick, and is hung from the ends of five eccentric driven rocker arms. Its speed is 15[illegible] strokes per minute, which is of such relation to the forward movement of the machine that the area of the concrete touched at each stroke overlaps that touched by the preceding stroke. In consequence all portions of the road surface are struck twice with this tool, and considerable of the surplus water is brought to the surface. The spader blade is adjustable as a whole as to depth of stroke, and by separate adjustments of the drive bolts can be varied in contour.

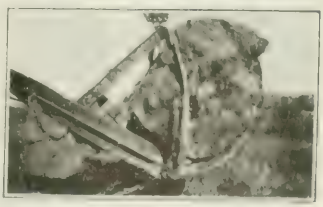
The tamper, a 4 in. channel mounted with flanges up, is hung from the rear



ends of the rocker, and has an alternate motion with that of the spader. It has a tamping and pressing action and its effect is over a greater area, but not as deep as that of the spader. The result of this action is to fill all surface and interior voids with mortar, and at the same time press out practically all of the remaining water, leaving the surface in an almost finished condition, and true to contour. This member has adjustment similar to that of a spader, both as to length of stroke and contour.

Tilting Dipper for Dredges

A dredge dipper which discharges by tilting forward so as to tip out its load instead of dropping it through the bottom of the bucket, is being marketed by the Bay City Dredge Works, Bay City, Mich. This new dipper has been used on drainage work in Wisconsin



and Minnesota and, it is stated, will handle any material but is particularly successful in handling sticky soil or soil containing boulders or roots difficult to drop through the regulation bottom-discharging dipper. The dipper is made in capacities of from ¾ cu.yd. to 2 cu.yd.

Out-of-the-Ordinary Trade Publications

The KOEHRING CO. of Milwaukee has issued a small booklet written by Philip Koehring of the company entitled "Ready To Endure." It is most attractively illustrated in color sketches. The science of the book is to compare on opposite pages ancient and modern structures of somewhat similar nature, such, for instance, as the Acropolis at Athens with the Bush Terminal; the Coliseum at Rome with the New York Yankees' stadium; the Roman viaduct at Nimes with the Tunkhannock viaduct. All of the modern structures are of concrete.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Contracts for First Quarter of 1922 Promise Active Summer Construction

All Construction Exceeds $700,000,000—Residential $250,000,000—Contracts of Last Six Months $1,360,000,000

Volume of summer construction can be fairly gaged by the number and value of contracts awarded in the first quarter of this year. Seventeen hundred sixty-nine important engineering contracts were let in the United States from Jan. 1 to Apr. 1, valued at $308,040,000—over $100,000,000 heavier than in the same period of 1921, and about $160,000,000 more than in the first quarter of 1913. These figures and those in Table 1 are compiled from Construction News, where minimum projects reach $25,000 each on public work and $150,000 in the case of commercial buildings. Residential building is not included, but is listed separately in Table II (F. W. Dodge figures) for the Northeastern quarter of the United States. Geographic distribution of contracts let, as reported by *Engineering News-Record*, is shown in the map and in Construction News, p. 239.

Smaller engineering construction contracts (jobs worth less than the minimum reported in Construction News) will easily aggregate 50 per cent of the value of the jobs reported. Thus, engineering construction already signed up and mostly underway exceeds $460,000,000 in the United States (about $50,000,000 for Canada). At least a quarter of a million dollars worth of residential construction was placed under contract in the first quarter. Total contracts for the first quarter therefore exceed $700,000,000. It must also be borne in mind that total contracts placed in the last quarter of 1921 reached $650,000,000. Probably one billion dollars' worth of construction is now under way.

TABLE I—VALUE OF CONTRACTS LET IN THE UNITED STATES IN JANUARY, FEBRUARY AND MARCH, 1922

	New England	Middle Atlantic	Southern	Middle West	West of Miss.	Western	Total
Waterworks	$15,000	$734,000	$341,000	$888,000	$1,014,000	$550,000	$3,542,000
Sewers	32,000	2,453,000	809,000	3,503,000	894,000	342,383	8,033,383
Bridges	220,000	2,165,000	963,000	572,000	1,009,000	297,000	5,226,000
Excav. and dredging	68,000	25,000	329,000	108,000	531,000	294,000	1,355,000
Streets and roads	1,165,000	10,504,000	20,293,000	11,500,000	9,689,000	9,994,000	63,145,000
Industrial works	4,905,000	9,811,000	13,150,000	7,493,000	2,425,000	2,938,000	40,722,000
Buildings	8,776,000	54,433,000	6,113,000	41,708,000	15,415,000	19,304,000	145,749,000
Fed. Gov't. work	41,500	6,013,000	962,000	47,000		2,252,000	9,315,500
Miscel.	423,000	23,530,000	215,800	914,810	3,460,460	2,408,000	30,952,070
Total	$15,645,500	$109,668,000	$43,175,800	$66,733,810	$34,437,460	$38,379,383	$308,039,953

TABLE II—RESIDENTIAL CONTRACTS LET, FIRST QUARTER, 1922

District	Value
Boston	$9,578,300
New York	55,908,300
Philadelphia	20,178,800
Pittsburgh	13,076,600
Chicago	22,038,100
Minneapolis	1,786,200
Total	$122,566,300

DISTRIBUTION OF IMPORTANT CONTRACTS FOR FIRST QUARTER, 1922



Sixth Week of Coal Strike Brings No Solution

Stocks Outlast Early Estimates—No Solution Adequate that Fails to Stabilize Industry

The outstanding feature of the coal strike now approaching the end of its sixth week is the utter indifference of the public, which, as time rolls on, appears to increase rather than to break down. When the strike began it was estimated that anthracite stocks would be adequate for six to seven weeks. Since then the miners and operators have been in conference off and on but no conclusions have been announced. Anthracite production has been practically zero, but no one appears to be in the least alarmed over the possibility of immediate shortage.

Bituminous stocks, it was estimated, would be good for not less than two months. The miners figured that production during the strike would not run more than 3,500,000 tons per week, while the non-union operators counted on 5,000,000 to 6,000,000 tons per week The fact is that weekly production hovers about 4,000,000 tons, which are supplemented by another 4,000,000 tons drawn from consumer stocks.

Immediately after the strike was called it began to make inroads on the non-union forces and today it is estimated that in central and western Pennsylvania alone more than 60,000 non-union miners are out. Despite this, the opinion prevails that lack of demand controls the output of the non-union mines and that if there were a market for it more coal could be produced.

Russell Sage Investigation

An investigation by the Russell Sage Foundation has disclosed that during the thirty years from 1890 through 1921 the bituminous mines have been open for work on an average of only 214 days per year. Based on a working year of 304 days, this means a loss of 90 working days, of which 37 per cent has been due to overdevelopment of the mines, which have a capacity of 700,000,000 to 900,000,000 tons annually to meet a demand of only 500,000,000 tons. Seasonal variation in demand is said to account for 47 per cent of the lost time.

It is generally recognized that radical readjustment is necessary if the industry is to be established on a stable basis and plans to accomplish this range all the way from government ownership to regional grouping of mine properties under private ownership, with standardized prices for the various sections of the country. Recent reports from Washington indicate that the President and his advisors are at work on the problem but no information is available as to the direction or progress of their thought except the intimation that they do not contemplate federal supervision. All things considered, it is probable that before June 1 conditions will demand some solution that will effect a prompt resumption of work in the mines.

"Ups" Balance the "Downs"

Is the Market Turning?—Construction 73 Per Cent Heavier Than a Year Ago

Looking over the *News-Record's* monthly prices in the May 4 issue one is rather startled by the numerous black-face figures. Bold-face type means higher prices. Light rails are higher by $1 a ton. Cast-iron pipe costs more in New York, Birmingham, Chicago and San Francisco than a month ago. Steel is recovering. Reinforcing bars are up in Pittsburgh, New York and Chicago. It won't be very long before Dallas and the Coast will reflect the new thrust. Prices of structural shapes are climbing. So with rivets. Steel sheets distinctly up. Lumber fairly steady, but a little downward.

By and large, prices are either holding their own or actually stiffening. Declines are fugitive: Sewer pipe cheaper in St. Louis, sand and gravel down in Chicago, cement one cent lower in Duluth, pine down $1 in Chicago, fir down $2 in San Francisco. Elsewhere prices are unchanged—or firmer.

Clearly prices are stiffening under the strong new construction demand. The "ups" just about balance the "downs." This is true throughout the list. *Engineering News-Record's* Construction Cost Index Number perfectly reflects the construction material and labor market. Last month 164.72, today 164.62.

Contracts let in April, 1922, as reported in Construction News, are valued at $142,800,000, as compared with $105,667,000 in April, 1921. Dividing each of these figures by the Cost Index Number applicable for the time, in order to reduce both values to 1913 purchasing power, gives only $50,000,000 for April, 1921, as against $86,600,000 for April, 1922. This means that contracts awarded last month were 73 per cent heavier *in volume* (not in mere money value) than contracts let in April one year ago.

This may explain why the market for construction materials is stiffening.

Next week—résumé of recent public bond sales.

Production and Materials Stocks in Ten Cities

Unfilled Steel Tonnage Gains—Brick Stocks Shortening—Growing Lumber Mill Shortage in Northwest

Steel—Unfilled steel tonnage on the books of the United States Steel Corporation on Mar. 31, 1922, aggregated 4,494,148 tons. Owing to developments in the coal strike this tonnage will be supplemented by an estimated gain of 500,000 tons, making the total unfilled orders for the month ending Apr. 30, 1922 amount to about 4,994,148 tons. Production increased about 2 per cent of capacity in the Corporation's plants, during the week ending May 6, bringing the output rate to about 73 per cent as compared with 70 per cent, for both the independents and the Corporation, on Apr. 26, 1922. Total pig iron production increased over 36,000 tons above March.

Cement—United States Geological Survey shows cement production 6,685,000 bbl. for March, 1922; an increase of 2,407,000 bbl. over February, 1922, and a decrease of 78,000 bbl. compared with March, 1921. March shipments increased 3,717,000 bbl. over February, 1922, and 781,000 bbl. over March, 1921. There were 13,824,000 bbl. on hand Mar. 31, 1922, as against 14,142,000 bbl. on Feb. 28, 1922.

Brick—Data as of April 1 from 100 plants reporting to the Common Brick Manufacturers' Association of America, show 39,000,000 bricks produced in March, with shipments 33,000,000. Number of burned bricks on hand totaled 22,969,000 as against 83,900,000 on Mar. 1, 1922. Current demand is moving the product about as fast as it can be burned.

Lumber—An average of 384 mills reporting to the National Lumber Manufacturers' Association for the four weeks ending Apr. 22, show 769,255,762 ft. cut; 831,148,266 ft. shipped and orders for 971,227,990 ft. b.m., as compared with 720,744,343 ft. cut; 743,469,637 ft. shipped and orders for 780,201,616 ft. during the month ending May 28, 1921. Prospects for the week ending Apr. 29 was 7½ per cent below; [illegible] per cent and demand 22½ per cent above normal.

New York—Manufacturers' stocks of construction materials low, but dealers have sufficient stocks to meet all normal demands except in the case of brick. Manufacturers expect, by rushing production, to ship the first new brick into New York by June 1, unless prevented by further developments in the coal strike or the brickmakers strike.

Chicago—Brick deliveries being made at a rate about four-fifths of production capacity. Sand and gravel stocks over 200,000 cu. yd. Activity in sewer pipe demand in outlying districts. Expanded metal lath stocks low; deliveries take 3 to 4 weeks.

Detroit—Local cement mills speeding production. Prompt lime deliveries from Ohio and Michigan. Only moderate supply in local yards to meet increasing lumber demands.

Denver—Lumber shortage at mills supplying this market, but no deficit yet felt in local yards. About 1,000,000 bricks on hand.

Minneapolis — Stocks ample. Deliveries from plants slightly delayed. Lumber stocks larger, averaging 75@80 per cent of normal in Northwest trade area.

Philadelphia—Proposed reduction in sewer pipe and hollow tile prices causes falling off in demand. Asphalt and manila rope shipments very active. Supply of paving stone and wood block sufficient for present requirements. Lumber stocks, in yards, fairly complete with the exception of hard woods. Demand for all grades of lumber greater than expected.

Boston — Common brick market serious; also shortage of "water struck" brick. No reserve brick in New Hampshire to draw upon. Local output is sold faster than it can be produced.

San Francisco—About 25,000 M. ft. of lumber on hand and more arriving every day; demand increasing.

Atlanta—Sand and gravel delivered in 24 hr. from local pits. 6,000 tons of structural steel shapes on sidings.

Birmingham—Small stock of track supplies; but cast-iron pipe reserve large and complete. Structural steel

CONDITIONS OF MATERIALS STOCKS IN IMPORTANT CENTERS

Stocks on hand in approximate figures, example: (cement, Denver, 10,000 bbl.); time required for delivery of carload lots to city job, example. (sewer pipe, Boston, 8 to 10 days), and stocks on hand in general terms, example: (common brick, Atlanta, plenty)

	Chicago	San Francisco	Detroit	Denver	Boston	Atlanta	New York	Los Angeles	Birmingham
Sewer pipe	700 cars	Plenty, local kilns	Ample	24 hr. del. local plant	Large del. 8 @ 10 days	Del. 48 hr.	Sufficient; del. prompt.	Plenty del. prompt	Local plants, large stocks
Cement	Ample	1,000 bbl., nearby mills	Plenty near Mich. mills.	10,000 bbl.	Plenty del. 5 @ 8 days.	35 cars	60,000 bbl.	Sufficient	1,000 bbl.; 24 hr. from Leeds.
Lime, common and hydrated	40 @ 50 cars	Fair stock in local yards.	10 @ 15 cars		Ample; quick deliveries	25 cars.	Moderate		10 cars
Common brick	100,000,000	Fair		1,000,000	Shortage	Plenty	Shortage	Yards well stocked; del. 24 hr.	Local kilns heavily stocked.
Hollow tile	Ample	3 @ 5 days from works	Small supply del. 4 to several days		Sufficient	Del. 3 @ 4 days	Large plants near city; shipments by water	Large stocks in local yards.	Local plants; heavily stocked
Lumber	Sufficient	25,000 M ft	Moderate supply in local yards	Ample 24 local yards.	Large stocks in local yards.	Plenty	Del. 24 hr. Stocks large.	Plenty of fir; no pine or spruce	Large mills within 200 mi
Asphalt		Del. from refineries, 2 @ 3 days	Small; del. [illegible] several days	10 cars			Refineries near city		

manufactured locally. No market for paving blocks, sand, gravel or crushed stone.

Labor in pine industry constituted 37 per cent of the total cost of production in 1921, compared with 46 per cent in 1920, according to the Southern Pine Association. Skilled labor rates decreased 22 per cent during 1921.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of May 4; the next, on June 1.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montrea
Structural shapes, 100 lb.	+$2.58	$3.35	$4.00	+$2.48	+$2.76	+$3.50	$3.10	+$3.60	$3.75
Structural rivets, 100 lb.	+3.50	3.90	5.50	+3.10	3.90	4.45	4.50	3.75	6.50
Reinforcing bars, ¾ in. and larger, 100 lb.	+2.48	3.25	3.50	+2.38	+2.66	3.42½	2.55	+3.60	2.75
Steel pipe, black, 2½ to 6 in. lap, discount	61%	61.15%	45%	59½%	61.9–5%	44%	+56.1%	53%	30.00
Cast-iron pipe, 6in. and over, ton.	46.80@47.80	42.00	48.30	+44.10	48.00	+55.00	+51.00	+52.00	−50.00
Concreting Material:									
Cement without bags, bbl	+2.60	2.39	2.25	1.97	2.24	2.90	2.73	2.94	−2.48
Gravel, ¾ in., cu.yd.	1.75	1.85	2.25	—1.80	1.50	2.50	2.25	1.50	1.50
Sand, cu.yd.	1.00	1.15	2.25	—1.80	1.00	1.10	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd.	1.75	1.90	2.73	1.60	2.25	3.50	2.25	3.00	2.00
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	48 00	36.00	+34.50	−40.00	39.00	+36.75	−26.00	20.00	47.00
Lime, finishing, hydrated, ton.	15.80@16.80	18.00	25.00	18.00	29.00	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	2.75@3.18	1.25	2.50	1.40	1.40	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000.	+21.40@23.40	9.00	11.15	11.00	15.00	12.00	15.00	14.00	16.00
Hollow building tile, 4x12x12, block	Not used	.0795	.115	.0821	.0752	.08	....	.12	−.09
Hollow partition tile 4x12x12, block	.11120	+.072	.115	.0657	....	.08	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal.	+.95	.96	1.09	+.99	+1.06	+1.12	+1.01	.86	−.97
Common Labor:									
Common labor, union, hour	.75	.35	.....	.80	.....	.50@.55	.56½	.50@.60	.....
Common labor, non-union, hour.	.44@.60	.20	.25	.72½	.40@.50	.35@.50	.47½@.50	.....	.20@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or − signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft lengths or over.

New York quotations are delivered except tiles, which are "on trucks." Common lump lime per 280-lb. net; both lump and hydrated quoted f.o.b. cars New York. Sand gravel and crushed stone are quoted alongside dock. Cement and steel pipe delivered to contractors on job. Gravel ready mixed $1.75 per cu.yd.

Chicago quotes hydrated lime in 50-lb. bags; common lump line per 180-lb. net.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed store quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to contractors in yards at San Francisco. Lumber price is for No. 1 fir, common.

Seattle quotes on Douglas fir instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks.

Montreal quotes on fir instead of pine. Sand, stone, gravel and lump lime per ton. Lime and tile are delivered; cement, sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 98.62 cents). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $30; 6-in., $110.

Changes Since Last Week

Price tendencies upward in principal construction materials. Steel shapes and reinforcing bars quoted at $1.60, Pittsburgh, with quotations creeping toward $1.70; the price of $1.50 per 100 lb. having very nearly disappeared from the market. Shapes and bars up 10c. per 100 lb. in New York, Chicago and Minneapolis during the last two weeks; stiff advances in Denver and Seattle. Stronger demand coupled with continued scarcity of pig iron reflected in rise in cast-iron pipe prices. Denver quotes $55 as against $52; Seattle $52 advanced from $51 and San Francisco $51 as compared with $50 per ton last week.

The coal situation, entailing increased production costs, has made itself felt in advanced cement prices, New York quoting $2.60 as against $2.40 per bbl. delivered, without bags.

Raw linseed oil quotations are above the dollar mark in four important centers, namely: Dallas, Minneapolis, San Francisco and Denver. New York price advanced 6c.; Chicago, 9c.; Minneapolis, 4c.; San Francisco and Denver, 7c. per gal. (5 bbl. lots).

Lumber prices, all grades, remain fairly firm throughout the country, Denver and Seattle, however, report growing mill shortages. Mills in the Seattle district are behind in shipments despite the fact that all operations are running full blast, with two shifts working. The labor situation at this point is practically stabilized with supply but trifle in excess of demand.

Common brick quoted in New York at $18@$20 as against $17 per 1,000 wholesale, last week. The Hackensack, Raritan, Staten Island, Connecticut and Haverstraw shipping centers, forwarding brick with all possible haste, cannot begin to fill the demand. The regular dealers' quotation of $18, advanced $1 during the week, was further supplemented by voluntary bids of $20 and higher on the part of buyers in order to obtain the much needed material. Strikes in the Raritan and Hudson River districts, coupled with shortage of coal and coal dust, add to the seriousness of the situation. Several manufacturers have granted wage increases in order to keep up production and negro labor from the South is being rapidly forwarded to plants supplying the New York market.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren *Editor*

Volume 88 — NEW YORK, MAY 18, 1922 — Number 20

Railway Tunnel as Public Work

THE action of a special session of the Colorado legislature in passing by a large majority a bill authorizing the creation of an improvement district to provide funds for a mountain railway tunnel indicates acceptance of the principle that under certain conditions a railway may be regarded as a public improvement. An older case in the same class was the construction by the city of Cincinnati of the 340-mile Cincinnati Southern Ry., shortly after the Civil War, in order to open up a trade route between the north and the south. In that case the money was raised by city bonds. Plans to build the Moffat tunnel by means of bonds issued by the State of Colorado or the city of Denver were not successful, but a project to build it by the bonds of an improvement district has now been authorized by the legislature. It is not probable that this system will be applicable in many cases but its development in connection with the six-mile Rocky Mountain tunnel will be watched with interest.

Building Dynamiting in Chicago

CHICAGOANS could hardly have been surprised at the dynamiting last week of a building under construction and the subsequent efforts to connect the crime to the band of crooks who control the Chicago building labor situation. The control by criminals has been well known and has been freely exploited in the controversies growing out of the work of the Citizen's Committee to Enforce the Landis Award. In fact it is generally recognized in Chicago that this criminal control is the chief bar against peace there in the building industry. For years the city has been "held up" by its building labor. Honest citizens resented the tactics but did not become aroused to firm action until labor refused to live up to its contract of accepting the arbitrator's (Judge Landis') award. The dynamiting outrage should serve to band all honest men, in labor ranks as well as among the general citizenry, for a fight to a finish to clear Chicago of this criminal influence. Reports from Chicago indicate that this is what is happening.

Safe Hydraulic Fill Dam Construction

THE studies of core formation at the hydraulic fill dams of the Miami Conservancy District, as they are summarized by Chief Engineer Charles H. Paul elsewhere in this issue do much to dispel the fear of hazards in construction which has been created by failures of dams of this type. Briefly the conclusions of the construction engineer from the experience at Miami are that the safe construction of hydraulic fill dams is quite possible, with a variety of glacial drift, and consists in holding the balance level between a speed of raising embankment which is safe and a speed of moving earth, fast enough to keep the costs low. This is a task of construction experience and judgment and the rules and procedure vary for every filling operation. Apparently the occurrences which the constructor has most to guard against in hydraulic fill dam building is to prevent variation of the position of the core in the embankment and the incursion into the core of coarse material by shore slips and subsidences. Bringing the fill up in low lifts, particularly when the embankment is built up by sluicing on one side at a time, and using an excess of core material and wasting the finest so that the core fill will stiffen up more rapidly, are correctives to both these hazards. Their employment, as stated, is determined by construction experience and judgment.

Rapid Transit or Politics?

UNFORTUNATELY, a long delay will probably intervene between the announcement of plans for New York rapid transit and the operation of trains. This is due not only to the need for time to study, legalize, and prepare, but also to the situation that has made of the New York transit problem a political football. We are not concerned with New York politics. We are, however, profoundly concerned with the efforts of engineering science and constructive energy to serve effectively the foremost American city in what is probably its most harassing physical problem. Engineers are available to plan and direct; thousands of workmen are ready to man the mills, shops, and quarries that will supply the materials; contractors with specially designed plant and skilled organizations are ready to take hold of the job; and mechanics and laborers of every sort are seeking employment. There is need for the work and there is need for the job, for the inadequate transit facilities of New York constitute a public scandal. In the face of these conditions, unnecessary delay, obstruction, or political manipulation would be little short of a calamity to the citizens of New York.

Fire Prevention and the Business Man

DOWN at Atlantic City last week a group of men as sincere and enthusiastic as any in the country discussed the question why fire prevention efforts have not been more successful. The question itself constitutes a remarkable admission of failure, failure in a necessary and worthy effort. Of course the fact of the matter is that there has been progress in fire-prevention ideas: The present-day attitude toward fire dangers and fire prevention is much more enlightened than that of two or three decades ago. But the change is hardly more than what would naturally result from general increase of enlightenment on matters of public concern. Real interest in fire prevention as a measure of public protection and economy is very slight indeed. Quite properly the fire-protection specialists desire more rapid progress in their campaign of betterment, which is of necessity in the main a campaign of public education; but [illegible] the [illegible] [illegible] [illegible] Hence the question which

was discussed by the National Fire Protection Association. There is a simple answer for it, we believe. It is that the fire-prevention men have never managed to present their case in truly convincing manner, or presented it to the right people. Everyone's experience will tell him that the big, impressive message of fire prevention has never been "put across" to the ordinary citizen, or, let us say, to the business man. Otherwise we would surely see the most directly interested class, the building owners and insurance-policy holders, making the campaign their own and working ceaselessly for reduction of the general fire danger.

Shingles and Radio

A GREAT deal of well meaning fire-prevention propaganda has been like the boy's cry of "Wolf" in the fable. After the first time or two it scared no one. The average citizen in the course of his daily ups and downs becomes more or less hard boiled, and is not very receptive to arguments that are rejected by his sound practical sense. This psychology is probably responsible for the ineffectiveness of the underwriters' persistent campaign against the wood shingle, a campaign whose weakness lay in absurdly overshooting the mark. The aim was to induce home builders to use incombustible roofing; the method was to endeavor to alarm the whole community over the imminent danger of destruction residing in its shingle roofs. Unfortunately, every citizen is fairly well familiar with the long satisfactory service of such roofs, and his common sense therefore not only keeps him from becoming alarmed as he was meant to be but also leads him to discount the real fire-prevention message. A less pronounced but newer example of the wolf cry appears in the current week's news. The Bureau of Standards has sent out a warning bulletin addressed to everyone—that is, to every owner of a radio receiving set—that he should equip himself at once with elaborate protection against the lightning danger residing in his aerial and lead-in wiring. The bulletin refers to a new radio-protection rule drafted by a committee of the National Fire Protection Association, which, by the way, is moderate, sane and practical in the highest degree. But the warning is couched in alarmist terms, vaguely but effectively suggesting that radio equipment is dangerous. No proof is given that antennas increase the lightning danger of a house, nor is even a plausible case established. The common citizen, whose home is already joined up with miles of electric light and telephone circuits capable of collecting atmospheric super-potentials along their whole length, and whose metal roof gutters and back yard trees afford excellent means for "attracting" lightning, will not become much excited over this warning bulletin. On the contrary, he will lose a little of the faith—such as he may have—in the dependability of public scientific organizations, and he will be less ready to believe future statements about lightning or fire danger, and to accept warnings issued from similar sources.

The Water War

STRIKINGLY like the world war in many aspects is the water war which is now being waged on the lower Mississippi to retain that stream within the levee system. The same precipitate action has been taken in expanding organization, in utilizing human power instead of machines for the task at hand, and in the making of quick decisions amounting to educated guesses. As in war, too, the whole expense is lost once the danger is past. Men were recruited in a few hours time not days. They had to be cared for and fed. A skeleton form of directing force grew into a workable unit over night. To provide subsistence for large forces at uninhabited points behind the levees is no small task. The work is most primitive, mostly handling sand or earth in sacks on the backs of men, for the laborers are many, the skill is little and most machines not sufficiently mobile to be of use. Decisions as to where to work and what to do when a soft back slope or a sand boil is discovered do not await an engineers' calculations or a layout by a transit. "Do it now" is the slogan, for a few hours delay too often means defeat. The really discouraging thing is the fact that temporary flood protection work is anything but satisfactory; it is costly and only by superhuman effort and the highest grade of morale is it effective.

Morale, A Factor

MORALE is noted as a factor in flood fighting because practically all of those in charge use this one word perhaps more often than any other. The activation of men to carry out orders, to get work done and material moved under unknown conditions is an asset without which failure would surely result; spirit, the engineers' officers like to call it. Leaders must be picked with the magnetic ability to transmit the spirit of fight and action based on good judgment. Organizations of all kinds must be harmonized and their efforts brought to bear on the situation in an effective way. Labor must be recruited continually. Relief, if it is not to be dissipated among loafers, must be co-ordinated with the labor recruiting. Money has some times been spent in topping levees, the most showy part of the flood fighters effort, simply to make people and the workers "feel" safer and better. River equipment is moved about from place to place for the same reason. "It it worth $500 to keep up the spirit of these people" was the significant remark of one of the engineers in ordering a quarterboat from one locality to another. So morale, meaning the belief that the river really can be held back, is no small part in the fight. In fact without it the fight were long ago lost, in the opinion of the leaders.

Mississippi Flood Facts Needed

JUST now the fight to hold the levees is the spectacular and dramatic feature of the Mississippi flood. Later there will come the reconsideration of the problem of controlling the river which is the regular sequel to every record flood. During normal water no one but those engineers concerned does any thinking or talking about the Mississippi, but as soon as the floods reach first-page notice new theories grow apace and old ones are revived and the proponents of the levee system are forced publicly to defend that method of control. After the 1912 floods the then president of the Mississippi River commission, Col. C. McD. Townsend, quite adequately filled the role of defender and his various papers in 1912 and 1913 (see *Engineering News*, Oct. 31, 1912) stand as masterly expositions of the hydraulics of the Mississippi. His disposition of reservoirs, reforestation, parallel channels, outlets and cutoffs leaves no doubt as to the inadequacy of the only suggested competitors of the levee, which, by elimina-

tion at least, justifies the adopted method of control.

Nevertheless when this year's waters go down there will be need for the broadcasting of some fundamental facts. So far as has been reported there was no record rainfall over the whole drainage area of the Mississippi, or at least the rainfall coincidences were by no means such as to produce the maximum river flow below the Arkansas. And yet we have had the highest water ever recorded in the Mississippi. This raises several questions which the river authorities will doubtless answer soon: What was the discharge this year; how near to the Commission's ultimate high-water estimate did this year's gages read; what was the relation between high water and the tops of the so-called completed levees? In other words, is it a fact, as some opponents of the levees are claiming, that a combination of rainfalls by no means as severe as may be possible has produced in the river a series of stages beyond previous predictions and rendered necessary a revision upward of the levee standards heretofore established as the ultimate to be required?

For around $50,000,000 it is claimed that the Commission's project can be completed and the river held, by strenuous methods in flood times, to be sure, but held at a not unreasonable cost. Experience this year in the work of defense upholds this view, but the extremely high water is ominous and needs some explaining. Have we reached the high-water stages which may be expected or are the levee-top ultimate elevations to be raised once more and probably again? These are questions which must await the full record of the flood and the statements of the Commission as to the relation between flood heights and levee standards as built.

A Plan for the New York District

NOTHING in the two or three decades of the present era of city planning in America equals in importance the news given out last week that work is well under way on a Plan for New York and Its Environs. There has been a growing realization of the fact that any plan for a city that is a great center is incomplete if it stops at its own boundary line. In the New York metropolitan district recognition of the importance of regional planning was shown several years ago when a conference on the subject was held. That conference gave promise of others designed to take up unified and co-ordinated planning for greater New York and allied or outlying territory to the east, the north and the west, in the states of New York, Connecticut and New Jersey. Apparently this project came to an end almost as soon as it was begun, very likely because of its magnitude, both physically, politically and financially, but more than all through lack of any one agency which in itself or as a nucleus for co-operation could offer that solidity and continuity that is a prime essential of even a city planning scheme for a single large municipality.

It may well be noted that, with the exception of our national capital, Chicago affords the most notable instance of city planning and city planning execution in the United States, and the achievements there have been due primarily to private effort. Rightor, in his notable exposition of the Chicago city planning work under the very misleading title, "What of the City," makes a strong plea for the endowment of city planning wherever it is to be undertaken. This or its equivalent is now being afforded by the Russell Sage Foundation, created for human betterment and directed by the deed of trust to expend some portion of its income for the special benefit of New York City and vicinity. If endowment of planning for a single city is considered necessary by one who has lived and worked through years of successful effort at Chicago, how much more necessary is it for the making of a suitable plan for New York and its environs, a task which will necessarily extend through many years and which, if ever one could expect that it would be taken up another way by the very large number of cities, big and little, towns and villages and wholly rural districts, would be subject to all the many mischances of inter-municipal jealousies and of the political changes in various municipalities which, under our American system, seem to make it mandatory for one political administration to discount and even undo what has been begun by another?

It is more than fortunate, therefore, that a plan for New York and its environs has already been put well under way by so stable an organization as that which has been created for this special purpose by the Russell Sage Foundation, as announced in detail in our news section this week. Confidence in the success of this notable attempt in American regional planning is all the greater because of the men who have thus far been associated with the work and are to continue as it grows in scope and detail.

Undoubtedly it will appear as time goes on that as great as may be the physical and financial problems which will have to be met, greater and more troublesome still will be those of a political nature, due to the location of the area involved in three different states. But this should only add interest to the work of unification by regional planning. In fact, taking a broad and far reaching view of the geographical field of regional planning, it is difficult to see how a unified governmental administration can be expected in this particular instance, at least, short of carving out a new state from portions of three old ones. In the future this may come. For the present co-operation and consolidation of governmental areas located in three states and scattered in hundreds of communities must be sought. Such co-operation has been achieved with notable success in some parts of the country, mostly within a single state and for what may be termed elements of a city plan, such as water supply or sewerage, or parks, rather than with city planning as a whole.

For the present the main thing to be considered, so far as the plan for New York and its environs are concerned, is that work is actually well under way on a magnificent regional plan. Such a plan once provided, it will at the very least afford an ideal toward which many of the diverse elements in regional planning may be shaped even if not everything is achieved. The need of the moment and of the next few years is for an embodied vision; the ideals of the seers—corrected by the common judgment, as Elihu Root happily phrased it at the conference when the plan was announced—reduced to the form of a plan or series of plans; the whole made plain, convincing and stimulating to the imagination by the combined work of the topographical engineer, the aerial photographer, the city planner and the brush of the artist as was done in the case of the Washington and Chicago plans, and as may be done on the far larger and grander and more varied scale for the larger area and the more diversified topography by water and land in the case of New York and its environs.

Fighting Floods on the Mississippi Above Vicksburg

Construction Methods of Handling Levee Maintenance During the Highest Flood of Record—Organization Details Down to the Plantation Laborers and How They Function Under Emergency Calls

By W. W. DeBerard
Western Editor, *Engineering News-Record*

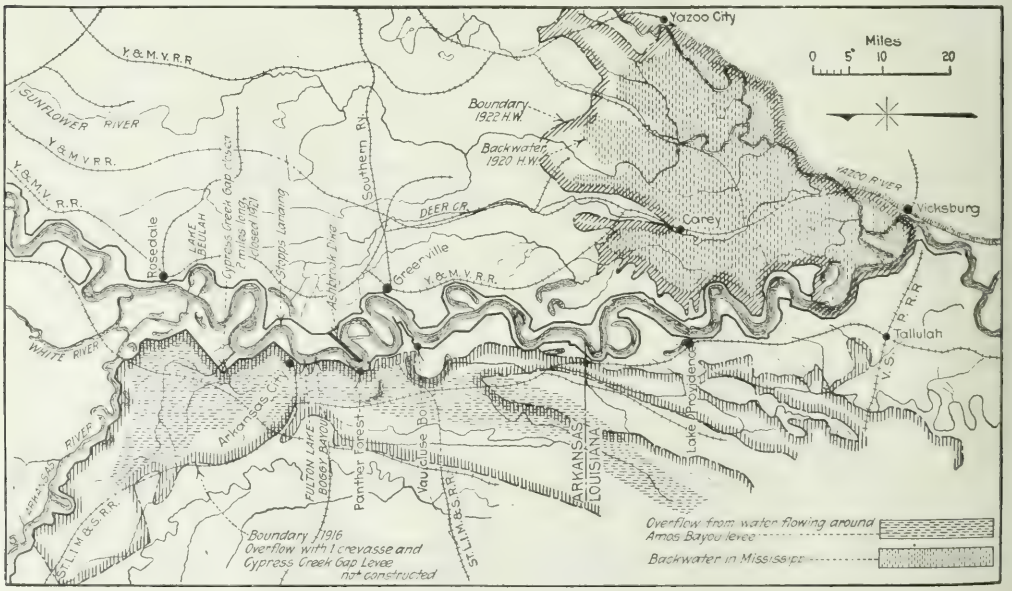
(With Insert Plate of Views)

THE highest flood of record persisting for the longest time yet recorded has been passing down the Mississippi River testing the strongest and highest levees, some of them to destruction. Crevasses have occurred at three points in Louisiana but as yet the upper stretches above Vicksburg where breaks would devastate the greatest areas have held; held by seemingly superhuman effort, vigilance, and pre-planning against tremendous odds because the floods have come in the midst of raising the levees to Mississippi River Commission standard grade and section. Many narrow escapes from failure have occurred. This article proposes a portrayal of some of the dramatic victories won by the flood fighters above Vicksburg, mainly directed by the engineers of the commission. The battles lost at the crevasses are heralded wide in the newspapers because of the devastation, money damage and physical deprivation, although less actual suffering occurs and less relief is required than is supposed. Inhabitants having always experienced flood water know how to live "upstairs."



FILLING TRENCH SACKS

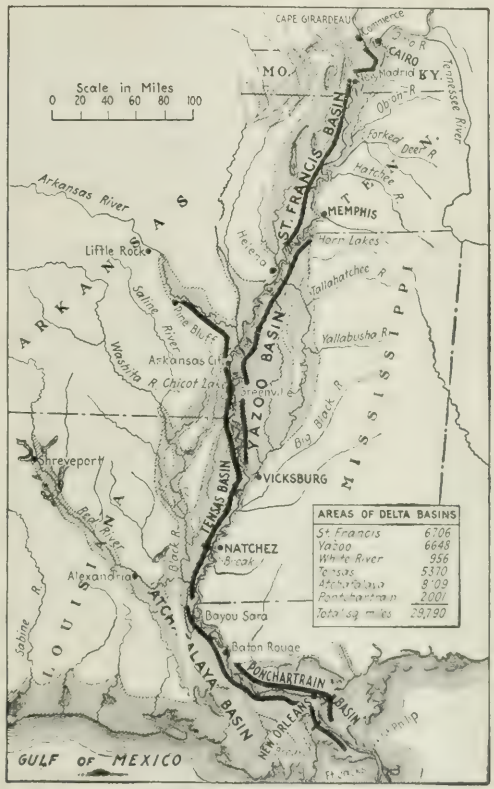
The control of the Mississippi by levees was fully described by J. A. Ockerson, of the Mississippi River Commission, at the recent Dayton meeting of the American Society of Civil Engineers in a paper abstracted in *Engineering News-Record*, April 27, 1922, p. 703. The problem, however, is so large on 2,000 miles of levees and the factors so numerous that few engineers outside of those directly in contact with it sense the outstanding features. The crux of the situation is the holding of the low and weak levees in the 200-mile stretch above Vicksburg. The stra-



THIRD DISTRICT LEVEES, FORMER AND PRESENT, SHOWING OVERFLOW AREAS

tegic points are the levees on both banks, in Arkansas centering on Arkansas City and in Mississippi the stretch between Rosedale and Greenville. Closing a 2-mile gap at the mouth of Cypress Creek in the west-bank levee 20 miles above Arkansas City last season eliminated an enormous backwater reservoir and outlet for 200,000 sec.-ft. available in all previous rises above flood stage. In consequence the streets of Arkansas City are dusty during a flood perhaps for the first time in its far-famed history. The added water held in by the new levee on top of the highest-of-record stages at other points shoved the Arkansas City stage 1.6 ft. above any previous flood. Engineers estimated that the closing of the gap might raise the normal crest at Arkansas City anywhere from 0 to 2 ft. and the embankments on both sides were being increased in height in this sector 5 ft. to meet the standard section and grade of the commission.

The work of levee raising near Arkansas City has proceeded just as fast as the limited funds of the commission and levee board would permit. To encounter a highest-of-record flood in the midst of any construction of hydraulic work seems the fate of the engineer. Perhaps it is as well. It teaches him humility and nature shows while he is on the job her worst side. The highest-of-record and the closed-gap factors occurring together threw down a gage of battle which only the most modern of flood fighters utilizing every scientific weapon at his command would seriously attempt to engage. There were available good roads for land transport of men and equipment, water transport including steamers, barges and gas launches for quick movement of material and men, the telephone to make organization easily mobile and organization, headed in a skeleton way by the U. S. Army engineers, whose every call for men and supplies was instantly answered by the local levee boards who were able personally to reach down through the highly interested planter to his field hands.



MAP OF THE LOWER MISSISSIPPI SHOWING PRESENT LEVEE SITUATION

DATA ON PRESENT AND PREVIOUS HIGH WATER STOPS OF MISSISSIPPI—MAXIMUM GAGE READINGS ON MISSISSIPPI RIVER AND TRIBUTARIES FOR HIGHEST FLOOD YEARS SINCE 1884

(Compiled by A. Miller Todd, U. S. Ass't. Eng'r.)

Stations	Miles From Cairo	Elev. of C.D.	Flood Stage	1884	1886	1887	1890	1891	1893	1897	1898	1899	1903	1906	1907	1909	1912	1913	1920	Up to May 5 1922
Cincinnati	504	449.4	50	71.1	55.8	56.3	56.8	57.3	50.6	61.1	61.1	51.5	53.2	50.2	65.1	54.3	51.7	69.8	54.6	52.1
Ohio River				19	12	6	7	9	1	8	10	3	6	1	10	4	3	13	10	
Nashville	244	334.8	40	45.6	49.3	44.3	50.7	29.0	20.0	48.8	24.0	37.6	40.6	34.3	28.2	39.8	46.6	44.9	44.1	45.1
Cumber'and R.				13	14	7	11	0	0	15	0	2	0	0	0	0	0	0	14	
Chattanooga	495	651.9	33	36.8	52.2	27.3	42.5	29.0	30.0	37.9	18.0	40.0	31.0	13.7	8.0	25.0	30.2	33.1	43.6	34.8
Tennessee River				4	11	0	5	0	0	6	0	8	0	0	0	0	1	5		
St. Louis	191	400.2	30	15.7	23.7	20.1	5.4	11.8	31.6	16.9	22.8	19.9	25.2	24.4	26.3	35.2	30.8	27.2	28.0	33.9
Upper Miss. R.				0	0	0	0	0	5	0	0	0	0	0	0	11	9	0	0	
Cairo	0	290.8	45	51.8	51.0	48.5	48.8	46.2	49.3	51.7	49.8	46.2	50.6	46.9	50.3	47.3	54.0	54.7	51.4	53.6
Miss. R. (below Cairo)				24	21	42	38	13	18	49	17	26	19	12	15	21	4	37	43	
New Madrid	70	275.7	34	41.5	40.4	37.7	38.2	36.4	38.1	40.2	38.3	36.1	39.6	37.0	39.3	38.6	44.0	44.6	40.2	
Memphis	230	203.7	33	34.2	34.8	35.3	35.6	34.9	35.2	37.6	37.2	35.2	40.1	37.1	40.3	38.6	45.0	46.5	40.3	42.3
Helena	307	162.0	42	47.0	48.1	46.3	47.7	44.7	47.9	51.8	49.1	46.8	51.0	47.0	50.4	47.6	54.3	55.2	50.1	52.3
Sunflower Ldg	357	147.1	39				42.9	40.9	43.0	47.2	46.0	44.3	48.0	45.2	47.7	45.2	50.8	51.3	48.2	
Little Rock	176	241.5	22	12.8	12.8	6.5	17.8	17.7	17.0	17.6	9.8	6.4	19.6	8.5	19.4	25.1	19.6	6.9	13.3	23.2
Arkansas River				30.6	17.9	17.6	23.9	20.7	27.2	22.9	29.3	25.9	26.2	21.8	20.4	6	25.2	19.9	22.3	
Clarendon	134	158.9	25		28.5	27.8	34.6	28.2	29.3	31.0	30.5	24.2	32.6	28.7	28.5	28.9	32.6	30.4	29.5	30.8
White River					29.2	27.9	31.6	29.1	33.9	32.4	35.4	29.6	60	33.1	32.3	44	86	39	29.6	
Mouth White River	393	128.7	42	47.9	48.2	47.8	50.4	47.7	49.5	52.4	51.0	48.5	53.7	49.8	51.9	50.0	56.3	55.4	53.1	56.9
Arkansas City	438	116.4	42	46.5	46.9	46.7	49.5	48.2	50.2	53.9	51.2	48.6	52.9	50.0	52.1	50.1	55.3	55.2	54.0	58.0
Greenville	478	108.0	36	41.1	41.2	40.8	43.4	43.2	44.3	46.7	46.2	43.0	49.1	44.9	47.8	44.8	50.5	50.4	47.0	52.0
Lake Providence	542	89.6	36	38.4	37.9	38.0	41.0	41.0	41.8	44.5	44.4	41.7	46.5	43.7	46.3	44.4	49.3	48.0	45.5	49.6
Yazoo City	65	93.3	25		22.1	23.8	26.6	28.3	25.6	31.5	24.4	25.8	27.9	22.6	26.1	25.9	30.3	29.8	31.0	31.9
Yazoo River					0	0	22	25	18	0	0	26	42	0	17	20	75	45	149	
Vicksburg	509	66.0	45	49.0	44.3	44.7	48.0	49.1	48.3	52.5	49.4	47.3	51.8	47.2	49.7	48.0	51.7	52.2	50.9	55.0
				29	6	6	26	64	45	70	27	32	64	20	34	27	62	38	64	
Natchez	700	36.8	46	47.4	53.2	44.2	46.9	46.3	46.8	49.8	47.4	46.2	50.4	46.7	48.9	47.7	51.4	52.6	51.5	55.5
				20	0	0	66	51	43	62	14	9	54	12	24		50	38	69	
Shreveport	320	160.9	29			18.4	34.4	25.2	24.0	24.1	13.6	15.6	33.1	12.3	16.5	10.2	30.3	12.3	31.0	
Red River						0	32	0	0	0	0	0	34	0	0	0	0	0	0	
New Orleans	957	20.9	16	15.5	15.8	8.5	16.0	16.0	17.4	19.0	15.9	16.0	19.4	16.0	18.7	17.9	22.1	19.3	19.2	22.6
Carrollton Gage				0	0	0	0	1	25	9	0	1	74	2	39	27	64	43		

So the problem above Vicksburg in its natural and man-made aspects appeared after several days contact with the "commissioned officers, non-coms and buck privates" in this war with water. It is a three-sided affair. If one side of the river loses the other side wins, for the common enemy, the river, can only ruin one side. While no one would be so base to suggest cutting a levee armed guards patrol 1-mile beats and have definite instructions to bring in those without business on the levee as well as to report on new leaks, seepages, boils or incipient slides.

Chicago was left on an hour's notice at the invitation of Col. C. L. Potter, president of the Mississippi River Commission, with Vicksburg as the destination and Major J. A. O'Connor of the U. S. Engineers in charge of the Third Division, as the first point of contact. "Go up the river and see the battle on the ground—and water. Talk with the flood fighters and then come back to Vicksburg" were his suggestions. "This office will get the statistics together in the meanwhile. C. B. Allen, engineer in charge at Rosedale, a veteran fighter for 30 years will pass you over the river to E. S. Maupin, assistant engineer in charge at Arkansas City, loaned from Monroe, La., to relieve W. L. Lipscomb, junior engineer, worn out and in the hospital. Mr. Maupin will get you down to the Vaucluse boil where C. J. Lawson, Greenville, is in charge." This article was written at Arkansas City under a 30-ft. levee, topped, drained and matted and after several days following these river men, tramping levees with the water nearly at its crest lapping the sandbag topping, making launch expeditions to boils, slides and mattressed back slopes. It is not intended to write a scientific article—the engineers reports are renowned for that—but it is the idea to tell of the work from the average engineer's viewpoint.

The problem of the Mississippi is to pass 2,250,000 sec. ft. of water draining two thirds of the United States down the tube of a funnel varying from 1 to 10 miles wide, with the adopted method of control—the delimiting of the flood channel by means of levees—only partly completed. Velocities of 11 ft. per second in 105 ft. of water indicate the horse power available. Reservoirs exist at the delta entrances of a few rivers but are of little use; 1,000 sq. miles at the mouth of the White and Arkansas and 1,500 sq. miles at the mouth of the Yazoo River. The methods of handling the work and the organization are somewhat complicated but the construction of mats for slides, of placing filled sacks for topping and around boils are comparatively simple; management, finance, human interest and politics a-plenty and intricate detailed engineering a miimum. Not a surveyor's instrument was visible. What need for levels when every layman had a high-water-mark stake to supplement those driven every mile by the engineers of the commission.

Incipient breaks and dangerous conditions have developed in many places, some of the most important of which are as follows: On the Mississippi side seeping back slopes and boils developed at Stopps Landing. On the Arkansas side north of Arkansas City boils and overtopped levees appeared near Chicot Landing. Soft back slopes and a slide occurred on the city river front. Boils showed at camp C-2 and a most serious slide occurred at Fulton Lake. The last was the closest to a failure in the 60-mile line. A large boil in the levee toe at Vaucluse was considered almost as serious and required five days attention with 1,000 men.



PACKING AND LOADING SACKS FOR RINGING BOILS

Maintenance of the Mississippi River levees during floods calls for central direction and practically a military though flexible organization down to the last laborer carrying sacks. The central skeleton organization heads up at St. Louis under Colonel Potter, president of the Mississippi River Commission, reporting to Maj. Gen. Lansing H. Beach, Chief of Engineers, U. S. Army. Each of the four districts is in charge of a district engineer. Major J. A. O'Connor, district engineer for the Third District in which one of the most serious situations was located has A. M. Todd as principal assistant engineer in general charge under the district engineer. In the field E. S. Maupin with headquarters at Arkansas City handles 60 miles of the west bank levees from Red Fork to and including Leland Dike, Ark. Continuing on the west side, J. R. Adams with headquarters at Lake Providence, La., has a 40-mile section from the Arkansas state line to Point Lookout, La. In Mississippi C. B. Allen with Rosedale as headquarters has a 65-mile section extending from the Coahoma-Bolivar County line to the Washington County line. Remaining portions of the levees in the Third District are in the hands of the local levee boards. The levee boards furnished the local labor. The commission furnishes the regular river equipment of steamers, barges, quarterboats, snag boats and launches. Supplies consist mainly of subsistence except sacks, of which 5 million are being used. Many trench sacks from war department stores have been made available.

At Arkansas City, which is an example of an extended organization, seven department heads report to the engineer in charge; construction, subsistence, office force, transport, advisory board, guards and a labor department.

The construction head has seven engineers or overseers; each is assigned to about 10 miles of levees and has from two to seven foremen working with the foreman accompanying the planter's quota of laborers. Five quarterboats and crews under a foreman are used for districts not within easy reach. Each has full responsibility for work and subsistence of his men.

The subsistence department head for 1,600 men has a purchasing clerk who distributes supplies from a main store to each of three camps and five quarterboats. A chief steward has stewards at a foreman's kitchen improvised on a depot platform and at each of the two 700-men camps located where work was formerly under way by levee drag-line operations. A group of 250 convicts are fed from one of the camps. Night and morning meals are served in camp but for lunch it is the stew-

ards duty to locate the men and transport meals to them on the job by launch.

The office work under a chief clerk consists mainly of pay rolls and is handled by a pay-roll inspector and seven clerks. Often it is necessary to pay off gangs every day on account of changing personnel. All records relating to bills, material and labor are kept in accordance with government precedure.

The transport department utilizes the railroads for materials, supplies and men from a distance. It has 9 launches, 3 steamers and 1 tug for towing and transporting men, 14 motor trucks for hauling in men but mainly for bringing to the levee sacks filled with "buckshot" clay. This haulage was over an asphalt state highway from a pit 1 mile away to a barge loading point in town within reach of a clam-shell bucket. The paved connection with the 153 miles of hard road recently completed greatly facilitated the movement of men from the various plantations. A special train of 21 cars having unlimited right of way brought 3 million sacks



TRUCK LOADING POINT ON RIVER STREET, ARKANSAS CITY

Trucks dump sacks, men load to a clamshell which dumps on the barge. River at this point is 30 or 40 ft. above the main street of Arkansas City, shown here.

from Schenectady, N. Y. in 90 hours, said to be record-breaking time for movement of freight.

The advisory board consisted of two old flood fighters, one in charge upstream and the other downstream both interested financially and politically in seeing that nothing was neglected to safeguard the levees.

Guards, 120 in number, patrolled the levee night and day. The levees were divided in ten sections of variable length. Two men watched two bad spots continuously. It was required that every section be walked top and toe at least once each shift looking for soft spots, cracks, insipient slides and boils.

The labor department has one man in charge from Louisiana and one from Arkansas. Labor is recruited through special local boards and the number of men requisitioned is prorated according to population. It is the business of the two labor heads to furnish transportation for the men and to look after them in personal ways while on the job. The laborers, mostly farm hands, are replaced weekly so as to inconvenience the planters as little as possible.

Labor at Stopps Landing under Mr. Allen was recruited in a marvelously quick time. An inspection at 2 p.m. indicated that trouble was imminent from boils and soft back slopes. At 4:30 p.m. a phone requisition to the Rosedale headquarters was put in for 1,500 men. The phone was used by the officials of the local levee board and by 8 p.m. that same night in a driving rain 400 men were on the ground. By 8 a.m. next day 1,200 more arrived in motor trucks with plantation foreman. Within a few days the force was raised to 6,000. The men came from a radius of 75 miles, 30 and 40 on a truck. The Delta Land and Planting Co., an English syndicate, owning 30,000 acres and working 3,000 people, formed the nucleus of the force. How Mr. Allen and K. C. Young, who happened to be in charge at this particular point of an inactive drag-line came, housed and fed these men besides getting results on the levees may be likened to the first few days of cantonment construction.

CONSTRUCTION

Levee maintenance during highwater periods is a primitive task carried on with sacks and brush put in place rapidly by hand. Only small tools are used, such as shovels and occasionally tampers and carrying barrows for heavy sacks. The divisions of the work are as follows: Stopping slides, reducing the flow of boils, topping the crown, erecting bulkheads for resistance of wave wash, draining the back slopes, and matting the back slopes with sacks and brush.

Slides are probably the most serious features to handle although boils in or near the toe of the levee may prove equally serious. Speed in reporting is highly essential with slides, as a large gang and plenty of materials are needed at once. Slides usually occur on thin, pervious, saturated land-slide enlargements of levees and the movement is fact. The most serious occurrence in the Arkansas section was the Fulton slide opposite borrow pits from which a land-side enlargement had been made. This slide developed about 10:30 p.m. April 16 and was discovered less than 30 minutes after it started by a guard who reported it to headquarters 2 miles away. A crack 180 ft. long, 2 ft. back from the water line appeared and was soon followed by a 1-foot drop. Despite the driving rain, within 2½ hours 300 men with barges filled with sacks and willows, kept on hand for such contingencies, were at work. A quarter-boat fitted with extra bunks carrying 400 men was available for emergencies, but this slide was so near Arkansas City 230 convicts quartered in a garage in the center of the town were rushed to the site. They filled 1,100 cu.yd. of sand into sacks the first night. The river was rising and was within 0.2 ft. of its crest level. The drop of material at the top of the slide eventually was 9 ft. and left only a 2-ft. thickness of earth to keep out the river. A Delco demonstrator lighting system mounted on a Ford truck was loaded onto a barge for light.

Repairs were made in the following order: (1) A willow mat was thrown over the portion immediately at the break and lightly loaded with sacks to prevent as much crumbling as possible. (2) A 6-ft. bulkhead was set up at the toe of the slide and sacks piled up 6 to 7 ft. deep over willows on the flattened toe of the sliding portion. The bulkhead was not relied upon as much as the weight of the sacks. (3) Willows, weighted lightly so as not to increase the tendency to slide were placed over the whole surface to maintain as much crust stability near the surface as possible. Additional weight was added where bulges appeared. The force was 150 men days and 400 men nights for 5 days during which time at least 500,000 sacks were placed on a levee length of about 200 ft. Failure would have resulted in a crevasse that would have inundated the west side down to the Red River. (4) A timber bulkhead 12 ft. from the center line of the levee and 8 ft. wide, filled with sand, was constructed to throw the center of gravity of

he remaining portion of the levee toward the river side. Sand was also spread along the water side of the levee as a blanket to reduce seepage to a minimum. Experienced river men considered this slide the most dangerous ever controlled.

Boils are indicative of a sandy foundation and lead to blow-outs due to carrying away material from the foundation. Undermined, the levee subsides if enough material is withdrawn or if becomes sufficiently saturated. Boils are most dangerous therefore when they occur at or near the toe. Beyond 200 ft. they rarely cause concern although they are not neglected if they carry silt and especially if they carry material which it is suspected may be coming from below the levees.

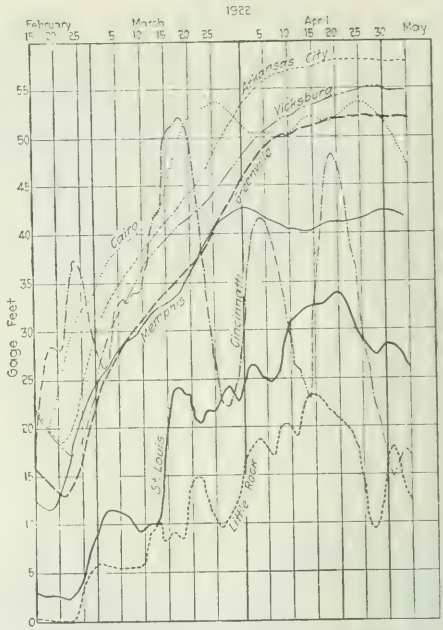
The method of repair is to raise evenly a water blanket over the boil just to the point where efficient filtration will begin and silt carrying cease. A greater height than necessary greatly increases the danger of a break outside the ring, loop, or sublevee of the enclosing embankment. Small boils are ringed with sacks filled with clay. Larger ones may have a sub-levee permanently thrown up around them from a previous flood as at Stopps Landing on the Mississippi side where many acres have been enclosed by sub-levees of various heights. Occasionally it is expedient to step down the head a second time and even a third time by concentric embankments. Usually the embankments are looped back to the levee if the boil occurs near the toe. A miniature crevasse was found at a high spot in one of the 20-acre sub-levees of bags at Stopps Landing, but was discovered before it unblanketed the whole area. Material was obtained for filling the sacks in the fields nearby.

A series of small boils occurred near Rosedale extending back about 1,000 ft. from the levee. As is usually the case the affected area is an old loop of the river and a long sub-levee will be the only feasible method of blanketing it. As the blue silt washed up was believed by Mr. Allen to be coming from about 60 ft. below the ground surface no trouble was apprehended so long as the flow did not materially increase.

Forty boils occurred 1 mile down stream from Arkansas City at Camp C-2 in an old landside borrow pit made when the levee was the 6-ft. railroad embankment. Now the levee is 25 ft. high and the original removal of the 4 ft. of clay cover over the quicksand in the pit permits an easy communication with the river. Under the present construction all borrow pits are on the river side and all old land-side pits giving trouble from boils will be filled as the levee is brought up to standard section. The material for the Camp C-2 boils was brought over the levee from barges by sliding the sacks in chutes to the toe and also from material sacked in the field.

The most serious boil was at Vaucluse, opposite Greenville where the crater occurred near the toe of the 40-ft. levee crossing an old river bed. It was 3½ ft. across and a sack ring 20 ft. in diameter was brought up 8 ft. high before checking it. Before finally coming under control, three concentric loops had to be built, stepping down the pressure three times. The levee settled about 3 in. for a distance of about 250 ft.

Topping where the bank is protected from wave action by nearby timber growth consists simply of dropping clay-filled sacks in place and locking them together by tamping and tramping. The best bag is a 100-lb. sugar



GAGE HEIGHTS OF 1922 FLOOD ON THE MISSISSIPPI RIVER

sack filled half full only. Trench sacks are too light and are easily flipped out of place by the waves. Where necessary to use part sand-filled sacks they should not be placed on the water side but as backing behind at least one row of clay-filled sacks. The sand washes out rapidly and permits the water to pass.

Timber bulkheads backed by sacks are used to minimize wave action. In front of Arkansas City the river is several miles wide and the wind has been known to throw logs into the street damaging the crown. A heavy 2-in. plank bulkhead has been placed for the entire length of the river street. It is braced every 6 ft. with 2 x 8-in. planks back to a railroad track on the banquette.

Near Stopps Landing about 3 miles of topping and matt on the back slope has been placed. For about 1,200 feet the levee was from 4 to 8 in. below the crest elevation. Probably 30 miles of the Arkansas section is topped but not so continuously at any one place. It is estimated that 40 miles of levees above Vicksburg has been topped; 10 miles in Mississippi and 30 miles in Arkansas and Louisiana.

Wave-wash protection by sacks behind a bulkhead may be necessary on newly completed full section levees as at Rosedale. Bermuda grass takes about 2 years to produce a matt that is immune to waves. Plans for completed levees at the more exposed points call for a 4-in. concrete slab pavement.

Back-slope matts and drainage are important since upon them is reliance placed to maintain the integrity of the surface crust and to weight it down. Drains down the slope are cut from 2 to 6 ft. apart to carry off seepage and rain water. Willows are placed up and down the slope, care being taken not to shut off the ditches. Sacks of sand are then piled on top of the willows. K. R. Young, superintendent at Stopps Land-

Along the Mississippi from Arkansas City to Vicksburg



Sand Bags Used to Back Levee at Slough Two Miles South of Arkansas City.







Sand Bag Enclosure to Step Down 5-ft. Difference in Elevation at Ashbrook Dike.



Catfish Point Loops and Sub-L



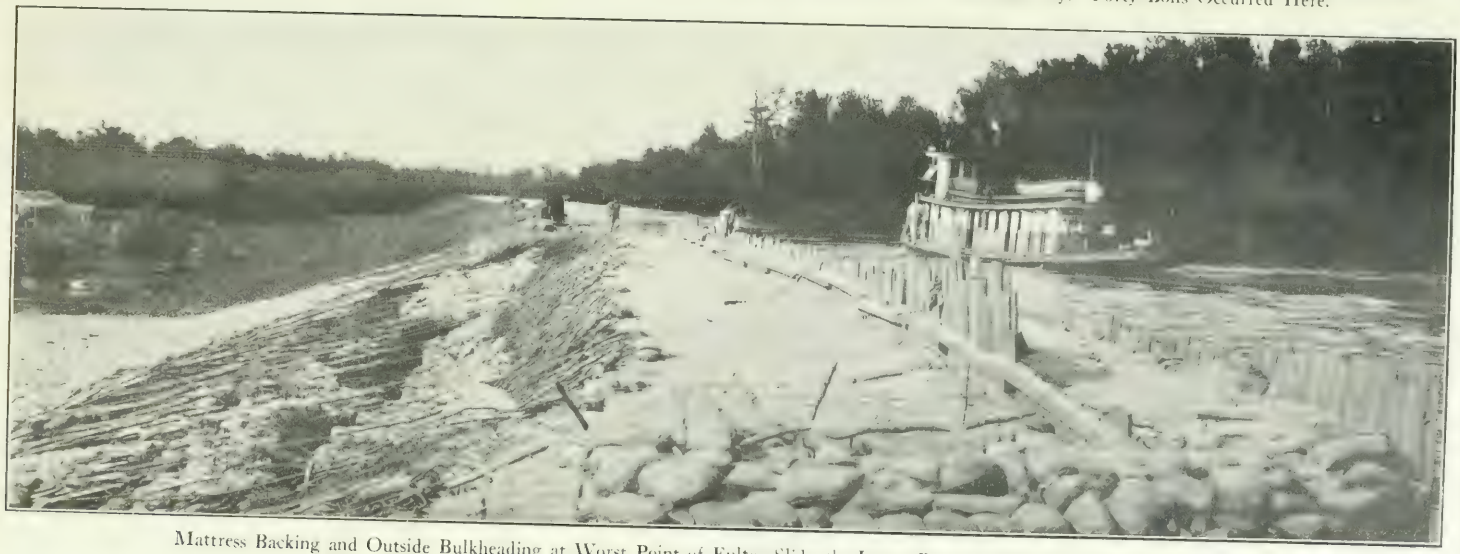
Along the Levee at Arkansas City. Extra Heavy Bulkhead and Sack Topping Braced to Railroad Tracks on Banquette.



evees to Hold Successive Boils.



Typical Sand Boil Near Arkansas City. Forty Boils Occurred Here.



Mattress Backing and Outside Bulkheading at Worst Point of Fulton Slide, the Lower Part of Which is Shown in an Upper View.

During the Record Flood Week of May 1 to 6, 1922



Sand Boil at Chicot, Three Miles North of Arkansas City; Ringed and Levee Topped with Sandbags





ing, cut the hoe-blades of his drainage maintenance crew into a V-shape to facilitate cleaning out the drains. Well-drained and particularly well-matted slopes are not likely to develop "puffs" which raise the surface grassed crust. These puffs indicate that the action and reaction are nearly equal. They usually contain clear water and the area should be drained and weighted with sacks. Many of these puffs developed in the levee slopes near Stopp Landing and were so handled. Blanketing with clay on the water face is one method of eliminating them as well as direct leaks.

Closing Cypress Gap—Closing the 2-mile gap in the river at the mouth of Cypress Creek in 1920 and 1921 is responsible in a measure for the 1.6-ft. additional rise at Arkansas City over previous crests. The maximum section occurs for about a mile and is 55 ft. high, has an 8-ft. crown and 425 ft. base. The elimination of this gap and the successful maintenance of the 60-mile levee



TWO SAND BOILS AT CAMP C2 IN THE BORROW PIT

front in Arkansas will completely protect an area of 7,000 sq. miles with an assessed valuation of $175,000,000 supporting a population of 200,000 people. This country has had protection from floods not exceeding 52-ft. gage height at Arkansas City. The gage during this flood was 58 ft.

Fallacies—Several views held by laymen and some held by the older flood fighters appear now to be accepted as fallacies. Perhaps the most often aired theory is that the increased height of the levees has lifted the river bed. The question was put to Colonel Potter who was encountered superintending a congressional investigating committee down the river. "Checking with the oldest records which we have, there is nothing to indicate any building up of the bed," said he.

As to whether reservoirs on the head water would prevent the floods, Benjamin H. Humphreys, congressman from Mississippi and Colonel Potter [illegible] this question at length and replied that the present flood discharge all came from rain that fell on areas below any of the proposed reservoir sites. In general then the 1922 flood indicates that levees are the only feasible method of protecting former overflowed areas and carrying the discharge to the Gulf.

Why do the engineers not permit the many curves and loops to be straightened is often asked. The last big change and loop cut off was at Vicksburg shortly after the Civil War. It took 50 years for the regime of the river to be re-established. About $2,000,000 was spent in putting Vicksburg back on the river by directing the Yazoo through the old channel. Ashbrook Neck held by a five-mile dike is on the third loop above Greenville. Had not the brush and concrete matts forced the water, which is 5 ft. deeper on the upstream side than on the lower side to traverse the additional 14 miles around the end of the dike, Greenville might by now have been left on a lake or it might have been engulfed by the extra horsepower made available by the 5-ft. fall.

This dike, which was built by dragline scrapers, has been held, although the water swings around the concrete end with a drop of 4 ft. and consequent high velocity. The pressure is not great but serious crumbling has been encountered. At one point one mile from the junction with the main levee a loop of bags was built in 16 ft. of water around a serious slough. About 75 ft. of concrete protection at the end was carried away but the engineers were then able to stop the crumbling by an immense sack dump. This dike, together with some of the levees in this district, are described in *Engineering News*, Dec. 14, 1916, p. 1114. A view of the protection work by a loop at the slough is shown on the plate of views in this issue.

Land-side enlargements of levees are taboo. Many of the slides and slips are along the plane joining the new and old levees. All new levees are built up on the water side.

Morale—The spirit created by dependence on local interests rather than on federal appropriation has done more than any other one thing to hold up the morale of the maintenance organization. But like meeting every crisis, the hardest task for the engineers has been to keep the men keyed up to a high state of efficiency after the crest has been reached and the river starts slowly to recede. The banks are becoming more and more saturated and factors of safety are dwindling so that in reality conditions are not in as good condition as they appear. The planter is anxious to get his farm hands back home so that the labor problem becomes acute. The engineers have had to resort to much commendable education of the public in engineering in order to maintain interest. Inspection trips are arranged, constant contact with the newspapers is maintained and officials of various cities and organizations are pitted against each other in forming future policies and carrying out relief measures. This is not exactly engineering but morale, and is largely credited with winning the river fight so far.

If the 1922 flood is handled with no further damage above Vicksburg that area will [illegible] water over the lower ends of the tributaries St. Francis, White and Yazoo Rivers, will be a good proposition this year, and the people in the protected areas will have the engineers to thank for their good fortune.

Hydraulic-Fill Dams Safe to Construct

Core Studies at Miami Conservancy District Dams Show Construction Hazard to Be Small If Precautions Are Taken

EXPERIENCE in constructing the hydraulic fill dams of the Miami Conservancy District indicates that: (1) the gradation of core material may be controlled during construction, even with borrow pit materials of widely different character; (2) a considerable excess of fines is required in the borrow pit material, in order to maintain proper control of the core and to prevent the encroachment of gravel and sand into the core zone; (3) a reasonably wide core, namely core width at any point equal to height of dam above that point, may be obtained with absolute safety; (4) a fairly high percentage of extremely fine material in the core is not objectionable, provided the material is properly graded; (5) such cores show a satisfactory rate of consolidation, and (6) such cores are stable, after a few months consolidation to the extent that they will not flow when the support of the outside slope material is removed.

These conclusions are stated by Chas. H. Paul, chief engineer of the flood protection work, in a paper "Core Studies in the Hydraulic Fill Dams of the Miami Conservancy District" in *Proceedings* of the American Society of Civil Engineers, March, 1922, p. 453. They are based on tests and observations when placing between seven and eight million cubic yards of hydraulic fill in five dams from 7 to 50 miles apart. Tests were made by placing Goldbeck pressure cells in the core fill as described in *Engineering News-Record*, April 18, 1918, p. 758. The general methods of constructing the dams were described in *Engineering News-Record*, Sept. 9, 16 and 23, 1920, pp. 487, 547 and 601.

Distribution of Materials—The general separation of material was obtained to the extent that the outside slope material was pervious, free-draining, and composed largely of coarse particles, whereas the cores were impervious and of fine material. The theoretical gradation of material outside the core zone, from coarse at the outside to fine toward the center, is hardly perceptible, except by careful examination, and then only in a general way. Although the material near the outside slope line contains a larger percentage of coarse particles and is more pervious than that near the edge of the core, still considerable coarse gravel is distributed through the section of the dam from the outside slope to the edge of the core, and there is considerable sand near the outside slope as well as near the core zone, which is of no importance. It is also true, however, that a considerable quantity of the fines is trapped in this outside slope material, which is of importance and must be taken into consideration in any analysis of borrow-pit material. *Unless such analysis shows a large surplus of fines in addition to that required by the theoretical core section, it is almost certain that the necessity of an additional supply of core material will develop during construction.*

At all five dams there was a distinct deposition of sand at the edge of the core pool, forming a definite separation between the slope material and the core material. The water flowing down the beaches from the discharge end of the dredge pipe, dropping the gravel and coarser material along the way, carried still an appreciable quantity of coarse sand when it reached the core pool. Its velocity was checked as it entered the pool, and its burden of coarse sand was immediately dropped, only the finest of the material, that is, the fine sand, clay, and silt, going into the core zone where it settled slowly through the core pool. This was what happened when construction conditions were right.

Irregularity in shore line, concentration of flow down the beach, deficiency of core material, and similar unfavorable conditions which continually occur on construction work, regardless of how well it is organized, occasionally resulted in tongues of the coarser material extending into the core zone, thus emphasizing the necessity of a *reasonably wide core section to take care of such contingencies* which, however undesirable, can hardly be eliminated.

Test Results—As a result of all tests with pressure sells the conclusions are that *after a few weeks the core material begins to consolidate and that after a few months the lateral pressures are about one-half the vertical pressures.* Observations where the core had to be cut through or was exposed by local washouts showed the material to be well graded, firm enough to stand for some time in vertical banks, and resistant to erosion.

Escape of Surplus water—There is difference of opinion as to how the water escapes from the core. Experience at the Conservancy dams indicates that this process is more rapid than could occur by ordinary filtration action. It is very likely that some of the water drains out laterally, but there are indications that the greater quantity is displaced and forced up, vertically, by settlement of the solids and by pressure due to the superimposed material.

There is further evidence that comparatively little of the water in the core material escapes laterally. While the dams were being built, seepage water was always in evidence at the toe of the porous slopes. This flow was greatly dimished at times when the dredge pumps were shut down and the level of the core pool had dropped 1 or 2 ft. The litle springs are still in action, and the consolidation of the core goes on, forcing the surplus water to the surface.

Gravel Slips—Once at Huffman and several times at Englewood, trouble was experienced by the gravel and sand sloughing or raveling into the core, its presence being detected by the rod soundings. In every case, this happened when the core material was not brought up fast enough to correspond with the building up of the outside slope material, and *it could always be prevented by keeping the core well filled with mud.* The coarser material takes a fairly steep slope next the core pool, and each layer overhangs the one below. Water pressure is not sufficient to hold it in place. If the core pool is kept well filled with mud, however, it consolidates fast enough to keep the coarse material from sloughing in. Here again, the advantage is apparent of having a surplus of fines in the core material so that some of the finest may be wasted.

A concentrated flow down the beach from the dredge pipe will tend to carry a tongue of gravel and sand out into the core. This may be prevented by shear boards to break up the concentration of flow, or by a floating timber held in ropes close to the shore of the core pool, at the point where the flow enters the pool. By building up the dam in lifts or not more than 2 or 3 ft. at a time, this trouble may be avoided more easily.

Caisson With Water-Ballast Tanks Lays Submerged Floor

By James A. Bjerregaard
Hydraulic Engineer, Bangor Railway & Electric Co., Bangor, Me.

An open caisson, with water-ballast tanks, was successfully used last year to replace a submerged floor of wood with precast-concrete slabs at the hydro-electric station at Veazie, Maine. By means of the water-ballast tanks the caisson was easily floated and sunk and could thus be shifted along the floor as successive sections were replaced. The drawings, Figs. 1 and 2 show the construction of the caisson and the manner in which it is floated and sunk, and the view Fig. 3 shows the entire slab-placing plant in operation.

A timber caisson of usual construction, Fig. 1, except for the water-ballast tanks and the gate valves, was built to enclose a floor space about 20-ft. square. The floor formed the bottom of the forebay and under it were the tail-race conduits formed by parallel masonry walls which carried the floor. In general the procedure was to sink and seat the caisson on a section of the floor to be replaced, then to tear out the old timber work and place the concrete slabs. The caisson was then floated and shifted to an adjacent section and the operation was repeated. A cableway brought the precast slabs from the shore to a derrick scow moored alongside the caisson and the derrick handled one slab at a time into the caisson where it was placed.

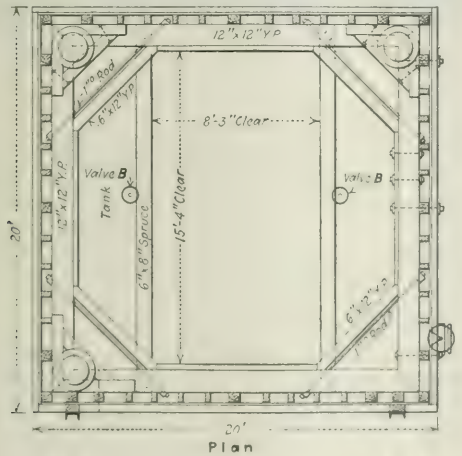


FIG. 1. TIMBER CAISSON WITH GATE VALVE AND WATER-BALLAST TANKS



FIG. 2. SEQUENCE OF OPERATIONS TO SINK AND FLOAT CAISSON



FIG. 3. PLACING SLABS WITH CAISSON, DERRICK SCOW AND CABLEWAY

The unusual procedure was the operation of the caisson by means of the ballast tanks and gate valves. With the tanks empty, the caisson was floated into position *a*, Fig. 2. The caisson was then sunk to position *b* by opening the tank valves *B*. In position *c* the caisson was drained through the floor and the work performed. With the work completed the tank valves were closed and the gate valve *A*, position *d*, was opened, thus letting in water and floating the caisson.

Although the caisson was sunk onto a fairly level and smooth floor, some difficulty was experienced in making the contact water-tight. At first a roll of canvas on an iron bar was tried without much success. If the crack was more than an inch wide, the canvas was forced through. Flaps of heavy canvas were then made with lengths of 3-in. diameter rope sewed into their lower edges. Lines attached to these flaps enabled them to be pulled up when the caisson was floated. Corner leaks and other minor leaks were stopped with gravel and cinders.

The average time required for one complete operation was:

	Hours
Removing planking and timbers	[illegible]
Inspecting and stopping leaks	[illegible]
Removing old floor	[illegible]
Sawing and grooving new slabs	[illegible]
Total	[illegible]

With one day for the grout to set, this made four days between moves, each move representing 15 ft. of floor laid.

Old Application for Imhoff Tank Granted

The process patent on the Imhoff tank applied for in 1913 has recently been granted to Dr. Karl Imhoff and Heinrich Blunk of Essen, Germany (U. S. Patent No. 1,399,561, dated Dec. 6, 1921). The fundamental claim of the patent is for "bringing decomposing sludge into intimate contact with fresh sludge."

Load Tests of Piers for Chicago New Union Station

Jacking Load of 87½ Tons Per Square Foot Gives Little Compression of Hardpan—Skin Friction of Pier in Clay

FOUNDATION loading tests on 4-ft. concrete piers 70 ft. deep, with loads carried to a maximum of 1,200 tons, or 87½ tons per square foot, and supplemented by a skin friction test, form a notable part of the studies made in connection with the design of the 20-story headhouse and office building for the Chicago Union Station Co., which is now under construction in that city.

Soil conditions at this site consist of about 70 ft. of Chicago clay (to 65 ft. below datum or river level) and 15 ft. of firm solid hardpan, followed by 3 to 4 ft. of soft clay, sand and loose wet gravel on top of bedrock. Test borings show that these conditions are fairly uniform for some considerable distance around the site. Geologists assume this hardpan to have been consolidated during the glacial period by an ice sheet 4,000 ft. thick with a weight approximating 115 tons per square foot. The compacting was done by the dragging or lateral movement of the ice sheet, rather than by direct pressure.

When the original design was made for a four-story headhouse, it was decided to support the foundation piers on the hardpan, on account of the great expense of sinking the piers to rock. This decision was made in view of the number of large buildings and bridges which have stood on similar foundations for several years without settlement, and of the further fact that the station building will occupy an entire block, so that future foundations of other buildings (at a minimum distance of 70 ft.) cannot cause undermining.

In an area 320 x 400 ft., 250 piers were sunk by the Chicago caisson or open well system to a depth of about 65 ft. below water level in the river. This work was completed in 1919. The piers are from 46 to 96 in. in diameter and are belled out or enlarged at the bottom to increase the bearing area, this being the usual practice with piers founded on the hardpan. They were figured for a maximum load of 6 tons per square foot, which is the limit usually specified by the city building department for foundations on hardpan. Tests up to 12 tons on a loaded area of one square foot at the bottom of one

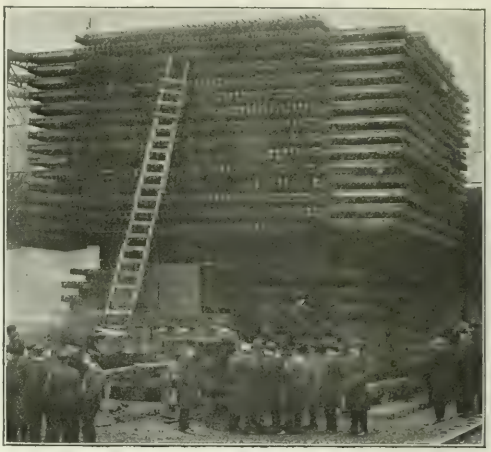


FIG. 1. LOAD TEST ON FOUNDATION PIER AT CHICAGO UNION STATION

Girders and I-beams on blocking carry 1,200 tons of rails as reaction load for hydraulic jack between girders and pier.

of the shafts or wells showed only a slight initial settlement and no subsequent movement.

With a change of plan calling for a 20-story building, in order to develop the air rights for revenue producing purposes, additional foundation work presented a difficult problem. It was found necessary to make the new design without regard to the arrangement of the foundation piers already existing, but to utilize these latter where practicable.

At this stage of the proceedings the building commissioner advocated carrying the piers to rock. Such a change would increase the cost enormously, partly by the great depth of the new piers and partly by rendering the existing piers useless, since a combination of piers of different depths would not be satisfactory. Under these conditions, it was decided to test the bearing capacity of the hardpan under exceptionally heavy loading, with the hope of convincing the building department that this stratum could be used safely as the support of the building.

It was desired to avoid possible injury to existing piers by loading tests, and also to avoid the heavy expense which would have been incurred in hauling the

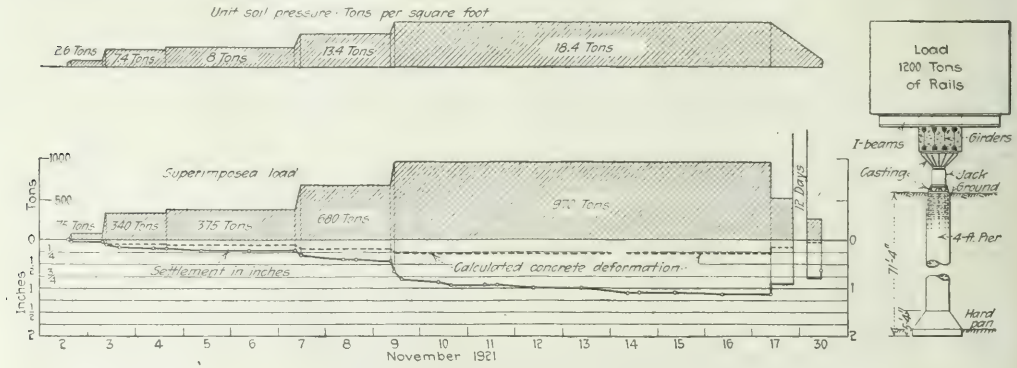


FIG. 2. DIAGRAM OF PIER LOADING TEST

test load of rails to the site. For this reason two test piers were built at the present station, where the rails and other material were delivered by cars and set in place by a locomotive crane. Wood-lined shafts or wells, 4 ft. in diameter, were sunk in the usual way by hand excavation to a depth of about 70 ft. below the ground-level or 65 ft. below datum. A 12-ton test on a loaded area of 1 sq.ft. at the bottom of each well resulted in only slight initial compression.

One of these piers was cylindrical for its entire depth, with a base area of 14.5 square feet. The other was belled out at the bottom in the manner usually employed for piers founded on the hardpan, giving a diameter of 8 ft. 4 in. at the base, with an area of 56.7 square feet. Concrete was a 1:2:4 mix, made with 1-in. broken stone, except that for 4 ft. from the top a 1:1:2 mix was used and was reinforced by vertical bars and a steel spiral to prevent crushing or spalling under load. This concrete was spouted into the wells and had a free fall to the bottom. The wood lining was left in place, but the steel ring braces were removed in the upper part of the shaft as the concrete reached them.

It was intended to carry the load up to 1,000 tons, but the balancing of a 1,000-ton load of steel rails on a 4-ft. pier would have been a troublesome matter. The plan adopted, therefore, was to place about 1,200 tons of rails over the pier but supported by blocking, and to employ this load as the resistance for a 1,000-ton hydraulic jack seated on the pier. This jack was built specially for the test. A cast steel base distributed the load over the entire top surface of the pier. Upon the jack was placed another casting in the form of an inverted pyramid to carry a group of four plate girders, 44 ft. long, with concrete packing between them. Across these girders were laid sixteen 24-in. I-beams forming the seat for the pile of rails. This method of loading was described in *Engineering News-Record* of Nov. 10, 1921, p. 763. From the view of this reaction load, Fig. 1, it will be seen that the ends of the girders and I-beams rested on blocking.

A hand-pump with ⅝-in. plunger of 1-in. stroke forced oil to the jack, the plunger of which was 21 in. in diameter. In addition to the usual pressure gage a boiler draft-gage was arranged to show the movement of the pier. This gage consists of a graduated glass tube 20 in. long, slightly inclined from the horizontal and containing a red liquid with a travel of 5 in. The tube was connected to a vertical 2-in. cylinder 10 in. high, mounted on a steel rod standing on the concrete pier, this chamber forming a reservoir for the gage liquid. As the cylinder dropped with the settlement of the pier it lowered the level of the liquid in the tube of the gage.

Levels were taken at frequent intervals, as well as direct measurements of the movement of the jack. The concrete was 30 days old before the loading began.

Test on Belled Pier—The first test was made on the pier with the belled base, and a diagram of this test is given in Fig. 2. At 430 tons (or a unit load of 7 tons per square foot) the settlement was less than ¼ in., and about half of this was the calculated deformation or compression of the concrete. This settlement took place on the first day and did not increase. On the fourth day the load was increased to 375 tons, causing ⅛-in. additional settlement. No further movement occurred until the load was increased to 680 tons (12 tons unit load) on the seventh day. The total settlement was less than ½ in. and practically half of this was in the concrete column.

With the load increased to 970 tons on the ninth day (18½ tons unit load) the settlement increased 7/16 in., and then continued gradually until it reached a total of about 1⅛ in. On removing the load some days later, this settlement was reduced about ¾ in. by the elastic recovery of the concrete and the hardpan. Three days later this recovery had increased to about ½ in.

Test on Cylindrical Pier—A slower rate of loading was employed in the test of the cylindrical pier, to which the rails and apparatus were transferred after the completion of the test on the first pier. A load of 149 tons (11.4 tons per square foot) was carried without any settlement. On the eighth day this was increased to 640 tons (31 tons unit), increasing the settlement to 1 5/16 in. This load was maintained for seventeen days,

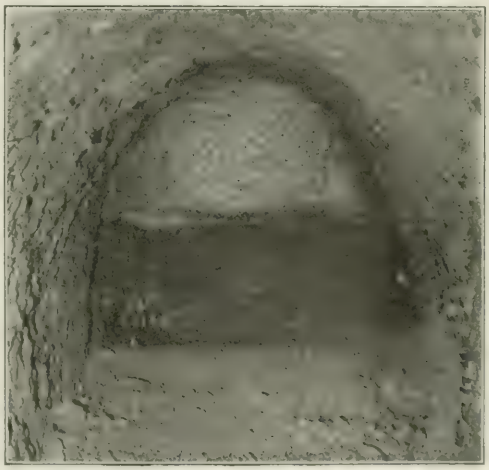


FIG. 3. INSPECTION TUNNEL FOR THE LOAD TEST
Showing bottom of pier exposed for test of skin friction.

but the settlement increased only 5/16 in., or a total of 1¼ in.

The load was then increased to 1,000 tons. At this juncture the commissioner of buildings expressed a desire to see something move and the load was pumped up to 1,200 tons, the jack then lifting the reaction load clear of its blocking. Following this spectacular movement the load was reduced to 1,000 tons. For the 22-day period of this test the total settlement was about 2 in., and after the load had been removed there was a recovery of ¼ in. The maximum unit load applied, without allowance for skin friction, was 87½ tons. In both tests the results were practically identical.

Tests of Skin Friction—For the purpose of examining the first test pier, a 4-ft. well was sunk in contact with it, the wood lining being omitted for a vertical strip about 1 ft. wide. Removal of the wood lining of the test pier disclosed a smooth and dense concrete surface. The shaft was carried down below the base of the pier, cutting through the bell. Samples of concrete from the bell showed concrete of excellent condition. This had been expected, owing to the hydrostatic pressure in the column of wet concrete.

From this inspection shaft a tunnel 6 ft. high and 4 ft. wide was driven for a distance of 45 ft. to and

beneath the bottom of the cylindrical pier. No timbering was required in this tunnel. Fig. 3 shows this tunnel, with the bottom of the concrete pier exposed at the far end.

With all material excavated from under the base of the pier, so that it was held only by skin friction in the clay, load was applied until the pier had been driven down 6 in. In this movement the hardpan in the roof of the tunnel was disturbed only for a distance of 2 ft. from the concrete plug. No movement occurred until the load reached 100 tons, but at 250 tons the pier began to go down slowly, so that it was not practicable to get a pressure higher than 260 tons.

Thus the skin friction would be 250 tons plus the 65-

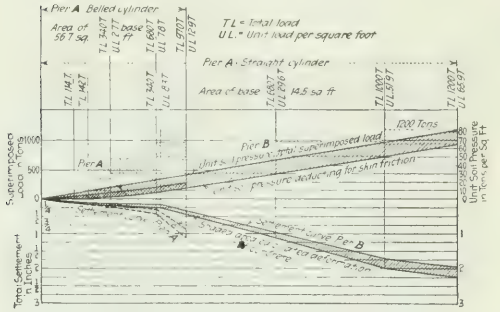


FIG. 4. DIAGRAM OF LOADING AND SKIN FRICTION TESTS

ton weight of concrete, or 315 tons for a cylinder 4 ft. in diameter and 70 ft. in the ground. This would have been decreased later due to the smooth surface caused by the movement. The timber lagging went down with the concrete cylinder pier, sliding in the clay. The skin friction may be taken as 700 lb. per square foot of the cylindrical surface, 888 sq.ft.

Compression stress in the concrete under the maximum load of 1,200 tons was 1,750 lb. per square inch at the top of the pier, and 1,400 lb. at the bottom. Tests of the crushing strength of this concrete showed an average of 2,410 lb. at 14 days, 3,390 lb. at 28 days and 3,720 lb. after three months. Fig. 4 is a diagram of both tests and shows the relation of skin friction to unit load at base of pier.

Conclusions—From these tests the conclusion is drawn that the allowable pressure on the hardpan stratum can be increased from the present 6-ton limit to 10 tons per square foot without any risk. This increase would be sufficient for the foundations as proposed for the 20-story building.

Based on the information acquired, the plan proposed is to sink a number of additional piers at points required by the design of this building. At some points the new pier will be close to an existing pier, with its bell overlapping that of the latter. The two piers will then be capped by a distributing girder carrying a column of the building.

These tests were planned and carried out under the direction of J. D'Espositó, chief engineer of the Chicago Union Station Co., and A. J. Hammond, assistant chief engineer, in co-operation with the architects, Graham, Anderson, Probst & White.

Applying Machinery to Railway Maintenance of Way

Enormous Aggregate Economy Seen in the Use of Labor-Saving and Material Handling Devices for Track Work

MANUAL labor in railway maintenance is becoming a seriously costly feature of operating expenses owing to the great army of men employed and the higher rates of pay now imposed on the railways. At the same time the conditions under which the work is done are unfavorable to efficiency and economy of labor. These circumstances have tended to cause a steady increase in the introduction of mechanical appliances to replace large forces of unskilled and seasonal labor. This subject has been dealt with in a paper read before the Western Society of Engineers by Robert H. Ford, assistant chief engineer of the Chicago, Rock Island & Pacific Ry. An abstract of this paper is given below:

Railway Labor—About 60 per cent of all railway employees are engaged in maintenance, the greater part being in maintenance of roadway, and of this proportion approximately 75 per cent are untrained workers. In 1921 about 460,000 men were required in roadway maintenance and $354,000,000 (about 54 per cent of the maintenance outlay) was expended for roadway and track repairs. Our conditions are such that the roads must depend upon the seasonal or extra-worker for the greater part of the annual maintenance program.

Time studies of seasonal or extra-gang labor have shown productivity to range from 28 to 33 per cent. The regular section gangs rank higher than this, but the effect of years of low rates paid to this class of really skilled labor has been to lower the standard and drive from its ranks much of the desirable material. In general the productivity of railway maintenance labor has not been commensurate with the results secured in other lines of industrial endeavor. Specialization in railroad maintenance has lagged far behind other lines of industry. This is not due to a failure on the part of the railroads to appreciate the importance of such matters, but to the fact that for years the roads have been too poor to be economical.

Roadway Ditching—The roadway must be continually drained and ditched, approximately $31,000,000 being expended annually for this work. In former years the work was performed entirely by manual labor at a cost of 10 to 25c. per yard. Today it costs 75c. to $2 per yard by hand or 50c. to $1.75 by teams. A self-propelled ditcher consisting of a small 14-ton steam shovel working from a flat car was introduced a few years ago and has afforded great opportunities for labor reductions in this direction. One of these machines will perform the work of 75 to 100 men. Flat cars have given way to air-dump cars with the steam ditcher placed between them. These machines can be put to a variety of uses such as handling coal and loading and unloading various classes of material.

A comparatively recent innovation is the ditcher-spreader consisting of a steel car equipped with wings similar to an ordinary spreader (for which it is also used) but with the addition of a detachable cutting edge shaped to the standard ballast section. In one operation this machine clears the ditches, shapes the subgrade from the ballast toe to the shoulder of the roadbed and also cuts and cleans the ditches beyond the roadbed. (see *Engineering News-Record*, March 9, 1922, p. 390). The machine is pushed by a locomotive and will complete from 10 to 25 track miles per day, ditching on both sides where necessary. It does the work of several hundred men at a cost of 2 to 6c. per yard. This machine can also dig new ditches, but its main advantage is to keep the ditches clear. The steam ditcher is most economical in long, heavy or sliding cuts.

In certain sections of the country right-of-way ditching

is necessary near the fence line. As a rule these ditches are deeper and larger than those along the roadway and construction by manual labor is expensive. A ditcher-tractor offers many attractive possibilities for reducing labor requirements on work that cannot be reached directly by machines operated from the track.

Unloading Earthwork—In strengthening and widening embankments it has been customary to use flat cars unloaded by means of a plow on the rear car and drawn through the material by the cable of a winding machine at the head end of the train. It was necessary for gangs of men to go between the cars (unless special aprons were provided) and shovel out the accumulations of dirt resulting from moving the plow over the cars. After the train moved out of the way, the spreader placed the larger part of the material on the widened embankment, the remaining portion being removed and placed by hand.

The air-dump car operated direct from the locomotive and loaded by the locomotive crane, steam shovel or other appliance has largely replaced the plow system and its large labor gang. A skillful operator can dump the cars at will with the train in continuous motion. The latest type is arranged with an apron extension so that the material can be dumped clear of the ballast and then followed up by a spreader where necessary.

Motor Cars—The section motor car is replacing the old hand-operated car and has now become an essential for track maintenance, both as a means of economizing labor and reducing expenditures.

Rail Renewal Devices—In renewing rails it is practicable to do the greater part of the work by mechanical means, from the unloading of the new rails, until the released rails and fastenings are placed on cars ready for shipment. Pneumatic drills, power bonding machines and power track wrenches are some of the several labor-saving devices that reduce the cost of this work and will permit increased efficiency and economy.

The labor cost of laying rail varies from $700 to $2,000 per mile, the large fluctuation being influenced largely by operating conditions and facilities. A fair cost today is probably about $1,400 a mile but, it will be practical to do this work by mechanical means for about one-third this sum. Last year $20,000,000 was expended for labor in this work.

Handling Rails—A pneumatic hoist mounted or built on a flat car equipped with a derrick at each end and placed between two flat cars, will load the equivalent of two miles of rail at about one-tenth the cost by former methods with large labor gangs. A light derrick truck that can be lifted from the rails by three men is now available for use at large terminals in moving frogs, rails, switch material and heavy timbers.

Locomotive Crane—A locomotive crane will do about everything required in lifting, placing and transferring material, pile driving, erecting, digging and any work of this class where manual labor has been necessary. The range of use of these machines is entirely a matter of education. Not only are they extremely valuable in maintenance of way but they are adaptable for various other lines of work.

Track Oilers—To prevent corrosion of rail fastenings, spikes, bolts, tie-plates and even the rail itself by brine drippings from refrigerator cars, these metal parts are oiled periodically and the work is usually done by track labor. The cost of oiling joints only by machine runs from $3.50 to $7 per mile (depending largely on the cost of the oil). This is far below that for manual labor.

Mowing and Killing Weeds—American railroads spend about $30,000,000 annually for clearing the weeds from their track, with an addition of about $16,000,000 for keeping the right-of-way clear of brush and weeds. It is customary to do much of this work by team mowers or by hand, since there is so much broken or rough and hilly land. There is a great opportunity for saving by development of the tractor and sickle-bar, both of which are now in use to a limited extent.

Cutting weeds forms one of the principal jobs of section labor and requires the services of over 100,000 men for five months of the year. A weed burner, operating twice during the season, will remove the weeds at a cost of $14 per mile per trip as compared with $135 for hand labor. This is only one of several devices for the purpose. On branch lines the ballast shoulders can be taken care of by the disc weed-cutter at a cost of about $4.50 per mile as compared with $25 for hand labor. Track mowing machines consist of a sickle bar attached to a motor car and adjusted to cut the weeds 6 ft. from the rail. These machines operate at 4 to 6 miles per hour and the work costs $5.50 per mile as compared with $40 per mile for both sides of the track by hand labor.

Destruction of weeds by chemical process is both possible and practical, although the field is open for further development. The time is not distant when a great part of the money now spent annually for weeding will be saved because chemical and mechanical means will render this labor cost unnecessary.

Tie Tampers—One of the largest items in roadway maintenance is the labor required to maintain the track in uniform surface. Approximately $44,000,000 is expended annually for this work which is almost exclusively a labor item and is performed by the section and extra gang forces. Tie-tamping machines operated both electrically and by compressed air reduce the cost by 70 per cent or more. In general these machines are better adapted for rock and heavy ballast than for light material and for this reason there is considerable room for further development. One trunk line is using a pipe line which parallels its track for over 100 miles to furnish compressed air for track tools.

Cleaning Ballast—Ballast becomes foul by use and must be either shoveled out by hand and wasted on the adjoining slopes or cleaned by screening. Many roads do the latter work by hand, but there are power-operated ballast screens that greatly decrease the cost and also conserve the ballast supply. Picking up scrap and cleaning the right-of-way and yards falls to the maintenance laborer. There are many opportunities for saving by means of local appliances that help to reduce the labor required. The tractor crane or locomotive crane equipped with a magnet offers great opportunities in this direction, especially when combined with its facilities for handling, collecting or piling miscellaneous material.

Railway Inventions—The patent office is full of discarded inventions for railroads that are theoretically good but practically impossible. A thorough understanding of the principles involved is absolutely necessary and the man unfamiliar with railway operation is handicapped until he can properly inform himself or co-operate with railroad men.

Railroad men of inventive turn of mind who will study railroad problems have a good start in this direction. Essential requirements are well grounded knowledge of costs under existing conditions, the experience of others on proposed remedies and their reasons for failure and also a knowledge of the cost of the proposed devices. With this there must be a willingness for investigation and the patience and perseverance which the inventor usually has. The main question is whether the device is conservatively safe, cheap, simple and essential. In conclusion it may be said there is a great field for design and standardization in railway labor saving devices.

Population of France and Its Largest Cities

The population of France as of March 6, 1921, according to recently published census figures, was 39,402,739. There were 15 cities with populations of 100,000 or more, headed by these five: Paris, 2,906,472; Marseilles, 586,341; Lyons, 561,592; Bordeaux, 267,409; Lille, 200,952. The decline in population from 1911 to 1921, after allowing for 1,710,000 added by the annexation of Alsace-Lorraine, was about 2,000,000.

Analysis of Connecticut's Traffic Census Data Yields Facts on Truck Overloading

Digest of Report Made for U. S. Bureau of Public Roads Shows Every Third Truck to Be Loaded Beyond Capacity of Truck and Tires

By J. Gordon McKay, Ph.D.
Professor of Economics, University of Wisconsin

TO SECURE data for an analysis of motor-vehicle traffic on trunk-line highways, with particular reference to truck overloading, a comprehensive study involving records of 75,000 vehicles, was made last year by the Connecticut Highway Department in cooperation with the U. S. Bureau of Public Roads. This survey (described in detail in *Engineering News-Record*, Jan. 12, 1922, p. 48) consisted of two traffic censuses, the first, at Enfield, covering the period Aug. 16-29, on the Hartford-Springfield road, and the second, at Greenwich, Oct. 3-16, on the Boston Post Road near the New York State line. In addition to the usual numerical count information was secured regarding weight of vehicle (by means of roadside

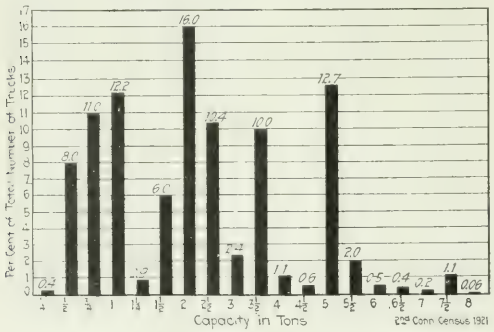


FIG. 1. COMPOSITION OF TRUCK TRAFFIC (SECOND CENSUS)

Based on rated load-carrying capacity. Only 4.2 per cent of trucks exceed 5-ton capacity.

scales), dimensions, commodity carried, length of haul, tire equipment, rated capacity and other details. Based on the data thus secured the following analysis from a report made for the U. S. Bureau of Public Roads, is presented. For the federal government Thomas H. MacDonald, chief of the Bureau of Public Roads and for the State of Connecticut, Charles J. Bennett, highway commissioner, were the representatives.

Factors in Transport Problem—The production of highways and of vehicles which utilize them represents two industries in which the yearly investment exceeds by far any other two industries in the United States. The interests of the highway engineer and the producer of motor vehicles are largely the same—the one to construct and maintain highways which will carry a maximum of traffic of economical weight units at a minimum cost, and the other to produce vehicles which will move the traffic at a minimum cost and with the least damage to the highway. We cannot afford the waste of building roads to carry all types of traffic and unlimited loads, nor can we fit the vehicle to all types of highways. It is a combination of both—the building of suitable and satisfactory roads and motor vehicles of the proper construction and weight. This is a joint industry of the road-maker and the road-user with a common object: the production of transportation at a minimum cost.

One of the most serious difficulties confronting the highway engineer today is the construction of roads which will remain in existence long enough to justify the investment and at the same time withstand the hammering of the steadily increasing volume of weight to which the pavement and subgrade are subjected. This presents a twofold problem: First, excessive loads beyond a given maximum weight which results in the premature destruction of the highway. Second, overloading per capacity.

We must fully recognize the necessity of automotive transportation and the need for construction which will carry modern traffic, but first we must determine the economic load units and, second, eliminate overloading. The weight of single units and speed are the two essential points of difficulty. The greater the speed of heavy loads the more damage to the highway. The ratio of damage to the road with an increase in speed is altogether out of proportion to the economies gained by faster movement.

It is not contemplated that we will ever construct our secondary highways to carry the maximum loads imposed on our primary roads. To prevent the destruction of our secondary systems by heavy trucking a classification of highways, based upon evidence and not mere belief, is necessary. Maximum weights of vehicles moving over each type of highway must be specified. Recent load restrictions in Wisconsin limit the market for sale of heavy-duty trucks. Strict supervision of weight of vehicles and severe penalties for violation of load limits are essential in order to compel obedience to law regulating the maximum and capacity weights which may move on the highway.

In Maryland all loads in excess of 10 tons, vehicle and load, are forced to unload excess weight and leave it on the highway. Ohio orders overloaded trucks off the road. Gross weight limits in the various states range from 6¾ tons maximum in Vermont to 15 tons maximum in California, Michigan and New Jersey. About one-half of the states specify a maximum load per inch of tire width ranging from 500 lb. in Idaho, Oregon, and Texas, to 800 lb. in Connecticut, Illinois, Iowa, New Jersey, New York, Pennsylvania, Washington, Wisconsin, Minnesota, Massachusetts, Maine and Kentucky. (See article, "The Trend of Motor Vehicle Legislation," *Engineering News-Record*, Sept. 1, 1921, p. 354.)

Regulations as to gross weight and overloading must take into consideration two road factors: First, the difference in road types, permitting heavier gross loads and loads per inch of tire width on the more durable types. Second, load restrictions during the early spring when the pavement is most easily destroyed.

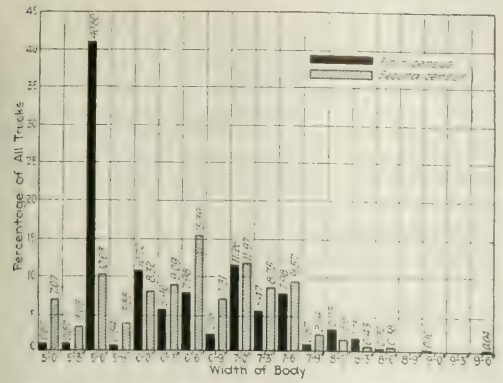


FIG. 2. VARIATION IN BODY WIDTH (BOTH CENSUSES)

Figures cover 2,993 vehicles; only about 5 per cent of truck-body width exceed 7 ft. 6 in.

The limitation of loads to 25,000 lb.—the allowable maximum in Connecticut—does not prevent the overloading of trucks whose rated capacity falls below the maximum load provision.

Methods Employed—At each of the Connecticut traffic census stations the width of tire was taken by measuring the impression made by the wheel load, front and rear, after passing over strips of impression paper. The front- and rear-axle weights were procured in order to determine the total load and the distribution of load on front and rear axle. From these figures the wheel load per inch of tire width for each truck, make and capacity was determined. The make and capacity of the truck were necessary in order to compare the manufacturer's total weights and percentage distribution of weights on front and rear axle with the actual weights recorded and thus arrive at the overloads per capacity.

Any analysis of overloading has certain limitations in the present state of highway research: (1) The lack of maintenance-cost studies of the highways on which the surveys occurred does not permit of establishing accurately the direct relationship which exists between overloading per capacity and high maintenance costs; 2) the effect of overloading on the pavement and subgrade can best be shown when correlated with impact studies of the several pavement types; (3) the overload data may be criticized on the basis of the standard used in determining overloads.

The weight standard used in this analysis for determining overloads for each make and capacity of truck consists of a summation of the manufacturers' 1920 weights for the chassis, body and rated capacity, giving the total weight when loaded to capacity. The percentage distribution of weight recommended by the manufacturers of trucks for front and rear axle load is used as a standard for determining overloads on the front and rear axle. In order to be conservative 5 per cent of the total chassis, body and capacity weight was added to the manufacturers' given weight and used as the standard for computing overloads per capacity. One-half of this 5 per cent was added to the front and rear axle standard weights in arriving at [illegible] the front and rear axles. For example, if the [illegible] weighs 7,000 lb., the body 1,600 lb., capacity 7,000 lb., a total of 15,600 lb., 5 per cent of 15,600 lb. or 780 lb. was added, making a standard for total overloads for this capacity of 16,380 lb. To the front and to the rear-axle weights 390 lb. was added and the totals used as a standard for judging the front and rear-axle overloads. This basis seemed fair, and even an allowance of 10 per cent would have made little material difference in the following results.

Commodities and Overloads—It has been generally believed that overloading has occurred primarily with trucks loaded with sand, gravel, brick, cement and lumber, and that this abuse has been restricted to a relatively small group of commodities. We find, however, that the practice is restricted to no typical groups of commodities, but is almost universal. For example, the loads in Table I are typical.

The types of commodities in which overloads occur per capacity, excluding all commodities in which the number of cases of overloads are less than four, range from apples to wire. Of the cases cited 75 per cent of the overloading was practised by regular trucking vehicles.

The commodity loads exceeding 25,000 lb. in the

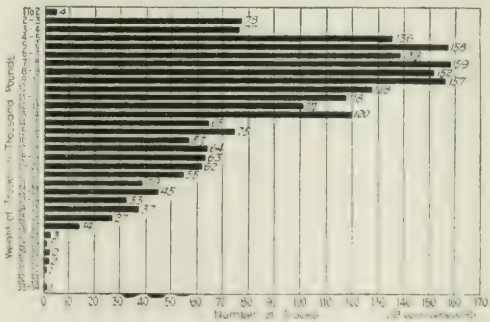


FIG. 3. CLASSIFICATION BY GROSS WEIGHT (SECOND CENSUS)

Only 51 out of a total of 2,182 trucks, or 2 per cent, had gross weights exceeding 25,000 lb.

TABLE I. NUMBER OF OVERLOADED TRUCKS OBSERVED AND TYPES OF COMMODITY HAULED, SECOND CONNECTICUT CENSUS

Commodity	Number of Overloads	Regular Trucking	Irregular Trucking
Apples	2	2	
Potatoes	8	8	
Sand	28	24	3
Brick or stone	6	5	1
Coal	6	6	
Cement	4	3	1
Hay	9	7	2
Dry goods	9	7	2
Sand	4	4	
Lime	10	7	3
Farm products	17	14	3
Lumber	20	8	12
Coal	5	1	4
Gravel	41	40	1
Household goods	8	7	1
Lumber	4	4	
Sand	1	1	
Stone	1	1	
Miscellaneous	4	3	1
Gravel	4	4	
Farm	5	4	1
Sand	1	1	
Stone	1	1	
Cement	1	1	
Wire	1	1	
Total	181	161	20

TABLE 2—NUMBER OF COMMODITY LOADS IN EXCESS OF 25,000 LB., SECOND CONNECTICUT CENSUS, 1921

Commodity	Loads	Overloads Per Capacity	Regular Trucking	Irregular Trucking
Brick	2	2	2	.
Butter	1	1	1	.
Cocoa beans	5	1	5	..
Drugs	1		1	..
Eggs	1	1	1	..
Fruit	6	5	6	..
Glass	1	1	1	..
Groceries	6	6	6	..
Litharge	3	3	3	..
Meat	2	2	2	..
Plumbing supplies	1	1	1	..
Rubber	5	4	4	1
Sugar	8	8	5	3
Tarvia	2	2	2	..
Valves	1	1	1	..
Vegetables	1	1	1	..
Vinegar	4	4	3	1
Totals	49	43	44	5
Percentage		87.8%	88.7%	11.3%

second census include such articles as Table 2 indicates. Of the total number in excess of 25,000 lb. gross weight 87.8 per cent were overloads per capacity and 88.7 per cent were overloads by regular trucking vehicles. In 39 out of 41 cases loads from 846 to 1,560 lb. per inch of tire width on the rear axle were observed.

Composition of Truck Traffic—Fig. 1 indicates principally the small percentage of vehicular movement above the 5-ton capacity truck—only 4.2 per cent of the total. This is not attributable to limitations of the Connecticut law, since a considerable portion of the traffic passing over the main highways on which the

Classification by Tire Types—Very few cases of heavy loads occur in which either pneumatic or a combination of pneumatic and solid tires are used. Trucks equipped with pneumatic tires, as indicated in the second census, are used largely in the lighter loads and smaller capacities, increasing rapidly from 2,000 to 5,000 lb. and decreasing rapidly to 10,000 lb. The number in excess of 10,000 lb. is negligible. The solid-tire type begins to increase rapidly at 5,000 lb. while the use of the pneumatic rapidly decreases. The combined solid-and-pneumatic-tire types are used by trucks in the weight classification between 3,000 and 14,000 lb.

The first-census data agree in general with the second census, noted above. Pneumatic tires and combination pneumatic-and-solid are used largely by lighter capacity trucks, and for lighter loads, increasing rapidly in the case of the pneumatic-tired trucks from under 3,000 to 5,000 lb. and rapidly decreasing at 7,000 lb. The general trend in both cases is the same.

Classification by Weight—The density of movement is shown by Fig. 3 (for the second census) as falling between the 4,000 and 14,000-lb. classes. A second interesting fact is the number of loads in excess of 25,000 lb. (the allowable maximum in Connecticut); they totaled only 51 out of 2,183, or 2.3 per cent. A maximum limit of 28,000 lb. gross weight would be of little value, since it would admit practically all of the traffic passing over the Connecticut highways. In the first census on the Boston Post Road near the New

TABLE 3—CONSOLIDATED TABLES OF NUMBER OF OVERLOADS PER CAPACITY, 1ST AND 2ND CONNECTICUT CENSUSES

I. Overloads Per Capacity

	½ Ton		1 Ton		1½ Ton		2 Ton		2½ Ton		3 Ton		3½ Ton		5 Ton		6 Ton		7½ Ton	
	L	OL	L	OL	L	OL	L	OL	L	OL	L	OL	L	OL	L	OL	L	OL	L	OL
1st Cen.	129	55	135	28	30	18	158	84	11	4	4	4	94	55	94	47	2	0	2	0
2nd Cen.	151	66	131	24	88	35	503	169	131	59	4	1	350	125	352	126	20	7	34	3
Total	280	121	266	52	118	53	661	253	142	63	8	5	444	180	446	173	22	7	36	3
Percent		43		20		45		38		44.5		62.5		40.5		40		32		8

Weighted average overloads 39%

II. Overloads, Rear Axle

1st Cen.	129	44	135	26	30	15	158	82	11	6	4	4	94	52	94	49	2	0	2	0
2nd Cen.	151	53	131	17	88	33	503	171	131	51	4	1	350	124	352	152	20	5	34	3
Total	280	97	266	43	118	46	661	253	142	57	8	5	444	176	446	201	22	5	36	3
Percent		35		16		39		38		40		62.5		40		45		23		8

Weighted average overloads rear axle 37.5%

III. Overloads, Front Axle

1st Cen.	129	42	135	63	30	16	158	62	11	4	4	4	94	53	94	25	2	0	2	0
2nd Cen.	151	106	131	15	88	41	503	163	131	81	4	1	350	174	352	74	20	13	34	4
Total	280	148	266	78	118	57	661	225	142	85	8	5	444	227	446	99	22	13	36	4
Percent		53		29		48		34		60		62.5		51		22		59		11

Weighted average overloads front axle 40%

* Note: L=Loads, OL=Overloads

data were obtained carried interstate traffic passing through Connecticut.

Width of Body—Fig. 2 indicates that by far the greater majority of truck-body widths are 7 ft. 6 in. or less. In the first census 914 truck bodies were measured, of which 53, or 6 per cent, exceeded 7 ft. 6 in. In the second census 2,079 body widths were measured, 102 of which, or 5 per cent, exceeded 7 ft. 6 in. A considerable portion of this excess was made up of vehicles with special-width bodies.

There is a direct relation between the speed and body width of trucks and width of the road surface. The wider the body and the greater the speed, the wider the pavement. Since an overwhelming majority of the trucks are less than 7 ft. 6 in. in width it would seem fair to restrict body width to that maximum, with a resulting saving in highway construction costs.

York Line, one of the heaviest truck-traffic roads in the country, only 7 out of 2,183 loads would have been in excess of a 28,000-lb. maximum. The density begins to fall rapidly for loads over 25,000 lb., indicating that this maximum is more nearly correct.

Weights per Inch of Tire Width—The analysis of weights per inch of tire width shows some interesting facts. We may have overloading on the front or the rear axle without having an overload per capacity. This is dangerous in that a shifting of the load to the front or rear, producing an excessive weight on either axle above standards, results in increased impact and destruction of the highway.

In the first census overloads on the front axle in excess of 800 lb. per inch width of tire number 29 cases in a total of 226, or 12.8 per cent. Overloads on the rear axle in excess of 800 lb. per inch of width

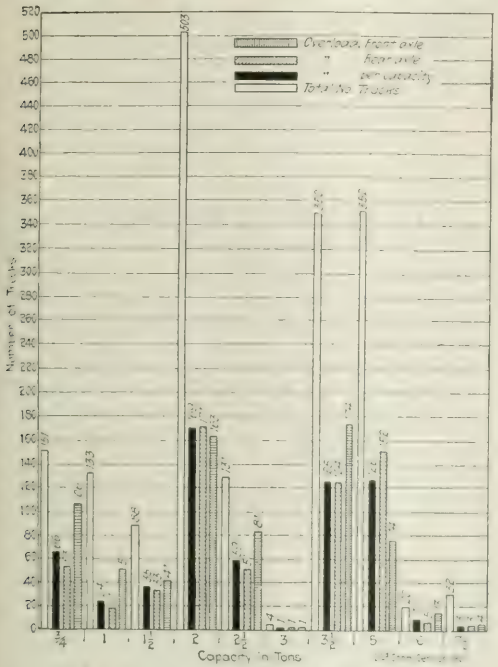


FIG. 4. TRUCK OVERLOADING PER CAPACITY (FIRST CENSUS)

More than every third truck (39 per cent) on the Connecticut highways was found to be loaded beyond the capacity of the truck and tires. Rear-axle overloads

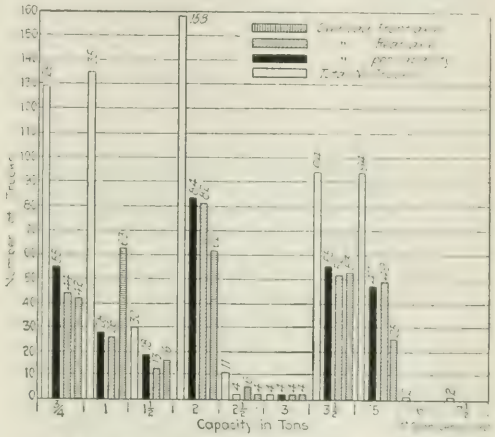


FIG. 5. TRUCK OVERLOADING PER CAPACITY (SECOND CENSUS)

occurred in 37.5 per cent, and front-axle overloads in 40 per cent. of the cases recorded. The rear-axle overloads are more serious from the point of view of road damage

number 138 cases in a total of 259, or 38.4 per cent. The number of overloads on both axles is 167 in a total of 585 cases, or 28.5 per cent. Overloads on the front axle range from 800 to 1,100 lb. per inch of width, density occurring approximately at 900 lb. per inch of width. On the rear axle overloads occur from 800 to 1,650 lb. per inch width, density occurring at 1,100 lb.

There is a close agreement of the overloading data in both censuses, although the traffic volume in the second exceeded the first. In the second census the per cent of overloads, front and rear axles is 24.6 per cent; overloads front 11.9 per cent; overloads rear, 36.5 per cent. In the second census the range of overloads on the front axle vary from 800 to 1,500 lb. per inch of tire width, while the rear-axle overloads range from 800 to 1,925 lb. per inch of tire width. The density of overloads, front axle, in the second census is 950 lb., while the density of the rear-axle overloads is 1,100 lb.

In both censuses the trend of the overload is to increase with thickness of tire to a certain thickness and then decreases. Beginning with 1 in. thickness of tires, the overloads increase, reaching a maximum with 1½ in. of thickness and decrease again as we approach 2½ in. of tire thickness.

Of all the charts and data presented Figs. 4 and 5, showing an analysis of truck overloading per capacity for the first and second Connecticut censuses are the most interesting. There can be little room for doubt that overloading exists. The weighted average overload per capacity (in Table 3) of 39 per cent means that more than every third truck on the highway was loaded beyond the capacity of the truck and tires.

Unquestionably highway damage occurs with this extraordinarily high percentage of overloads. It is not only the problem of total overloads per capacity, but overloads on both front and rear axle. The rear-axle overloads, of course, are the more serious since the greatest weight distribution is placed upon the rear axle. A total of 37.5 per cent of all loads moving on the highways surveyed were overloaded on the rear axle. Further, 40 per cent of all trucks observed were overloaded beyond the load permissible on the front axle. It will be recalled that 5 per cent was added to the total gross weight to be conservative. In the light of the percentages just given even a safety factor of 10 per cent additional weight would make little difference.

Responsibility for Overloads—This analysis presents the problem of truck overloading. Who is responsible for the rapid destruction of highways under frequent recurrence of overloads? The highway engineer? He cannot be held responsible for the rapidly growing volume of truck traffic of excessive vehicle weights and speed. He is confronted on the one hand by destruction of new and old roads, and on the other with little or no knowledge of what to expect of future traffic. Is the fault that of the manufacturer producing trucks with inadequate tire equipment? The fault is not entirely his. Not knowing in many cases the type and weight of body which is to be built on the chassis we cannot hold him to account for overloads due to excessive body weights. Is it the fault of the individual owner of trucks? In the majority of cases the blame belongs to him and in addition some responsibility is attributable to the designer of motor trucks for not specifying tire equipment to carry more than the maximum load. There is some truth in the suggestion that the manufacturer who does not produce a vehicle with a complete body cannot regulate the body size and consequently the loads to be carried. Of course an increase of the tire width would provide for these cases of overloads. Neither can the manufacturer control the loading of the vehicle or the distribution of weight. The entire load may be on the rear axle or distributed more on the front axle than is safe.

It is not the purpose of this discussion to attempt to settle the responsibility for overloading. The facts speak for themselves. We are confronted with the practice of overloading even beyond what we believed in the past.

Conclusions—The following are the more important conclusions to be drawn from the study of truck traffic in Connecticut:

1. Overloading occurs in practically all types of commodities.
   (a) Not, as popularly, supposed only in building materials, gravel, sand, brick and lumber.
2. Trucks carrying loads in excess of 25,000 lb. are overloaded per capacity 87.8 per cent of total number of loads.
   (a) Majority of overloads in excess of 25,000 lb. are trucks not capable of carrying 25,000-lb. load, or trucks whose rated capacity falls below 25,000-lb. load class.
3. Overloads occur with greatest frequency between 3.4-ton capacity trucks to and including the 5-ton truck, ranging from 20 per cent overload per capacity for 1-ton trucks to 62½ per cent overload for 3-ton trucks. The weighted average overload per capacity is 39 per cent.
4. Overloads occur on both front and rear axle. Since tires are built to carry rated capacity and wheel load recommended, the trucks are undertired when overloads occur on either axle.
5. Overloads on the rear axle, according to the manufacturer's weight distribution, and overloads on the rear axle in excess of 800 lb. per inch of tire width agree, indicating that both methods of analysis are correct. A considerable difference between front-axle weights, according to recommended axle load and load per inch of tire width, occurs. Overloads per inch of tire width, front axle, average 12 per cent and overloads per capacity, front axle, 40 per cent, indicating the manufacturer's recommended weight is incorrect and in excess of tiring for front wheels.
6. A direct relation exists between the width of truck body in excess of 7 ft. 6 in. and overloading per capacity.
7. A direct relation exists between overloads per capacity and overloads in excess of 800 lb. per inch of tire width, not only loads in excess of 25,000 lb., but in cases where the load is an overload per capacity.
8. Regular trucking lines are consistent overloaders. The overloads in excess of 25,000 lb. are 88.7 per cent regular trucking lines.

Recommendations—1. Classification of highways, depending on construction type, and designation of vehicle load permitted on both primary and secondary roads.
   (a) Such classification to be based on accurate information as to the effect on the highway of different loads.
2. Seasonal restrictions of vehicle loads; reduction of gross weight during spring seasons of year when possibilities of damage are high.
3. Prohibition of overloads beyond capacity of truck, restricting wheel load to 800 lb. per inch of tire width.
4. Maximum body width 7 ft. 6 in., projections from truck bodies to be included in maximum width.
5. Maximum total, front and rear-axle weights, to be determined by state highway commission for each make and classification of trucks; these data to be placed in conspicuous place on the vehicle; basis of overloads to be determined in each individual case.

Testing Concrete Material for Detroit Sewers

IN DETROIT until recently concrete aggregate for city work has been accepted with only a cursory examination, although all cements used in municipal work have been tested for many years. The Department of Sewer Construction, which is now engaged in an extensive program of construction, has recognized the importance of the quality of concrete aggregates, however, and has equipped a laboratory for the study of aggregate in charge of W. H. Dorrance, Jr.

A survey of local conditions revealed the fact that gravel used in city sewer work came from different localities. Some supply contractors furnished bank-run gravel from outlying pits, while others sold river sand. This naturally complicated the problem of inspection for it was to be expected that a wide range in quality should be found. In order definitely to establish this range and pave the way for future limitations in the specifications, three simple tests were decided upon. Since it was desired to keep the initial expense well within $100, these tests should of necessity require no elaborate apparatus. On the other hand, they must conform to recognized standards in order to be of any future value. The tests are: (1) The Abrams-Harder test for organic impurities; (2) the mechanical analysis of fine aggregates, and (3) the decantation test for silt. The organic test has been found entirely adequate in the detection of organic impurities. The analysis of aggregates under ¼ in. is made with a Universal sand tester. While the screens are not Tyler standard, they conform to the principle in that each sieve has an opening width double that of the preceding one. In this way a comparative modulus of fineness can be computed for each sample. It is admitted that the value of this analysis as a current means of regulation is nothing under the existing specifications. However, it is believed that it is the cheapest means of placing on record the mechanical structure of the concrete. Future specifications will undoubtedly place more stress on this heretofore neglected characteristic. The decantation test for silt is used in conjunction with the organic test; this is really a field test, but no means of performing a more exacting test were available.

The ordinary weekly routine is simple. An endeavor is made to cover each job at least once a week. Samples are taken from the material piles and prepared for the tests by passing through a ¼-in. screen. The calorimetric test is recorded after being allowed to stand at least two days, at which time an approximate silt percentage can be estimated. If this percentage is rather high the sample is set aside for an immediate decantation test. Once a month or oftener samples are put through the sand tested and sieve analysis curves plotted. Reports of all tests are made to the inspection department and the engineer at the end of the week.

Alumina Cement; Its Development, Use and Manufacture

History of and Properties of High Strength, Quick Setting Cement Now Being Produced Commercially in France

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THE purpose of this paper is to make available to the American engineer, in the form of a digest, definite information relative to the alumina cements now commencing to be generally used in France. These cements are differentiated from portland cements by their chemical composition and by the fact that both in mortars and concretes they develop strength at the 48-hour period equal to, or exceeding, that developed by portland cement at 28 days. In addition, alumina cements show a markedly greater resistance to the attacks of sea water and water carrying sulphates in solution.

Owing to lack of space no detailed chemical discussion will be attempted and references to laboratory investigations will be confined to a brief résumé of conclusions drawn by the different investigators.

Early Study.—Almost twenty years ago the thought occurred to the writer that it might be possible to produce a better and more uniform cement than portland, and possibly a cheaper one, by the mechanical admixture of the separately prepared compounds then considered its essential components. With this object in view, the writer, at first in collaboration with Dr. E. W. Lazell, and subsequently with E. L. Conwell, had made and studied in his laboratory, the various silicates, aluminates and ferrates of lime then thought to be essentially present in portland cement together with a number of possible variants of these compounds, among which were aluminates of lime in proportions corresponding to two and three molecules of alumina to one of lime.

The purpose in making these various low lime aluminates was to ascertain the minimum amount of lime necessary to make the alumina active and cause it, on being added to lime, either in the form of oxide or hydrate, to combine with it.

Briefly summarized, the conclusions drawn in relation to aluminates from this investigation which covered a period of over ten years, were:

That cements resembling portland cement in their action could be made from mechanical admixtures but that these cements did not develop strengths comparable with the strengths developed by low lime calcium aluminates.

That where the lime present in the aluminates exceeded that required to form a mono-calcic aluminate, the aluminate was usually too quick setting for practical use as a cement.

That where the lime present approximated that required to form mono-calcic aluminates they could be made either slow or quick setting by varying the hardness of burning. The lighter burned aluminates were quick setting and the harder burned, slow setting.

That when the lime present was less than that required to form mono-calcic aluminate, the aluminate was slow setting.

That the quick setting mono- and di-calcic aluminates could be made slow setting by the mechanical admixture of slow setting low lime aluminates.

That both the slow setting low lime aluminates and the slow setting mechanical mixtures of quick setting and slow setting aluminates were slow setting but very quick hardening and developed strengths greatly in excess of portland cement, especially at short time periods. The 24-hour tests showed strengths exceeding those of portland cement at 28 days and that the lime content in the aluminates could be reduced as low as three molecules of alumina to one of lime without apparently affecting the cementing value of the product.

That other sesqui-oxides could be substituted for alumina and that the presence of sesqui-oxide of iron up to 10 per cent seemed beneficial.

That the presence of silica in any considerable proportions tended to reduce the early strength of aluminates, probably through replacement of the alumina content to which the high early strength was attributed.

That the cementing values and soundness of aluminates were apparently unaffected by wide variation in the ratio of the lime to acid acting elements provided the lime was not present in excess of that required to form mono-calcic aluminates.

That these alumina cements were strongly resistant to dilute acids and unaffected by sea water. The very low lime aluminates interposed greater resistance to attack by acid solutions than the higher lime ones.

It was also found that these aluminates, in addition, had the property of combining with hydrated lime and that their addition gave to lime mortars quick hardening properties and plasticity and that relatively small additions of these aluminates greatly increased the early strength and natural and puzzolanic cements.

Attempts at Development.—As the purpose of the research was strictly commercial, no attempt was made to obtain even relatively pure materials but on the contrary low grade bauxites that could be cheaply secured in the market were used.

The equipment of the laboratory did not permit of such research work as was subsequently carried out by Day and Sheppard, Rankin, Bates and others, consequently no attempt was made to determine the chemical compounds formed in the various aluminates produced.

During the first years of the investigation, the aluminates were produced in the laboratory either by calcination in a small kiln 12 in. in diameter and 3 ft. high, or were fused in graphite crucibles heated in a gas-fired reverberatory furnace. Subsequently aluminates were produced on a semi-commercial scale in a kiln 3 ft. in diameter and 10 ft. high. Both kilns were operated continuously. The raw materials after being ground, moistened, and molded into small bricks and dried, was fed into the kiln with the fuel and the calcined material was drawn from the bottom. In all, some 20 tons of slow setting, quick hardening alumina cement was manufactured.

In 1909 the Aluminate Patents Co. was formed for the commercial development of the patents granted the writer, but as the writer's patents covering the alumina cements had been held up by interference proceedings between his application and M. Bied's, which interference was subsequently decided in the writer's favor, and as the use of alumina cements as an addition material to lime seemed the most promising of immediate financial return, no effort was made to place the low

lime alumina cements on the market nor was any description of them published at that time.

As the aluminates made from mixtures of lime and bauxite in the manner described above, were very expensive, there was substituted for them, a high alumina slag produced by the Pennsylvania Steel Co. from the smelting of the Mayari ores of Cuba which gave slags low in silica and having an alumina content of about 30 per cent. While this slag in itself, was an inert material, it could be made by special treatment sufficiently active to combine with lime and serve as an additional material.

The writer regrets that his test of the high alumina cements were confined to tensile and compression tests of the cements either neat or 1:3 sand mortar. His explanation for this omission is that the importance of concrete tests was not recognized at the time.

Early French Investigations.—Jules Bied, Director of the Laboratories of J. & A. Pavin Lafarge, le Teil, France, began some time previous to 1908 a study of calcium aluminates which covered much the same ground as the writer's work and led to the same conclusions except that Bied concluded that the fusion of the bauxite and lime mixture was essential to the production of cement and that he failed to note the value of aluminates as addition material to lime or other low grade cementitious materials. The work of Bied, therefore, was confined exclusively to determining the value of the low lime aluminates for use as a cement. His work showed not only the high strengths at early periods of fused mono-calcic aluminates, but also the continuance of the strength so developed over long periods and also the resistance of these cements to the destructive action of sea water and water carrying solution sulphates of the alkaline earths.

As a result of Bied's laboratory investigations, the firm of J. & A. Pavin Lafarge commenced about 1912 to place fused mono-calcic aluminate cements on the market under the trade name of "Cement Fondu." The outbreak of the war stopped the commercial development of these cements but their manufacture was continued for military use.

Corroborating Investigation.—P. H. Bates of the Bureau of Standards (see Technologic Paper 197) has recently reported results of a very extended study of aluminates undertaken by the Bureau of Standards under his direction. This research included the microscopic determination of the compounds formed both by the calcination and hydration of the aluminates as well as physical tests of neat, mortar, and concrete specimens made from eight different lots of alumina cements of varying compositions produced by calcination in the rotary kiln.

His conclusions in general correspond with those of Bied and the writer. He found that the higher lime aluminates were quick setting and that the lower lime aluminates were slow setting and that the hydration of the lower lime aluminates consisted in the formation of hydrocalcic aluminate and hydrous alumina. He found that the low lime aluminates gave high strength at short periods, the rapid hardening being due to the rapidity with which the aluminates hydrated and the high strengths due to the thoroughness of the hydration and the large amount of colloids formed, but, that owing to the susceptibility of these colloids to moisture changes, the alumina cements would not be satisfactory for use when subject to the action of water.

Laboratory Conclusions.—The work of these three independent investigators demonstrates beyond all possible question the fact that slow setting, quick hardening cements can be produced by the calcination of mixtures of alumina and lime in which the ratio of available lime to alumina does not exceed the monocalcic proportion: that the cement so produced gives strengths, neat, in cement mortars, and in concretes, at the end of 24 and 48 hours as high or higher than the strengths ordinarily developed by portland cement at 7 and 28 days and that the strengths of low lime high alumina cements continue to gain up to the three month period. So far the conclusions drawn by the three investigators from their work are in complete accord. Mr. Bates also states "that the methods of storage of the test pieces showed that these cements had their strengths rather materially reduced by the absorption of moisture. This was due to the large amount of colloidal products of hydration which are very susceptible to moisture changes. They would, therefore, not be satisfactory for use when subjected to the action of water." This action noted by Mr. Bates is not in accord with the experiences of M. Bied and the writer in their laboratory work nor with the results obtained by actual use in work in France of such cements extending through a period of over ten years. This difference on so vital a point is unfortunate and it is to be hoped that continuance of the tests and further analysis of the results will lead Mr. Bates to a modification of his conclusions which, however, applies only to the particular cements made by the Bureau of Standards tested under the methods employed.

So far as indicated by his reports, the resistance of the high alumina cements to the destructive action of sea water and water containing sulphate solutions was not noted or studied by Mr. Bates.

Present Use in France.—With the end of the war, high alumina cements were again placed on the French market. At present two firms are engaged in their manufacture and sale, J. & A. Pavin Lafarge and the Bureau D'Organisation Economique. When the writer was last at the works of Lafarge in 1919, alumina cements were being produced in a small furnace, the coke, limestone and bauxite being fed into the furnace without preliminary fine grinding. The molten material was drawn from the furnace in the same manner as slag from an ordinary blast furnace. The iron oxides contained in the raw material, owing to the reducing action of the furnace and difference in specific gravity, partially separated out from the slag as metallic iron, but not sufficiently to affect the color. All commercial alumina cements are much darker in color than portland cement. If bauxite low in iron is used, a white cement can be produced. Lafarge markets his cement under the trade name of "Cement Fondu." This company is now constructing a second plant at Moutiers, Savoie, France, where the electric furnace will be used. The alumina cement produced by the Bureau d'Organisation Economique is fused in an electric furnace, hence its trade name, "Cement Electric."

Properties of French Cement.—In a recent letter, the Bureau D'Organisation Economique makes the following claims for "Cement Electric":

The cement is a mono-calcic aluminate containing a fixed quantity of silica and oxide of iron and is made by the grinding of a product produced by the fusion in an electric furnace of a predetermined mixture of silica, alumina, iron and lime. The finished product is a mono-calcic aluminate containing certain quantities of silica and oxides of iron.

The cement is slow setting and is gaged like the ordinary portland cements but is distinguished from them by the altogether special qualities that it hardens rapidly and gives high strengths at early periods and is indecomposable by selenious waters and sea water.

It is used in the same manner as portland cement but hardens more rapidly.

It is no exaggeration to say that at the end of 24 hours its strength equals that of portland cement at the end of a month, therefore, forms may be removed from walls after 24 hours and from girders and slabs after 48 hours. Concretes mixed 1 part cement, 1 part sand, and 3 parts gravel show compressive strengths of 7,500 lb. per square inch at the end of 3 days, 8,500 lb. at the end of 28 days and 9,000 lb. at the end of 3 months and continue to show slowly increasing strength with time. Concretes mixed in the proportions of 1 cement, 1½ sand, and 3 gravel, give strengths of 5,750 lb. at 2 days, 6,000 lb. at 7 days, 7,500 lb. at 28 days and 7,750 lb. at 3 months. Therefore, in making calculations for structures, the compression members may be figured at 2,000 lb. per square inch instead of at 700 lb. generally used for portland cement. This results in a marked diminution in the section of compression members which together with the saving in form lumber, offsets the higher price of the cement.

The writer has no recent figures covering the strengths developed by the "Cement Fondu" but from information obtained in 1919 believes there is little or no difference in the strengths developed by the two cements.

Owing to the higher price, the use of alumina cements in France to date has been confined to work where the special qualities are more important than price, such as repairs of streets and pavements, floors of factories, urgent alterations, foundations for machinery, etc., and in work exposed to water carrying injurious solutions and to special construction of which the following are typical examples:

Structural Uses.—In the construction of a large coal storage depot for the Compagnie du Nord it was found that the foundations must be carried through a thick layer of quicksand and sunk to a depth of about 25 ft. The quickest and most economical method of sinking the foundation was by the use of caissons. This method was adopted, but with this novelty, the caissons which were constructed of alumina cement were also the outside foundation walls. The largest of these had exterior dimensions of about 85 ft. in length and 25 ft. in width with a height of about 25 ft. This caisson, in addition to serving as a foundation for the coal storage bins mentioned above, was to be used as a room for the installation of power plant and coal handling machinery. Sinking the caisson, which was loaded with 225 tons in addition to its own weight, was started immediately after pouring. By reason of the unequal resistance of the soil during the descent, this caisson at times was very apparently deformed but never cracked or fissured and after being finally set in place there was absolutely no permanent deformation.

In another case it was desired to remodel a five-story building, the three upper floors of which were occupied as apartments and the two lower floors as offices of a bank. The work involved the removal of a maze of small rooms, the walls of which, as is customary in France, were masonry and carried the upper stories so as to form the large halls and offices of a modern bank. This reconstruction had to be done without interruption to the work of the employees in the bank in the two lower floors and without inconvenience in any way to the occupants of the three upper floors. Steel beams and columns could not be used as it would be impossible to put them in place without interfering with the occupancy of the building. Ordinary reinforced concrete was also objectionable as it would have required leaving the forms and supports in place for two or three weeks. It was, therefore, decided to use concrete of alumina cement. This was found very satisfactory as the forms and supports could be removed within 48 hours. In addition, a considerable saving in cost resulted as compared with portland cement through the use of smaller sections, a reduced quantity of form lumber and time required for the work.

Commercial Possibilities.—As made in the laboratories of Bates and the writer, the manufacture of alumina cement differed in no way from the customary processes employed in the manufacture of portland cement and any portland cement mill could produce alumina cements from a mixture of bauxite and lime without change of machinery.

Omitting the price paid for the bauxite, the cost of manufacture, provided the aluminates did not materially reduce the production of the kiln through excessive ringing up, should be no greater than for portland cement. Theoretically it should be somewhat less as, owing to the low lime content and consequent reduced loss on ignition, a less quantity of raw material would have to be handled and in addition there should be some saving in the fuel required.

The use of the dry process, however in connection with so high priced a raw material as mixture of bauxite and lime, would not be economical owing to the dust losses and these should be minimized by the use of the wet process. It is probable that this dust loss together with the tendency to ringing up in the kilns of the lime-bauxite mix, was what induced the Bureau D'Organisation Economique to adopt the electric furnace, for in 1919 M. Bied told the writer that as a result of his discussion with him in 1917 he had repeated his experimental work and found that fusion of the alumina cement was not necessary. Therefore, in the design of the new plant he expected to use the rotary kilns.

At present cost of fuel in France there is no marked economy in the use of the electric furnace, for while the number of kilowatt hours required to fuse a ton of cement is relatively low, this economy is offset by the high consumption of electrodes the cost of which offsets any fuel economy due to the use of hydro-electric power.

The increased cost of alumina cements produced in this country over portland cement will, therefore, be dependent on the price paid for bauxite. Assuming a price of from $12 to $15 a ton for bauxite delivered at the works, this increased cost would amount to from $1.50 to $2 per barrel which should permit of the alumina cements being manufactured and sold at a price

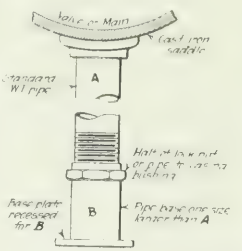
of about $4.25 per bbl. f.o.b. works, exclusive of package, which price corresponds to that at which it is now being sold in France. If, however, there was substituted for the better grade bauxite suitable for chemical work, bauxites high in iron, or there was substituted for part of the bauxite high alumina slags such as those produced by the Pennsylvania Steel Co. where the alumina content ran from 28 per cent to 32 per cent and the lime from 28 per cent to 30 per cent, or some other waste material high in alumina, a very marked saving should be made in the costs of these cements. Furthermore, the cost of the high grade bauxites would be much lower for mills located near the deposits as the price of bauxite used was f.o.b. Philadelphia.

While at first thought the use of a cement costing two or three times that of portland cement would seem prohibitive, the saving in time and form lumber will to some extent offset this and still further saving would be made, if as claimed by the French, a material reduction in section can also be made and still give a stronger structure.

Convenient Means of Supporting Mains or Valves in Pumping Plant

A convenient means of supporting the weight of water mains or valves in a pumping plant being used in the new plant at Sacramento, Cal., consists chiefly of a pipe of suitable size and length, as shown in the accompanying illustration.

The saddle on which the valve or main is to be supported is an iron casting on the underside of which is a circular groove to fit the pipe *A*. The latter sets loosely in *B*, which is a size larger than *A*, and the weight carried by *A* is transmitted to *B* by means of one-half of a lock nut or a pipe-to-casing bushing. The latter gives a more workmanlike appearance, but before being suited to this purpose its lower end has to be cut off in a lathe and the threading for the pipe *A* run clear through. The bottom of pipe *A* has a long thread for adjustment. When ready for service the bushing is turned until pipe *A* thrusts the saddle up snugly against the weight above it and takes the desired amount of load. The base plate is recessed with a circular groove to take the pipe *B*. When the exact location is known in advance a neater job is obtained by imbedding the base plate in the concrete. If installed later the plate can be set on top of the finished floor.



CONVENIENT SUPPORT FOR MAINS HAS ADJUSTABLE FEATURE

Lining Tunnels Under Traffic

Plant and methods employed in lining a number of railway tunnels without interrupting traffic are described in a 45-page report in the 1921 proceedings of the American Railway Bridge & Building Association (Secretary, C. A. Lichy, Chicago). The lining in most cases was concrete placed by hand or by the pneumatic method, but in one case cast-iron segments were used.

Window Protection Recognized as a Serious Fire Problem

Round-Table Discussion of Fire Protection Based on Burlington Fire—Water Spray and Outside Shutters

SINCE the destruction of the Chicago, Burlingham & Quincy Ry. offices in the Chicago fire of March 15, with its demonstration of the vulnerability of office buildings to outside fire attack, concern has been felt by building owners and insurance men over the obvious necessity of providing such buildings with more effective window protection than is now in use. The National Fire Protection Association therefore arranged a discussion of window protection against exposure fires at its annual meeting at Atlantic City on May 10. Active exchange of views developed in this discussion, with the main result of showing that the problem affects large numbers of important buildings, that the reliance upon street-width separation of buildings for protection is unwarranted, and that means for protecting window openings require much further study.

Mathews Describes Burlington Fire—W. D. Mathews, of the Chicago Board of Fire Underwriters, opened the discussion with a description of the Burlington building fire (see *Engineering News-Record*, March 23, page 495). According to his description, the fire from burning buildings to the eastward crossed the 80-ft. width of Clinton St. very rapidly. After it entered the building, the heat produced by combustion of the contents of the building itself was the determining factor in the destruction produced; the heat effects were considerably more severe at the windows on the west and south sides of the building than on the north and east, where fire originally entered.

Except for what was in the vaults the contents of the building were entirely destroyed from the ninth to the fifteenth floors. The contents of the vaults were not harmed, even a feather duster in one of the vaults being found uninjured. The vault walls were of 6 in. of reinforced concrete and 3-in. tile facings inside and outside, and were equipped with double doors. The outer doors warped, but the inner doors remained tight enough to keep out the heat. The enclosure containing the stairs was not penetrated by the fire, and in fact remained accessible throughout the fire; one of the fire officials remained in the stair shaft during most of the fire. The fact that there was no standpipe in this shaft greatly reduced the means for fighting the fire.

Question being raised as to whether the fire was transmitted to the Burlington building by direct flame or by heat radiation, Mr. Mathews expressed the opinion that radiation was probably not the cause. Others, however, held that radiation was responsible, and cited other instances of very strong transmission of radiated heat. In particular A. R. Small, of the Underwriters' Laboratories, reported experiments on transmission through windows which demonstrated a strong transmission effect.

Mr. Small characterized the Burlington fire as equivalent to a 1- to 1½-hour test, judging by the effect on the terra cotta exterior of the exposed walls. Had the fire been longer it would probably have done damage to the contents of the vaults and the performance of the vaults in the actual fire should therefore not be given too much weight. He expressed the opinion that

a north-south cut-off wall through the building would have saved the western half. The resistance of the wire glass in the elevator enclosure was favored. Mr. Small believes, by the fact that the lights were of small size which, as shown by tests, have much greater resistance than large lights.

Windows Need Wire Glass Plus Something—Ira H. Woolson, consulting engineer of the National Board of fire Underwriters, called the Burlington fire the most important demonstration in recent years of the need for better window protection in high-grade office buildings. For years the National Board has advocated wire glass for windows separated by a horizontal distance of 50 ft. or less from other buildings, and in any case above 75 ft. height. Of a large number of cities to which this clause was recommended, in the revision of building codes, only 17 per cent accepted it, 30 per cent ignored it and the others adopted less severe provisions, as, for instance, a 30- to 35-ft. exposure width. But the Burlington fire demonstrates that the Underwriters' own recommendation is not drastic enough.

Mr. Woolson concludes that windows in office buildings should be protected by wire glass plus something. What that something is cannot yet be told. The choice so far as known at present lies between inside and outside shutters, a water curtain, spray from an outside sprinkler directed on the window, and inside sprinklers. The protection of window openings is one of the big questions before the public today. Glass alone is not sufficient.

Outside Shutters Regarded Favorably—Mr. Woolson expressed the opinion that on present showing an outside shutter affords the best possibility for window protection. An automatic rolling shutter such as used by the American Telephone & Telegraph Co. seems the best available device. D. K. Boyd, architect, Philadelphia, disagreed with this view, and stated that shutters are difficult in application and esthetically objectionable, so that a water sheet or curtain appears the more desirable solution.

Water Curtain and Sprays—Favorable testimony concerning water sprays directed against the outside of windows by outside sprinklers was given by several. A. R. Small reported experiments at the Underwriters' Laboratories in which a hose stream directed on a glass window in a test partition very greatly reduced the transmission through the window of heat from a fire built on one side. A water curtain 15 in. away from the window did not stop the radiation in the same degree. A steel shutter stopped more radiation than the plain glass window; a wood-filled door stopped much more heat than either.

In the case of a fire in Worcester, in January, 1921, cited by R. S. Moulton, assistant secretary of the association, outside sprinklers protected a building 30 ft. from a fire. J. J. Conway, superintendent of the Salvage Corps, Cincinnati, instanced a case where a water curtain held a 10-story building face against a severe fire exposure on an 80-ft. street. The windows in this building face were plain glass in wooden frames, and remained undamaged after the curtain or spray got into action, although wire glass 400 ft. distant from the fire was cracked. He warned against the danger of failure of such protection through insufficient water, however. Lack of water is a common cause of sprinkler failures, and in this particular service the requirement is to supply sufficient water for all the heads that may open from simultaneous exposure of many floors to radiant heat.

On this particular point, H. P. Weaver stated that if all the windows in the north and east faces of the Burlington building had been equipped with outside sprinklers, a supply of about 8,000 gallons per minute would have been required to feed them. In general, outside sprinklers on a large building might require from 4,000 to 10,000 gallons per minute throughout a two-hour period. Present supply systems do not make such volumes of water available.

Inside Sprinklers—One case of effective protection through inside sprinklers was instanced by J. H. Brumbaugh. In a fireworks building fire in Chicago six or eight years ago, a building 12 or 14 stories high was exposed. The firemen who entered this building at once knocked open the line of sprinklers nearest the windows on each floor, with the result that the contents of the building were protected although the bricks on the outside of the wall spalled.

Question To Be Investigated—On motion of W. H. Merrill, of the Underwriters' Laboratories, the question of window protection was referred to the executive committee of the association for inquiry through a questionnaire by which information and experiences are to be collected. If the results of the inquiry warrant, the subject may then be referred to a special committee for study.

Herbert Hoover on a Plan for New York and Its Environs

Substance of an address before a meeting at the Engineering Societies' Building, New York City, May 10. See News columns for details of the meeting.

THE action of the Trustees of the Russell Sage Foundation in providing for a survey of New York City and its environs by engineers and other experts and for the preparation of a comprehensive plan for the development of the entire district deserve the highest commendation.

The enormous losses in human happiness and in money which have resulted from lack of city plans taking into account the conditions of modern life, need no comment. The lack of adequate open spaces, of playgrounds and parks, the congestion of streets, the misery of tenement life and its repercussions upon each new generation, are an untold charge against our American life. Our cities do not produce their full contribution to the sinews of American life and national character. The moral and social issues can only be met by a new conception of city building.

The great growth of industry since New York was originally planned presents a host of new problems. The cost of distribution of necessities within the boundaries of the city increases each year. The inadequate system of transportation terminals and commodity distribution taxes New York 10 or 15 per cent upon the cost of living above more adequately served centers.

Many of our industries are seasonal. If we are to secure high living standards and to gain in national productivity, these industries must be so interlocked as to give more continuous employment. The fact that New York has at all times the largest proportion of unemployment of any of our cities is due partially to this ill adjustment.

New York is the gateway of Europe into the United

States and the dumping of great hordes of people into our slums is a poor introduction to Americanization.

One part of such a regional plan as is proposed must be to bring home to each economic group in the district a full realization of its function in the great whole of which it is a part. With this understood, residential districts whose interests center largely around low cost of living and educational and recreational facilities would insist on better means of distribution of commodities and of the development of public utilities. The manufacturing districts would demand not only better aligned transportation but also co-ordination of manufacturing to residential areas along human lines. Manhattan in particular needs today not more centralization but decentralization.

The vision of New York and its environs as a well planned location of millions of happy homes and a better working center of millions of men and women grasps the imagination. A definite plan for its accomplishment may be only an ideal. But a people without ideals degenerates; one with practical ideals is already upon the road to attain them.

Long Colorado Railway Tunnel to Be Built by Improvement Bonds

RAISING funds for the construction of a railway tunnel by the organization of an assessment or improvement district authorized to issue bonds, on the same general basis as an irrigation or drainage district, is an innovation which has been made practicable by the recent passage of a State law in Colorado providing for the Moffat tunnel improvement district on the line of the Denver & Salt Lake R. R.

Development of the territory served by this railway, its traffic facilities and its economy of operation are all hampered by the present open line over the range with grades of 4 per cent and a summit elevation of 11,660 ft. Financial assistance in extending the railway through a productive district in order to complete a new link in a transcontinental route hinges largely upon the construction of this tunnel in order to remove the present operating handicaps. But the railway company, in which Denver industries have a large interest, is unable to finance this desirable work.

In view of this situation and the potential advantages of a favorable line in relation to the commerce and development of Denver and the State of Colorado there has been a strong movement for the undertaking of the tunnel as a public work. The first plan was to issue State bonds to raise funds for the Moffat tunnel and two tunnels on other routes, but this project was defeated by public vote (see *Engineering News-Record* of April 8, July 1 and Dec. 30, 1920, pp. 716, 44, and 1302). The next plan was to organize a tunnel district in which assessments for benefits would be levied. This plan has been made practicable by the passage of the bill noted above.

The tunnel bill provides for the formation of the Moffat Tunnel Improvement District by means of which bonds may be floated for constructing a tunnel through James Peak at a cost not to exceed $6,720,000. The district, which will be contiguous to the railway in Denver, Adams, Jefferson, Boulder, Gilpin and Moffat counties, will include territory directly benefited by the tunnel. All real estate exclusive of improvements will be assessed, levies will be paid as taxes, and bonds will be issued at not exceeding 6 per cent to cover the cost. Rights of protest and appeal are allowed, consent of owners of 50 per cent of the property being required to make the bond issue legal.

Both the financing and construction are to be directly under the control of a commission composed of five members appointed by the governor. The law provides for the use of the tunnel for other than railway purposes, including the carrying of water for the future use of the city of Denver. Surveys indicate a tunnel about six miles long with a summit elevation of 9,100 ft. and having approaches with grades not exceeding 2 per cent and curvature not exceeding 10 degrees.

Determining the Penetration of Wood Preservatives

THE effectiveness of any wood-preservation treatment is measured very largely by the depth to which the preservative penetrates. This can be determined by the following tests used by the Forest Products Laboratory.

The presence of creosote oil is indicated by the dark discoloration. The degree of penetration may readily be determined by taking a sample at a point free from checks and other imperfections and at a considerable distance from the end. The sampling may be done either with an ordinary ½-in. bit, or with an increment borer which brings out a core of wood that shows in cross-section the depth of penetration. The observation should be made at once because the oil spreads rapidly over the cut surface. To prevent infection the hole in the treated piece should be tightly closed with a creosoted plug.

As zinc chloride is colorless the depth of penetration of this preservative must be ascertained by chemical means. After cutting the stick in half or getting a sample with the increment borer, the freshly-cut surface is dipped for not to exceed 10 sec. in a 1 per cent solution of potassium ferrocyanide and the excess solution is removed by blotting paper. The sample is then dipped into a 1 per cent solution of uranium acetate and dried. The treated portions will be whiter than the natural wood and those untreated will have a dark red or a maroon color. This method does not give sharp contrasts on wood which is reddish in color like red oak, but otherwise it is satisfactory and affords a permanent record.

Another method, developed by Galen Wood, consists in spraying over the freshly-cut surface a mixture of equal parts of a 1-per cent potassium-ferrocyanide solution, a 1-per cent potassium-iodide solution and a 5-per cent solution of soluble starch. This colors the treated portion a very dark blue but does not affect the untreated wood. Although the color fades in time it may be brought back by spraying again.

Sodium fluoride is colorless; no satisfactory method of showing its presence in wood has been devised.

Mercuric chloride is also colorless but dipping the wood in a solution of hydrogen sulphide turns the treated area black.

As individual pieces may show an abnormally high or low degree of penetration, a sufficient number of tests should be made to obtain a fair average. Samples should be taken at a considerable distance from the ends of the stick, in order that they will not be affected by the heavy longitudinal penetration.

ENGINEERING LITERATURE

Office Circulation of New Literature

Sir—I have read with much interest Miss Canavan's article on "Office Circulation of New Literature," in your issue of Feb. 16, p. 288. At Stone & Webster's Boston office library the system is similar to the one described by Miss Canavan, but the following objections have been raised by one of the members of our staff: (1) If in a hurry for a particular issue there is some delay in running a copy down. (2) The magazine, moving in an automatic way, has sometimes gone to the 'grave yard.' For instance, copy is delivered to Mr. Smith, who is away for a few weeks, and in that case Mr. Jones will receive it at a later date when it has lost its value to some extent.

G. W. LEE,
Librarian, Stone & Webster, Inc.

Boston, Mass., March 20.

"Human Engineering"

Sir—As a result of the war, many men are wondering if humanity is on the right track and if the human race is really achieving its destined place in the scheme of things. Alfred Korzybski, in "Manhood of Humanity, The Science and Art of Human Engineering" (E. P. Dutton & Co., New York City; $3), asserts that man is not developing as he should because he is not living in accord with the laws of human nature. He presents a new concept of man based upon his supreme faculty of appropriating and using the fruits of the labors and experiences of past generations as intellectual and spiritual capital for development in the present, and the capacity of conducting his life in the ever increasing light of inherited wisdom. By reason of this faculty, man's development is not subject to the laws that apply to animals, but is nevertheless governed by natural laws, the laws of human nature. It is man's chief duty to his race to discover the laws of human nature and teach his fellow beings to observe and live in accord with those laws. Then will humanity emerge from its infancy and attain its manhood. Human Engineering is defined as "the science of Human Nature and the Art of directing the energies and capacities of human beings in accordance with the laws of Human Nature for the advancement of Human Weal."

The book is carefully written in simple, precise language. The arguments are based upon a wide range of historical facts and the conclusions are supported by mathematical deductions which leave the reader with the conviction that the author has presented new ideas of man and his destiny which are convincing and deserve careful consideration.

Engineers, both by their training and method of thought, are perhaps the best qualified to discover and prove the laws of human nature, and when discovered, help to apply them for the advancement of the human good. Surely there can be no more noble task for engineers than to engage their talents and labors in this human problem which the author calls the Science of Human Engineering.

Harriman, Pa., Feb. 20. WILLIAM FITCH SMITH

Modern Roads from French Point of View

LES CHAUSSÉES MODERNES—Par P. LeGavrian, Ingénieur en Chef des Ponts et Chaussées. Paris: J. B. Baillière et Fils. Paper; 6 x 9 in., pp. 431; half tones and line cuts. Paper, 40 fr.; flexible binding, 50 fr.

Happily, the author of this book avoids that tedious recital of road building history, beginning with the practice current among the ancient Romans, with which so many American and British authors feel it necessary to preface any text on the general subject of highways. Instead, he starts with a statement of the pressing problems of to-day, due to changes in the character and volume of traffic. The technique of highway practice has undergone so many changes within the past few years in order to cope with the needs of increased motor transport that most of the former standard texts in French are inadequate. Some of the newer American and English books have more nearly kept pace with recent progress, but none of these has been translated into French. In bringing together into one volume a statement of methods, materials and machinery used by road builders of today, M. LeGavrian has performed a real service, not only for his compatriots but for engineers of other countries who are able to read French.

For a task of this sort the author is particularly well qualified. In his several capacities as *ingenieur en chef des Ponts et Chaussées*, professor at the *Ecole Nationale des Ponts et Chaussées*, and secretary of the Permanent International Association of Road Congresses, he has had unusual facilities for the preparation of a comprehensive and authoritative text on modern road building. The book consists, in part, of material which M. LeGavrian used in lectures to students at the *École Nationale*.

The book is divided into two parts, the first dealing with bituminous materials—their nomenclature, methods of production and physical and chemical properties and tests—and the second with the design and construction of the several standard types of paving surface, including bituminous, concrete and block pavements.

In French and British practice engineers have devoted far more attention to roads of bituminous types than to concrete pavements. This trend is clearly reflected in the book, 215 pages of which are devoted to tar and asphalt types, while only 30 pages deal with concrete. There is an extensive treatment of the nomenclature of tars, bitumens, asphalts and their derivatives with detailed reference to American, German, British and French terminology. M. LeGavrian deplores the confusion created by the classification of the same materials, in different countries, under different names.

The second and third chapters are devoted to the methods of production and specifications for bituminous binders and to methods of testing the physical and chemical properties of these materials. There follow several chapters on methods and materials employed in penetration and in mixed bituminous con-

struction, together with notes on distributing apparatus, mostly French and English. In these types of work the instructions of the British Road Board are are extensively quoted.

One of the most interesting chapters is the one dealing with the formation of "waves" in bituminous surfaces. One of the chief causes emphasized by M. LeGavrian is faulty rolling and he illustrates a three-wheel tandem roller, designed by Col. Crompton, a British engineer, to eliminate the formation of waves during construction. The author lays great stress upon the importance of proper methods of compression in bituminous pavement construction to prevent waves.

The chapter on concrete roads, particularly that part of it dealing with construction methods and machinery, makes frequent reference to American practice, although it is evident that French engineers are not yet prepared to accept the concrete road with the same degree of confidence as do their American confreres. This opinion is reflected on p. 253 of the text where the author states that French engineers are still of the belief that the concrete pavement possesses insufficient elasticity to resist economically for any length of time heavy traffic even though it be not intensive. Nevertheless, reference is made to the conception of the concrete road as not necessarily a permanent surfacing, but rather as a means of carrying traffic until its condition becomes such as to require some form of covering, such as an asphaltic top. Comparatively little space is devoted to reinforced-concrete roads. In American practice, at least, there is a distinct trend toward reinforcement on trunk-line routes and even in those states where a considerable yardage of this type has been built heavier reinforcement than has been adopted in the past is common.

The final portion of the book deals briefly with block pavements, including wood, brick, asphalt block and stone mosaic. On these types the author mentions only the outstanding features and avoids entirely the matter of detail, either in design or construction.

An exceedingly valuable portion of the book is the dictionary of road-building terms which forms the first appendix. Here one may find a concise definition for example, of the types of pavement, called "Ferromac" or "Gladwell" and other special terms or patented types of construction. The volumes concludes with quotations from French ministerial instructions on paving methods and materials, and specifications approved in 1915 by the Direction Administrative des Travaux of the city of Paris.

Novel in Its Method of Approach

REVIEWED BY LEWIS E. MOORE
Consulting Engineer, Boston, Mass.

ESSENTIALS IN THE THEORY OF FRAMED STRUCTURES —By Charles A Ellis, A.B., Vice-President, The Strauss Bascule Bridge Co.; with American Bridge Company 1901-1908; Assistant Professor of Civil Engineering, University of Michigan, 1908-12; Designing Engineer, Dominion Bridge Co., 1912-14; Professor of Structural Engineering, University of Illinois, 1914-21. New York and London: McGraw-Hill Book Co. Cloth; 6 x 9 in.; pp. 330; illustrated. $3.50.

The author has produced a textbook which is quite novel in its method of approaching the subject and which should prove very useful because its aim is to develop the student's ability to think and reason rather than to produce either a good draftsman or a finished designer. In his endeavor to educate rather than instruct, as stated in the preface, the author has presented his subject in what he conceives to be the most natural sequence for the human intellect to grasp, i.e., illustrative problems are shown first, from which the underlying principles and formulas are deduced.

When it came to actually writing the book, the author evidently did not always find it possible to use this method, particularly not in the case of the chapter on the deflection of beams, but the method has been followed as closely as appears to be practicable.

The first chapter deals with the fundamental mechanics of the subject, taking up the equilibrium of co-planar forces, beginning with the parallelogram of forces and using both algebraic and graphic methods. It would seem that the treatment of the equilibrium of forces could have been improved by laying much more emphasis upon that most useful of mechanical concepts, the free body diagram.

The next chapter carries the application of the principles of equilibrium; as for the determination of the stresses in trusses, and discusses external and internal forces and the conditions of stability and redundancy. The usual methods of joints and of sections are illustrated and discussed. Beams come next. Graphical methods are first used to determine bending moments and later the ordinary forms of shear and bending moment diagrams are given. The method of distinguishing between positive and negative moments is stated in such a way that it would appear to the student to be a purely mathematical concept. It would seem that the author here missed an opportunity to give the mechanical concept that positive moment occurs with compression in the top fiber and negative moment with tension in the top fiber. Some attention is given to the development of the parabola in view of its importance in engineering diagrams. The chapter closes with illustrations of frames having members which act as beams, such as cranes, portal frames, etc., and gives the usual assumptions with regard to horizontal reactions and points of contraflexure.

The third chapter deals with roof trusses and pays careful attention to the uncertainties surrounding the design and to the assumptions which are made and the reasons for them. The author makes the point that the assumption of equal horizontal reactions in mill building bents is incorrect and gives a table based on accurate analysis made strictly in accordance with the elastic theory of structures. This table should be useful to the practical designer within the limits for which it is deduced. The author points out that it is in many cases unnecessary to make a stress diagram for wind only and that the uncertainties as to the values of wind pressure are such that a sufficiently accurate analysis can be made from vertical loads. Special consideration is given to columns and knee braces and to the web members which meet the knee braces. The author points out that there is no generally accepted standard specification for buildings in America and that as a matter of fact design is quite largely a matter of opinion with each designer. There is no standard type and so there are great difficulties in the way of a strictly scientific solution or analysis which will be of wide applicability without being exceedingly cumbrous.

Chapter IV deals with bridges, more particularly trusses, and begins by finding maximum stresses by means of influence lines, later bringing out the criteria for loadings which will produce maximum moment and shear. The subject is extended to cover curved-chord, as well as parallel-chord trusses.

The chapter on the deflection of beams is worthy of careful reading and study. The author has compressed into thirty pages much valuable information and gives the first complete demonstration of the area-moment method of handling the question of deflections that the reviewer has seen in an American text. This method is so simple in its application, and so quick in its results, as compared with the cumbrous integration of the se ond differential coefficient of the elastic curve, that it should be thoroughly understood by every engineer who has occasion to find deflections of beams. It is given with sufficient illustrations so that careful study will make its application in almost any case obvious. The chapter concludes with a statement of Maxwell's theorem of reciprocal displacements.

Restrained and continuous beams are next treated, using the area-moment method throughout. In the latter part of the chapter the theorem of three moments is briefly presented. The subject of partially continuous beams and continuous beams in foundations closes the chapter. The latter subject illustrates the errors made in common practice in designing continuous grillage beams in a foundation. The next chapter deals briefly with deflection of trusses, using both the method of least work and the Williot diagram. In the final chapter, on swing bridges, a short method of determining stresses in swing span trusses is given.

Finally, and writing as one who has had a number of years' teaching experience himself, the reviewer has long felt that the teaching of engineering is becoming too much a matter of deducing formulas and teaching facts, and too little a development of the philosophical side of the subject taught and of the student's power to think. A book of this type, which emphasizes the philosophical and imaginative side, should be welcomed, more especially by the mature and experienced teacher, and should prove very valuable in his hands. Whether it will prove as useful in the hands of a young teacher may, perhaps, be questionable, but in any case it is certainly a step in the right direction.

Information on Mexico for Americans

MEXICAN YEAR BOOK, 1920-1921—By Robert Glass Cleland, Ph.D. Los Angeles: Mexican Year Book Publishing Co. Cloth, 6 x 9 in., pp. 524. $7.50.

The editor of this Year Book anounces that his purpose is to meet the demand for unbiased and systematized information concerning Mexico, prepared to suit American needs and having no official Mexican patronage. The subject is considered under seven heads: History and Geography; Politics and Government; Travel and Transportation; Commerce and Manufacturing; Natural Resources; Public Finances, Currency, and Banking; Labor Conditions and Educational Systems. Each of these subjects has been discussed by an authority and is replete with descriptive, historical and statistical data. The appendix includes practical suggestions for the business traveler in Mexico, and gives details concerning postal and tariff regulations, the recent colonization decree, and the treaties now in force between Mexico and the United States. It contains also a bibliography of works on Mexico. Three maps show the political divisions, principal cities, lines of communication, mining centers and the Panuco-Tuxpam oil fields.

Pioneer Investigations of Acoustics

REVIEWED BY F. R. WATSON
Professor of Experimental Physics University of Illinois

COLLECTED PAPERS ON ACOUSTICS—By Wallace C. Sabine, Late Hollis Professor of Mathematics and Natural Philosophy in Harvard University. Edited by Theodore Lyman. Cambridge, Mass.: Harvard University Press. Cloth, 5 x 11 in., pp. 279, illustrated. $4.

Professor Sabine's important investigations in architectural acoustics have been set forth in various periodicals since 1900. His unexpected death in 1919 made it desirable to publish the available results of his work in a single volume. The labor of collecting this information was undertaken by Prof. Theodore Lyman, a colleague of Professor Sabine's, who also acted as editor for the publication.

The papers deal almost entirely with the acoustics of buildings. The larger part of the discussion concerns the action of sound in auditoriums, a question which first engaged Prof. Sabine's attention. Two papers on The Insulation of Sound and Building Material and Musical Pitch mark the beginnings of a fundamental investigation of a second important problem which unfortunately was interrupted by Prof. Sabine's death. A paper entitled Melody and the Origin of the Musical Scale suggests the theory that the musical scale might have been developed when enclosed rooms were first used because of the prolongation and overlapping of successive tones in singing. Whispering Galleries is the title of a paper dealing with the whispering phenomena exhibited in some rooms and natural caverns.

The extension papers on Reverberation give important conclusions concerning the acoustics of auditoriums that resulted from Prof. Sabine's pioneer work in this little-understood subject. He developed the formula: $t = kV \div a$ where t is the time taken for a sound of standard intensity to die out in a room, k is a constant, V the volume of the room and a the sound absorbing power of all the surfaces. To make the formula of practical use, he experimentally determined the coefficients of absorption for the surfaces usually found in auditoriums—plaster, wood, glass, etc.—as well as individual objects, such as chairs, people, pictures, etc. By means of this equation and the constants, any auditorium, whether already constructed or in the process of design, can be analyzed and recommendations given for securing satisfactory acoustics.

Prof. Sabine's substantial findings have given confidence to other investigators to proceed in this difficult domain. In the United States, additional investigations have been made by Stewart, Watson and P. E. Sabine. (See Bibliographies in Bulletins 73, 87 and 127 of the University of Illinois Engineering Experiment Station, Urbana, Ill.) Prof. Franklin in America and Jäger in Vienna developed reverberation formulas from theoretical considerations that conformed with Sabine's results. Aigner in Vienna calculated sound-absorbing coefficients by instrumental measurements that were in agreement with the ear measurements taken by Sabine. A recent book by Eugen Meinhard, Horsamkeit Grosser Räume, draws heavily from Sabine's conclusions.

It may well be said that the investigations described in these Collected Papers clear the subject of acoustics of buildings from the fog of mystery that previously enveloped it and allow the essential phenomena to be seen in the light of scientific laws. Prof. Sabine's pioneer results furnish the basis for any further advances in this field

PUBLICATIONS RECEIVED

AMERICAN GOOD ROADS CONGRESS, 1922—New York: American Road Builders' Association, 11 Waverly Place. Cloth; 6 x 9 in.; pp. 273; illustrated. $3.

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION: Proceedings, 1921—Secretary, C. A. Lichty (C. & N. W. Ry.), Chicago. Cloth; 6 x 9 in.; pp. 246; illustrated. $1.

Reports are given on cinder pits, station platforms, tunnel lining, tool equipment for pile drivers, treated timber and repairing leaks in water mains.

APPLIED CALCULUS—By F. E. P. Bisacre, P.B.E., M.A. (Cantab.) B.Sc. (London) A.M.Inst.C.E. New York: D. Van Nostrand Co. Cloth; 5 x 7 in.; pp. 446; illustrated. $3.75 net.

ASSETS OF THE IDEAL CITY—By Charles M. Fassett, Specialist in Municipal Government at the University of Kansas; former Mayor of Spokane. New York: Thomas Y. Crowell Co. Cloth; 5 x 8 in.; pp. 177. $1.50 net.

THE BORDER METHOD OF IRRIGATION—By Samuel Fortier, Associate Chief, Division of Agricultural Engineering. Farmers' Bulletin 1243, United States Department of Agriculture, Washington, D. C. Paper; 6 x 9 in.; pp. 41; illustrated.

CITY OF ALEXANDRIA TOWN PLANNING SCHEME—By W. H. McLean, M.Inst. C.E., Member of the Institution of Municipal and County Engineers; Member of the Town Planning Institute; Engineer-in-Chief, Municipality of Alexandria. Cairo: Ministry of Finance. Boards; 8 x 14 in.; pp. 18; maps and halftone plates. P. T. 50.

Besides street plan, parks, transportation, zoning, housing, etc., this report includes a historical sketch dealing with the Ptolemaic Arab and modern Alexandria.

CITY PLAN FOR EAST ORANGE, N. J.—Prepared by the City Plan Commission; Technical Advisory Corporation, Consulting Engineers, New York City. Paper; 8 x 11 in.; pp. 80; 4 maps.

A comprehensive report on all phases of city planning and public improvements. Contains novel score sheet for choosing among nine civic center sites, population curves, municipal program for public improvements to fit future financial ability of city.

CONCRETE COMPUTATION CHARTS—By Mr. Richard T. Dana, M. Am. Soc. C. E., Chief Engineer, Construction Service Co. and James M. Kingsley, B.S. New York: The Author, 119 Broad St. Flexible; 9 x 12 in.; pp. 14; 21 full-page diagrams. $5.

DEPARTMENT OF CONSERVATION AND DEVELOPMENT, STATE OF NEW JERSEY—Annual Report, 1920-21—Trenton. Paper; 6 x 9 in.; pp. 103; illustrated.

DIVISION OF HIGHWAYS AND THE REGISTRY OF MOTOR VEHICLES—Annual Report of the Department of Public Works, The Commonwealth of Massachusetts, 1920-21. Paper; 6 x 9 in.; pp. 141; illustrated.

EINFACHE, RECHNERISCHE BEHANDLUNG des Durchlaufenden Tragers fur Unbewegliche Lasten—Zahlenbeispiele Anwendungbeispiele für den Eisenbeton. By G. Soll, Dipl.-Ing., Studienrat an der Staatlichen Baugewerkschule in Barmen-Elberfeld. Berlin: Wilhelm Ernst & Sohn. Paper; 6 x 9 in.; pp. 112; 42 text figures.

THE EMPIRE MUNICIPAL DIRECTORY AND YEAR BOOK, 1922-1923—London: Municipal Engineering and the Sanitary Record (The Sanitary Publishing Co., Ltd.). Cloth; 7 x 9 in.; pp. 288. 11s. net.

Like the previous edition of this useful work, noted in these columns Aug. 18, 1921, p. 289.

ENGINEERING AND LEGAL ASPECTS OF LAND DRAINAGE IN ILLINOIS—By G. W. Pickels and F. B. Leonard, Jr. Urbana, Ill.: State Geological Survey. Cloth; 7 x 10 in.; pp. 322; map in pocket.

Besides a review of the status of drainage in Illinois, gives information regarding 29 drainage areas.

THE ENGINEERING FOUNDATION: Report for 1921-22 and a Report of Research on The Fatigue of Metals—Engineering Societies Building, New York, N. Y. Paper; 7 x 10 in.; pp. 92; illustrated.

THE ENGINEERING INDEX, 1921—Compiled by The American Society of Mechanical Engineers, New York City. Cloth; 6 x 9 in.; pp. 584. $6.

Follows general lines of 1920 and 1919 issues. Contains over 14,000 items, referring to articles in 600 publications, the selections having beeen made from 100-odd periodicals, etc. The 1920 Index was noticed at length in these columns for Sept. 15, 1921, p. 456.

FOR COMPULSORY LICENSE OF PATENTS—How the Stanley Bill (S. 3410) Imperils Inventors, Manufacturers, and The American Patent System. Washington, D. C.: American Patent Law Association, 614-619 Washington Loan & Trust Bldg.

HANDBOOK OF MUNICIPAL GOVERNMENT—By Charles M. Fassett, Specialist in Municipal Government at the University of Kansas; former Mayor of Spokane. New York: Thomas Y. Crowell Co. Cloth; 5 x 8 in.; pp. 192. $1.50 net.

HUMAN FACTORS IN INDUSTRY: A study of Group Organization—By Harry Tupper. New York: Ronald Press Co. Cloth; 5 x 8 in.; pp. 280. $2.

HYDRAULIC CALCULATOR for the Solution of Flow of Water Problems in Canals, Flumes, Culverts, Pipe Lines, etc.—Devised and for sale by J. R. Jahn, M.S., Irrigation Engineer, Berkeley, Cal. Diagrams mounted on one piece of 8 x 12-in. stiff cardboard, accompanied by flexible transparent straight edge and 8-p. pamphlet of directions for use. $5.

A nomographic chart for the purposes stated above and for various other calculations incident to irrigation, water power and water supply including pumping plants, weirs and earthwork estimates. Values for "n" in open and closed conduits and for "V" in open canals are suggested.

INDUSTRIAL DIRECTORY AND SHIPPERS' GUIDE—New York: New York Central Lines. Cloth; 8 x 11 in.; pp. 968; maps and half-tones.

A compendium of information concerning the several railroads of the New York Central system and the communities along its lines, with suggestions and instructions for shippers as to packing, claims and related subjects. Aims to promote American industries by acquainting business men with the traffic facilities of the railroad system it describes. Successive editions are proposed.

INVESTIGATION OF THE PROPORTIONING OF CONCRETE MIXTURES—1921—By Peter Gillespie, Professor of Civil Engineering, and A. R. Duff, Research Assistant, University of Toronto (Ont.), Faculty of Applied Science and Engineering School of Engineering Research. Paper; 6 x 9 in.; pp. 13; illustrated.

JOINT TERMINALS AT CHICAGO, ILL.: Report of Board of Economics and Engineering to S. Davies Warfield, President, National Association of Owners of Railroad Securities, Inc., 1 Madison Ave., New York City. Paper; 8 x 11 in.; pp. 38; 10 maps.

Owing to the reduction of net revenues by mounting terminal costs the board named above decided to investigate joint terminals, and selected Chicago and New York for that purpose. The Chicago report contains many valuable data. Col. F. A. Molitor is chairman of the board.

THE LOCAL GOVERNMENT OF THE UNITED KINGDOM—By John J. Clarke, M.A., F.S.S., Lecturer in Law of Housing and Town Planning in the University of Liverpool; Lecturer in Public Administration, Local Government and Citizenship for the Liverpool Education Authorities. With a Foreword by Sir Homewood Crawford. London, Toronto, New York: Sir Isaac Pitman & Sons, Ltd. Cloth; 5 x 7 in.; pp. 374. 8s.

NEW SOUTH WALES WATER CONSERVATION AND IRRIGATION COMMISSION: Report for 1920-21—Sydney, N. S. W. Paper; 9 x 13 in.; pp. 32. 2s.

OBSERVACIONES HIDROLOGICAS, 1911-20—Boletin 102, Cuerpo de Ingenieros de Mines del Peru. Por Pedro García Gastañeta, Jefe Hidrólogo. Lima. Paper; 7 x 10 in.; pp. 156; tables.

PREPARATION AND USES OF TAR AND ITS SIMPLE CRUDE DERIVATIVES—By W. W. Odell. Prepared under a co-operative Agreement with the Illinois State Geological Survey and the Department of Mining Engineering of the University of Illinois. Washington: Bureau of Mines. Paper; 6 x 9 in.; pp. 84.

REPORT ON DRAINAGE AND PREVENTION OF OVERFLOW IN THE VALLEY OF THE RED RIVER OF THE NORTH—By P. T. Simons, senior Drainage Engineer, and Forest V. King, Drainage Engineer. Washington: Bureau of Public Roads. Paper; 6 x 9 in.; pp. 89; illustrated. 50c.

ROAD DRAG COMPETITION: Report of the Ninth Annual Competition, Saskatchewan Department of Highways, Regina—Paper; 6 x 9 in.; pp. 20.

SELECTED PROFESSIONAL AND BUSINESS BOOKS—Compiled by Scovell, Wellington & Co., Accountants-Engineers, Boston 9, Mass. Paper; 4 x 9 in.; pp. 25.

Mostly books on accounting, auditing, banking, advertising and selling; includes a few on municipal government, a number on engineering and industry, and some on economics, etc.; 400 in all.

SEPARATION OF STREET AND RAILROAD GRADES, PATERSON, N. J.—A Report of the City Plan Commission by Herbert S. Swan and George W. Tuttle. Paper; 8 x 11 in.; pp. 29.

Includes plans but no cost estimates for elimination of all grade crossings on Erie, Susquehanna and Lackawanna railroads.

SOUND-PROOF PARTITIONS: An Investigation of the Acoustic Properties of Various Building Materials with Practical Applications—By F. R. Watson, Professor of Experimental Physics, University of Illinois, Engineering Experiment Station. Paper; 6 x 9 in.; pp. 83; illustrated. 45c.

STATISTICS OF COMMON CARRIERS, 1920: Preliminary Abstract—Washington, D. C.: Interstate Commerce Commission. Paper; 9 x 12 in.; pp. 221.

STREAM POLLUTION STUDIES—By Russell Suter, Senior Assistant Engineer, and Emmeline Moore, Investigator in Fish Culture; and Studies in Oyster Culture, by William Firth Wells, Biologist and Sanitarian. Albany, N. Y.: State Conservation Commission. Paper; 6 x 9 in.; pp. 34; illustrated.

TENTATIVE ZONING PLAN FOR AKRON, OHIO; Also Report on Limitation of Heights of Buildings—City Planning Commission, E. A. Zeisloft, Chief Engineer and Secretary; Charles F. Fisher, Planning Engineer. Paper; 6 x 9 in.; pp. 22 and 15.

THE THOROUGHFARES AND TRAFFIC OF PATERSON—A Report of the City Plan Commission. Prepared by Herbert S. Swan, Consultant. Paper; 8 x 11 in.; pp. 82; illustrated.

A comprehensive report. Gives much attention to the way the traffic is hindered by lack of a city plan, narrow and dead-end streets, grade crossings, poor routings of street railways and jitneys. Improvements mapped out and ways and means of providing them suggested.

WORK IN COMPRESSED AIR AND IN TUNNEL CONSTRUCTION—Industrial Code Rules (as amended) of New York State Industrial Board. Effective May 1, 1922. Albany, or 124 E. 28th St., New York City. Paper; 5 x 8 in.; pp. 35.

WATER SUPPLY NEEDS AND RESOURCES OF THE COMMONWEALTH: Report of the Joint Board Consisting of the State Department of Health [of Massachusetts] and the Metropolitan District Commission. Boston. Paper; 6 x 9 in., pp. 283; folding maps.

Deals chiefly with an additional water supply for Boston and vicinity and Worcester, but proposes several other districts. Abstracted at length in *Engineering News-Record*, March 2, p. 360.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Trusses Should Rest on Columns

Sir—The particular point again emphasized by the Knickerbocker Theater disaster is one which has long been recognized by structural engineers, namely, the necessity of firm anchorage of trusses to suitable steel columns.

It would be impressive if there could be generally circulated pictures made after the earthquake of 1906 of certain San Francisco structures showing wrecks similar to that of the Knickerbocker Theater, which would not have occured with trusses firmly fastened to their supports. The trusses at the North Beach Power House of the United Railroads, for example, were set on pilasters and were shaken off by the earthquake. The wreck of the Majestic Theater was even worse, and if the shake had come at a time when the parquet was filled with people few would have escaped.

In his report on the condition of buildings in San Francisco after the earthquake, A. L. A. Himmelwright concluded his remarks about the Majestic Theater as follows: "The inadvisability and danger of carrying large trusses on bearing walls at great height, as was done in this case, is clearly shown. Steel columns should be provided and the trusses rigidly connected to them and braced." Such fundamental principles of good structural practice should be incorporated in the building laws of all cities and then should be enforced.

ARTHUR J. GRIER.

Oakland, Cal.
Mar. 30.

Questionnaire for Prospective Bidders

Sir—The following questionnaire is a suggested method of restricting competition to responsible contractors, either on public or private work, when advertising for bids, following out the principles laid down by Secretary Hoover's Conference on a Standard Contract Document, which advocated: "The award of contracts on a basis of skill, integrity and responsibility, with the policy, where practicable, of eliminating irresponsible or inappropriate bidders before their proposals are received."

The suggestion is, briefly, to have the designing engineer or architect do in advance what he always does after bids are received, namely, consider the merits and ability of the various bidders. It requires that the designer request each bidder to answer a questionnaire on the three points of skill, integrity and responsibility. If the answers are satisfactory the applicant is allowed to take a set of plans and specifications and make a bid, and the lowest of these is automatically awarded the contract. If the answers are not satisfactory he is not allowed to bid.

It is believed that if this method, or some similar one, were generally followed it would in a few years revolutionize the construction industry because it would eliminate all irresponsible and ignorant contractors, many of whom are crooked, and leave only the other kind. These would have an opportunity to make a profit, and as they can do work as cheaply as it can be done and done rightly, the owner of the building would be benefited by restricting his work to this class; therefore, all parties to the industry would be benefited.

L. C. WASON,
Aberthaw Construction Co.

Boston, Mass.
May 3.

QUESTIONNAIRE

The following information is for the [illegible] and will be treated strictly confidentially by me.

Signed [illegible]

SKILL:

1. How long have you been in business [illegible]
2. How long have you been in responsible [illegible]
3. What training in school, college or [illegible] had to fit you for this business
4. Give a concise outline of the work you have done with examples and dates from your start in the contracting business.
5. Give a list of similar work to that in view with brief description, size, location and date that you have executed.
6. Have you a skilled superintendent now in your employ competent to be entrusted with executing the work in view?
7. State the training and experience of the man you propose to put in charge of this work.
8. Have you now in your employ the principal assistants to the works' superintendent for the work in view?
9. State their position, training and experience.

INTEGRITY:

10. Give the name and address of the last five Architects (or Engineers) and the owners of the work with address for whom you have completed contracts.
11. Will you give them as references?
12. Have you any objection to my inquiring of any or all of them about you?
13. If so, why?
14. Give any other references you care to.
15. Has any work been taken out of your control due to dissatisfaction of Architect (or Engineer) or Owner?
16. If so, describe the case.
17. Have any of your contracts resulted in law suits?
18. If so, describe the cases.
19. Have you had controversies with your sub-contractor..... .....or with municipal building departments?
20. If so, state the nature of them?

RESPONSIBILITY:

21. I estimate that if you fulfill the requirement of plans, specifications and contract as to progress the amount of cash and credit required of contractor before first payment is made will be $....., and that the maximum requirements of cash or credit in the most active period of the work between payments will be $.....
22. Have you the required resources in cash or credit?
23. Give a condensed statement of assets and liabilities.
24. What volume of work have you unfinished in $
25. How much cash or credit does this require?
26. How much cash or credit does this leave free for other work.
27. I estimate approximately that the following plant will be the minimum amount needed to properly handle this work.
28. Have you this amount of your own available for the work?
29. If not, do you know that you can get it as and when needed?

Moon Phases and Timber Life

Sir—Many years ago, when traveling over the Panama R.R., an American roadmaster pointed out sound hardwood ties which had been in the track ever since it had been laid 40 years previously, while others which had not been laid 12 months were quite rotten. The explanation given was that these last had been cut at the wrong time in the month.

Later, while building a railroad in a low tropical district of Columbia, I collected what information I could on the subject, of which the following is a summary.

1. In the first and second quarters of the moon—called "Cresciente"—the natives never fell timber because they say, it is full of sap. Only in the third and fourth quarters—called "Minguante" do they cut, when they say the sap is down. They commence cutting after full moon.

2. The natives say that timber cut in "Cresciente" will speedily rot. Europeans, who have ignored this, admit that within twelve months the timber has so completely rotted as to require renewal.

3. Being tied down to a limited time under our contract we had to fell continuously. Within twelve months after being laid some of the "Cumula" sleepers showed signs of rot with fungi growing on them, although laid in sand ballast, and well drained.

4. A keen lady gardener in this district said she always planted her flower seeds in the third and fourth quarter, because, when planted in the other quarters, they grew up but never flowered.

5. In the temperate climate of the Bogota plateau (elevation 8,600 ft.) and in the lands at a higher elevation the natives cut timber at all phases of the moon.

The timbers we used for the work were principally Cumula and Guayacan, but a few Diomate were admitted. Particulars are as follow:

		Weight in lb. per
		[illegible] ft.
1	Cumula	49
2	[illegible]	[illegible]
3	[illegible]	[illegible]

[illegible] sinks in water but [illegible] Zygophillum arboreum [illegible] similar timber to Greenheart.

ROBT. I. MORRIS.

London, Eng.,
April 24.

NEWS OF THE WEEK

New York, May 18, 1922

Propose New Rapid Transit Routes for New York

Transit Commission Announces Plans for $218,000,000 Project—City Government Hostile

New rapid transit subways aggregating 32.55 miles in length with a trackage of 84.20 miles are included in the plans announced last week by the New York Transit Commission. It is expected that the cost of construction, estimated as $218,000,000, will be raised through the sale of city bonds. Means for providing the $100,000,000 estimated as the cost of equipment, will depend on the outcome of the movement now under way to reorganize the existing transit system in accordance with the Transit Commissions Plan.

Before construction of any of the new lines can be begun public hearings must be held, the routes legalized, and appropriations made by the Board of Estimate and apportionment of New York City. The available margin of the city's borrowing capacity has not been determined exactly, but it is understood to be substantial. If the reorganization plan for the existing transit system should be adopted and the lines established on a paying basis the city funds now tied up in those lines would be released from the debt limit and made available.

May Be Delay

Although the need for additional transit facilities is urgent, action on the proposed plan will probably be deferred as a result of the long-standing controversy between the Transit Commission and the city government relative to transit matters. Already news reports foreshadow a hostile attitude on the part of the Board of Estimate and Apportionment which, under the regular procedure in subway construction, has several opportunities to interpose obstruction. Mayor Hylan has announced that the city administration will soon make public a program of its own, looking to recapture by the city of some of the existing lines and formation of a system to be city-operated as well as city-owned. He has declared that city funds will be appropriated only on such a basis. Even under favorable conditions the time required to build a new subway including the laying out and validation of routes, the drawing of plans, the preparation of contracts and the actual construction varies from three to five years.

The routes now proposed are as follows (see map on p. 843):

1. Extension of the Corona line, in north Queens, from Corona to Flushing.

2. Extension of the 42d St. crosstown line in Manhattan, with a moving platform connecting with all existing and future north and south rapid transit lines, both subway and elevated.

3. A Staten Island tunnel to connect with the Fourth Ave. subway in Brooklyn, and with the steam and trolley lines on Staten Island.

4. Extension of the Broadway-Seventh Ave. line of the Brooklyn Rapid Transit system from 59th St., Manhattan under Central Park West, 110th St., and Seventh Ave. to 155th St.

5. A Brooklyn crosstown line from Queensborough Plaza in Long Island City to connect with the Brighton Beach line at or near Franklin Ave. and Fulton St., Brooklyn.

6. A new subway and East River tunnel to connect the Fulton St. elevated line, in Brooklyn, with the Broadway-Fourth Ave. line at the City Hall station in Manhattan.

7. A new trunk line subway to run from downtown Manhattan to Washington Heights, following in the main, Eighth and Amsterdam Avenues.

It is the judgment of the Commission that so far as possible, work on all these lines should be taken up at once and that the entire program should be carried out by units, each of which may be operated as a part of the transit system immediately on completion. The plans contemplate such a procedure, in the interest both of speedy increase in facilities and of reduction in amount of accumulated interest on cost of construction.

The plans now presented have been prepared by Daniel L. Turner, consulting engineer to the Transit Commission. Preparation of construction plans and specifications and supervision of construction will be under the direction of Robert Ridgway, chief engineer.

Am. Soc. T. M. Nominations

The nominating committee of the American Society for Testing Materials has announced the following regular nominations for officers to be voted on at the coming annual meeting; President, George K. Burgess, U. S. Bureau of Standards; vice-president, W. H. Walker, Massachusetts Institute of Technology; members of the executive committee D. M. Buck, W. M. Corse, W. K. Hatt, and J. R. Onderdonk.

Lower Niagara Arch to Be Four-tracked

The four-tracking of the lower arch bridge across the Niagara River gorge, used by the Grand Trunk Railway, is under contemplation by the company which owns the structure, the Niagara Railway Arch Bridge Co. C. E. Fowler, New York City, has been retained as engineer.

To Spend $3,000,000 on Buildings for Auto Plant

Announcement has been made by A. R. Erskine, president of the Studebaker Corp., of South Bend, Ind., that the board of directors had authorized the expenditure of $3,000,000 for the erection of new buildings. Construction will begin immediately. It is planned to employ 2,000 additional men before the first of the year.

Making a Plan for New York and Its Environs

Surveys Under N. P. Lewis and Program for Regional Plan Announced By Russell Sage Foundation

At a largely attended meeting of public officials, architects, engineers, city planning experts and others, held at the Auditorium of the Engineering Societies' Building, New York City, on the evening of May 10, called by the trustees of the Russell Sage Foundation, details were given out for the first time of a survey of New York City and its environs in three states that has been under way for a year or more looking forward to a comprehensive regional plan for the district indicated. This survey, together with the further work on the plan itself, is being financed primarily by the Russell Sage Foundation, with assistance from a large number of citizens.

For more than a year past, a physical survey of the district in question has been under way by Nelson P. Lewis, formerly chief engineer of the Board of Estimate and Apportionment, New York City, assisted by a staff of engineers. During this period Mr. Lewis has had the aid and advice, among others, of D. L. Turner, consulting engineer, New York Transit Commission; Benjamin F. Cresson, Jr., chief engineer, Port of New York Authority; Jay Downer, engineer Bronx Parkway Commission, New York City; Morris R. Sherrerd, consulting engineer, Department of Streets and Public Improvements, Newark, N. J.; Frederick L. Olmstead, city planner and landscape architect, Brookline, Mass.; and George C. Whipple, professor of sanitary engineering at Harvard University, Cambridge, Mass., and of Hazen, Whipple & Fuller, civil engineers, New York City.

Committee in Charge

The general direction of the survey and planning work is in charge of a committee appointed by the trustees of the Russell Sage Foundation, which has as its chairman Charles D. Norton, formerly chairman of the Chicago City Plan Commission; as secretary, Frederick P. Keppel, formerly dean of Columbia College and Assistant Secretary of War; as assistant secretary, Flavel Shurtleff, secretary of the National City Planning Conference.

In his address at the meeting last week, chairman Norton said that Mr. Lewis, "with the aid of a special group, including William A. Delano, Jules Guerin, George D. Pratt and Sherman Fairchild," hopes "to develop a new type of map for city planning, in which the painter with his mastery of arrangement and color, will be guided by the accurate contours of the engineer and the new viewpoint of the aerial photographer."

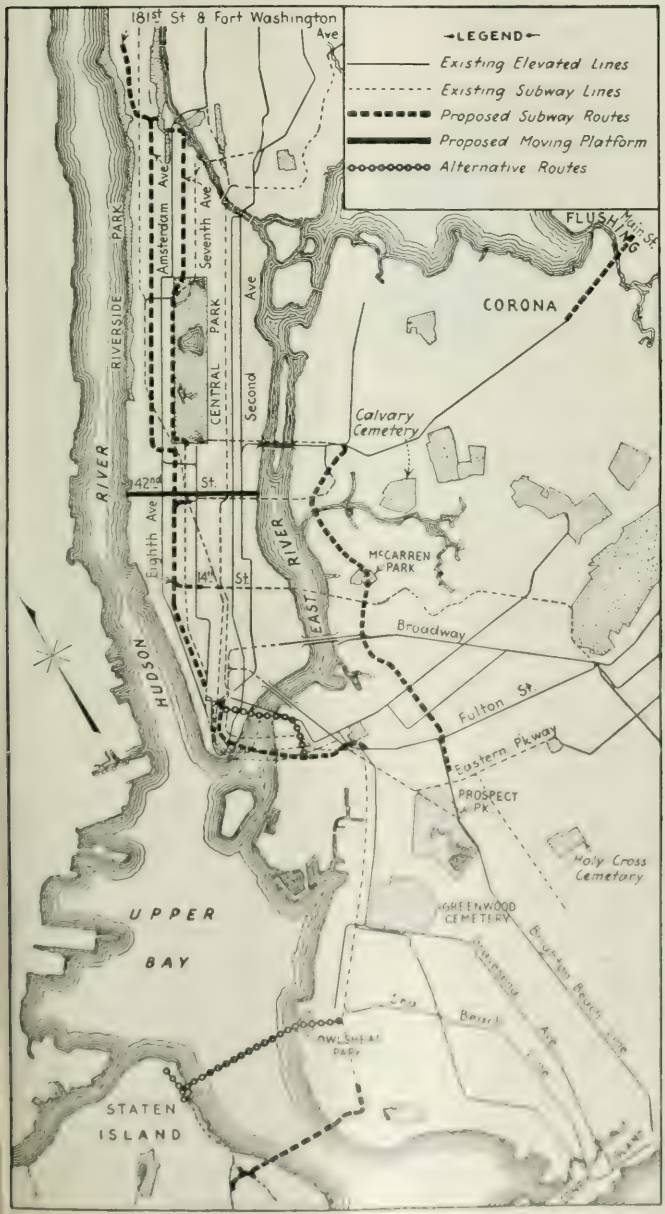
Besides the engineering and physical survey, the studies under way and proposed include a consideration of eco-

(Continued on p 846)

To Vote on $12,800,000 Bonds for Los Angeles Outfall Sewer

Los Angeles, Cal., will vote Aug. 29 on a $12,800,000 bond issue for a new ocean outfall sewer and a sewage-screening plant at Hyperion, instead of Aug. 12, as announced in *Engineering News-Record*, April 13, 1922, p. 618. The city is committed to no particular type of fine screens, according to information received from W. T. Knowlton, engineer of sewers, who also states that the local section of the American Society of Civil Engineers has withdrawn from the report of its committee, abstracted in the issue of this journal mentioned above, all that portion relating to increasing the capacity of the present outfall sewer by using pumps.

Routes Proposed in New York's New Transit Plans



Illegal Election Charged at Road Builders' Meeting

Controversy Over Vote on New Officers and Directors Ends in Adjournment Until June 15

Following charges of illegality in the conduct of the election of officers and directors, the annual meeting of the American Road Builders' Association, held at the Automobile Club of America, New York City, May 15, adjourned, after a heated session, to reconvene June 15 for the purpose of deciding the isues on which no agreement was reached after an entire evening's debate. A deadlock resulted in the attempt of the Board of Direcors to choose a president, the two candidates, Thomas J. Wasser, state highway engineer of New Jersey, and Col. W. D. Uhler, chief engineer of the Pennsylvania Highway Commission, each receiving 14 votes.

The chief controversy, however, involved the election, by letter ballot, of seven new directors. At the beginning of the evening session the president of the association, Col. H. L. Bowlby, of Washington, D. C., announced the election, as directors, of Col. R. Keith Compton, Baltimore; George C. Diehl, Buffalo; H. K. Bishop, Washington; C. P. Fortney, Charleston; W. R. Neel, Atlanta; F. S. Bramley, Cleveland; and Frank Terrace, Seattle.

Protest Made

The foregoing result was immediately protested by Major F. A. Reimer, of East Orange, N. J., on the ground that letter ballots had not been distributed to the membership at least thirty days before the date of the annual meeting as provided for in Chapter 2 of the by-laws of the constitution. Evidence in the form of a postmarked envelope and verbal testimony was produced to support this contention and it was claimed that during the afternoon session E. L. Powers, secretary of the association, had admitted that the sending out of the ballots had been delayed. Col. Bowlby refused to receive the evidence as valid and Mr. Powers, who was seated beside him, volunteered no explanation in reply to the charge that had been made except to say that he was sick when the ballots were mailed and could not specify the date on which they left his office.

Major Reimer then offered a resolution demanding that the report of the tellers be laid upon the table. The motion was duly seconded but the president, in his capacity as presiding officer, refused to put the resolution to a vote. A resolution calling for an appeal from the decision of the chair on this point was made and seconded and on this question, also, Col. Bowlby refused to call for a vote. His point was that the election was legal because, even on the assumption that the ballots went out late, the membership had had ample time to register their choice and ballots had been received and counted from as far west as the Pacific Coast.

Bertrand H. Wait, of New York, emphasized the fact that the delayed issue of the ballot was immediately followed up by an electioneering campaign by Col. Bowlby, who had sent out a letter on the official stationery of the American Road Builders' Association in support of seven candidates for directorships. This action, Mr. Wait maintained, took an unfair advantage

of those desiring to support other candidates and left them insufficient time in which to organize effective support for another ticket.

The meeting by this time had divided into two factions and an acrid debate followed. A point was reached where a resolution was offered and seconded, but not voted upon, calling for an appropriation of $2,500 of the association's funds to pay for court proceedings and counsel fees. The discussion closed with neither side making concessions and presumably the question of fact as to the date of sending out from the secretary's office the ballots for the vote on directors will be investigated between now and June 15 and reported on at the adjourned meeting on the latter date.

VOTE FOR OFFICERS

On the other point, relating to the vote of the directors for officers, resulting in the tie between Mr. Wasser, the nominating committee's choice, and Col. Uhler, whose name had been written in on the ballots cast for him, it was charged that the vote of at least one director, which had been sent by mail, had not been received and recorded.

As vice-presidents of the association, the directors elected F. E. Everett, for the Northeastern District; Frank Page, for the Southern District; J. Frank Smith for the Central District; and Samuel Hill for the western district. For secretary the directors cast 15 votes for E. L. Powers, the present incumbent, and 12 votes for Charles M. Upham, state highway engineer of North Carolina. J. H. McDonald, of Connecticut, was re-elected treasurer.

The combination of circumstances involving the protest of the election of directors and the tie vote for president by the Board of Directors, presents a complicated issue. Mr. Wasser is at present a director, with his term of office expiring with this year's annual meeting. The constitution provides that the president must be chosen from among the membership of the Board of Directors. If, as Col. Bowlby held, the annual meeting cannot legally be adjourned until June 15, Mr. Wasser's term of office as a director automatically ceases and he therefore becomes ineligible as a candidate for president at a subsequent voting by the directors.

At the afternoon session a resolution was passed calling for an audit of the finances of the association, following a complaint that the reports of the secretary and treasurer had not been printed and sent to the members of the association at least ten days before the annual meeting, as required by section 5, chapter 3 of the by-laws of the constitution. In reply to a query as to why this provision had not been carried out, Secretary Powers answered that "it had become a dead letter."

This is the first time in the association's history that the annual meeting has been adjourned to a later date. A decision on the protested election of officers and directors is looked for at the June 15 meeting.

Boston Sells 4-Per Cent Bonds

Another notable break below the 4 per cent yield point for municipal bonds was recorded last week when Boston sold $1,233,000 of 4 per cent bonds at a premium. It is reported that the market rate will yield 3.85.

Discuss Window Protection and Special Fire Hazards

National Fire Protection Association Holds Meeting at Atlantic City May 9-11.

A round-table discussion of window protection for office buildings, stimulated by the fire which destroyed the upper half of the Burlington building in Chicago March 15, was the outstanding feature of interest at the annual meeting of the National Fire Protection Association, held at Atlantic City, May 9 to 11. The discussion, summarized on another page of this issue, gave emphasis to exposure-fire hazards.

The value of wire glass was given due credit, for example, in the statement that the Burlington building might have been saved if it had been equipped with wire glass on its north and east fronts. Protection additional to wire glass was considered to be necessary, however. Automatic rolling shutters such as are being applied by the American Telephone & Telegraph Co. to its exchange buildings were given high praise. Outside sprinklers which, when operated by heat, discharge a spray that runs down the outside of the exposed window, were also described as effective protection. Several cases of protection by automatic sprinklers inside the building were cited.

REPORTS EXTENSIVE

Automatic sprinklers, tanks, inflammable gases and inflammable liquids were the subject of extensive reports. Some amendments to the rules governing automatic sprinklers included one requiring dry-pipe systems to be kept dry instead of being operated as wet pipe systems in the summer months. New specifications for tanks were presented and finally adopted; they are a unification of the heretofore differing specifications of the association and the Associated Mutuals.

In the subject of gases, new rules for internal-combustion engines and producers were presented, amending the old rules. These also were finally adopted. Rules for acetylene systems and for acetylene compressing plants were presented by the same committee. Those for acetylene systems were referred to the executive committee to consider the relation of the rules to patented devices. The rules for compressing plants were continued as tentative. A refrigeration safety code was also offered in tentative form.

In the subject of inflammable liquids, the regulations for fuel oil plants were amended, an important change permitting electric preheating. Specifications for concrete fuel-oil tanks drawn in co-operation with the American Concrete Institute were finally adopted; these apply to heavy oils (35 Beaumé or heavier), including gas oil. Regulations were adopted also for oil-burning equipment for domestic use, these represented no important change from a tentative draft presented last year. As a wholly new item, a recommendation as to freeing oil tanks of vapors before entering was adopted.

Dust-explosion hazards are to be studied by a committee headed by D. J. Price; the work of this committee has only just been started. Another new committee has just been organized to deal with storage of combustible fibers, headed by R. P. Strong of the Louisiana Fire Protection Bureau.

Rules for the storage and handling of pyroxylin plastics, presented in tentative form last year, were finally adopted at this meeting. Reports were presented by the electrical committee, the signalling committee and others.

Two classes of buildings were the subject of work by the committee on building construction (ch., I. H. Woolson) during the past year. Class E office buildings (joisted brick construction), and frame dwelling houses. The latter contain no engineering rules but simply call for loads and stresses in accordance with good practice; on the subject of fire protection and suitable construction therefor they are unusually complete and practical. Suggested changes and additions, covering provision of roof scuttles, extinguishers and sprinklers (the latter over furnaces), and a more rigid requirement for roof coverings, will be considered by the committee later. The meeting adopted the specifications without change as tentative.

Dr. Henry Marion Howe

Dr. Henry M. Howe, professor emeritus of metallurgy at Columbia University, past-president and honorary member of the American Society for Testing Materials, and, during the World War, chairman of the engineering division of the National Research Council, died May 14 at his home in Bedford Hills, N. Y., in his seventy-fifth year. He was a leader in the science of metallography both in this country and abroad and his distinction brought recognition not only from his own country, where he was awarded the Fritz medal in 1917, but also formal honors from England, France, Russia, Germany and Sweden. In 1912 he was president of the International Association for Testing Materials and presided at the triennial meeting held that year in New York City.

Dr. Howe was graduated from the Boston Latin School in 1865, and from Harvard University in 1869, receiving from the latter institution a B.A. degree. Two years later he received the equivalent of a B.S. degree from the Massachusetts Institute of Technology. Harvard made him a Master of Arts in 1872 and a Doctor of Laws in 1905. After graduation he was identified with steel and copper works both in this country and Canada, and in 1883 he entered private practice in Boston as a consulting metallurgist. In 1897 he was made professor of metallurgy at Columbia University, a position which he held until his retirement in 1913.

His war work had to do largely with investigations into the making of gun steel, and due to his concentration on the subject of its metallurgy he was able to have reduced, to a large extent, the rejections in this class of ordnance that prevailed early in the United States' participation.

Dr. Howe was the author of many books on his specialty and was a frequent contributor to the proceedings of the technical societies. One of his chief contributions was a remarkable paper on the structure of steel which was read at the 1911 meeting of the American Society for Testing Materials.

He was a son of Julia Ward Howe, author of the "Battle Hymn of the Republic."

Canada Centralizes Control of Government-Owned Railways

Establishment of a single representative board of directors for the unified control of the government-owned lines has been announced by the Hon. W. C. Kennedy, Canadian Minister of Railways, as the first step in carrying out the government policy of reorganization. Under this new board will come the Grand Trunk properties, the Canadian Northern Ry., the Grand Trunk Pacific Ry., the Transcontinental Ry., and the Intercolonial and Prince Edward Island Ry. and branch lines. The minister stated that he was not in position to announce the personnel of the new board.

On the advice and recommendation of this board will depend the division of the unified system into operating units with regional headquarters. The aim of the management will be centralization of general direction and control and decentralization in local detail.

Want New Bid on Water-Works Dam for Columbus, Ohio

Due to the refusal of the lowest bidder to sign the contract awarded for the O'Shaughnessy dam for the water-works of Columbus, Ohio, new bids have been invited by the director of public service, to be opened on May 25. The contractor has sued to recover his certified check of $100,000.

The lowest of the 12 bids received for this work on April 20 was $1,001,616 from the Columbus Construction Co. The next highest bid was $1,115,119 from Thompson-Starrett Co., New York City. In all, there were seven bids below the engineers' estimate, which was $1,375,000. (Seen Construction News, this issue, for details.) C. B. Hoover is engineer in charge of the Columbus Bureau of Water-Works Extension, and Prof. John H. Gregory of Johns Hopkins University, Baltimore, Md., is consulting engineer.

The lower bidder claimed that he had made three errors in his bid, totaling about $73,500. He admitted on the stand that after allowing for the errors he would have a profit of $20,000 to $25,000, but urged that the margin was too small for so large a contract. The errors claimed were: (1) Sand figured at $1.60 per cu.yd. instead of the same unit price per ton, making a difference of $27,000; (2) on cement for concrete, an arithmetical error of 49c. per yard on 48,000 cu.yd., totaling $23,500; (3) overhead of $5,750 per month figured on only 20 months when it should have been 24, totaling $23,000.

The O'Shaughnessy dam is to be built across the Scioto River about 16 miles north of Columbus. It will be (1) an overfall masonry structure with a maximum height of about 70 ft. and a length of about 1,000 ft., including abutments flanked (2) on either side by earth embankments, making a total dam length of about 1,500 ft. There will be a roadway on top of the structure, carried across the overfall section on a 12-span reinforced-concrete arch bridge. Built into the masonry portion of the dam will be an outlet gate chamber, a power chamber and a pavillion. Down stream from the dam a spillway channel will be built to carry flood waters. The contract will also include about 5,400 ft. of new highway adjacent to the dam.

The Engineer in Public Life

While engineers, as a class, have been charged with neglect of public responsibilities, individual members of the profession have engaged in public service of a non-engineering character. "Engineering News-Record" is recording their activities in this series of biographical sketches.—EDITOR.

GEORGE C. DIEHL

In its selection of executive officers the American Automobile Association, this year, chose a civil engineer, George C. Diehl, of Buffalo, N. Y., as its president. For years Mr. Diehl has been a prominent figure in the good roads movement, and in addition to his consulting practice, he has served as county superintendent of highways of Erie County, N. Y., as engineer of many towns and villages in Western New York State, and as commissioner of Allegany State Park. He is a graduate of Rensselaer Polytechnic Institute, class of 1894.



Mr. Diehl has been prominent in a number of Buffalo activities. He is a past-president of the Buffalo Automobile Club and of the Buffalo Rotary Club, and served fifteen years in the National Guard of New York State with the various ranks up to that of major. He has been a member of many city and state boards and committees of the Buffalo Chamber of Commerce and other civic organizations. He has worked continually for the interests of boys and has served as chairman of the Boys Work Committee of the Y. M. C. A. in Buffalo and also as a member of the Boy Scout Council.

Flood Conditions at Dallas Halt Traffic

For the second time within two weeks, heavy rains have precipitated flood conditions in and around Dallas, Texas, menacing street car lines and cutting off steam and interurban traffic temporarily. The Trinity River, ordinarily a small sluggish stream dividing Dallas and Oak Cliff, a populous suburb, rose from 12.5 ft. at 7 a.m., May 8, to 41.6 ft. at 3 p.m., May 9. This flood crest is 0.7 ft. lower than the flood two weeks ago. Travel by railroad, interurban and highway has been paralyzed by destruction of bridges in every direction except to the north. However, as none of the bridges washed away was of unusual length through connections were quickly restored.

City Engineer George Fairtrace reports that six streets paved with wood blocks were made impassable in some sections and all streets of this type were damaged to some extent, due to the blocks buckling. All breaks will be repaired with brick as has been the custom for several years past.

A feature of the floods during the past two weeks has been the delivery of newspapers, mail and movie films by airplane.

Muscle Shoals Power Commonly Over-Estimated

In a paper read at the spring meeting of the American Society of Mechanical Engineers at Atlanta May 8 to 11, Charles G. Adsit, executive engineer, Georgia Railway & Power Co., says that the amount of available power at Muscle Shoals on the Tennessee River is much exaggerated in the published reports. He says that the greatest fluctuation in any stream in the Southeast probably occurs in the Tennessee River.

The government in planning the development at Muscle Shoals recognized this fact and contemplated an installation of 400,000 kw., only a portion of which can be depended upon for continuous power. In accordance with the hydrograph of the river at this point the amount of strictly primary power at Muscle Shoals averages 60,000 hp. and even this figure is based on the assistance of some steam capacity which must be maintained. The contemplated capacity of 400,000 kw. could be operated at full load only at widely separated intervals since the river does not equal this amount of power except on an average of less than thirty consecutive days per year. In 1904, for instance, the river flow curves show that at dam No. 2 (the Wilson dam) the flow would have produced only approximately 50,000 kw. for a large part of the year, while for the maximum of the year for a large part of the time the flow falls below 200,000 kw. A study of the hydrographs for a typical period show that the continuous output that can be depended upon throughout average years is in the neighborhood of 100,000 kw. Mr. Adsit says "It can be seen that the statement of 1,000,000 hp. which has appeared in the press repeatedly is a gross exaggeration of the output to be expected from the plant at this location."

Cleveland Business Men Oppose St. Lawrence Waterway

A committee of bankers, lawyers, and business men of the Cleveland Chamber of Commerce has reported against the St. Lawrence waterway project. In its report the committee declares that that "the financial condition of the country does not warrant the expenditure of the large sums that must be involved in the completion of the project," and expresses doubt that it can ever justify the expense.

New Power and Irrigation Project Near San Diego

Contract was awarded May 1 to Bent Brothers of Los Angeles for the construction of a dam on the San Louis Rey River in San Diego County, Cal., which is to cost $750,000 and which is the first step in a proposed $6,000,000 power and irrigation project. The project is to be carried out by the San Diego County Water Co. which is allied with the Santa Fe Ry. Co. Two other dams on the San Dieguito River are proposed for later construction. The plan is to store water for domestic purposes in the city of San Diego, for the development of power and for the irrigation, ultimately, of about 50,000 acres of land.

Federal-Aid Road Bill in Legislative Jam

House Instructs Conferees to Insist On Its Measure—Senate Has Different Views

(*Washington Correspondence*)

By a formal vote May 13 the House of Representatives instructed its conferees considering the postoffice appropriation bill to insist upon the highway bill passed by the House recently. This action means that the conferees will attempt to work out a compromise between the Senate highway proposition, which was put on the postoffice appropriation bill as a rider, and the bill as passed by the House.

Highway legislation, therefore, again is caught in a parliamentary jam, for the Senate Committee on Postoffices and Post Roads insists that the rider on the postoffice appropriation bill should prevail. It is believed the House will refuse to accept highway legislation as a rider on an appropriation bill.

The position of the House is that it has passed the highway bill which is now before the Senate committee. If it is not satisfactory to the Senate committee, it is pointed out that the measure may be amended as it sees fit. The differences then can be threshed out in conference. This contention would be stronger if an actual appropriation were made by the House bill. Instead it simply authorizes an appropriation and it is feared that much delay will ensue before the actual money is voted. On the other hand, the postoffice appropriation bill carries the actual money.

Differ on Cost Per Mile

There is very determined opposition in the Senate to any reduction in the existing maximum which the Federal Government many contribute. It is contended that the Federal Government should be willing to contribute as much as $20,000 per mile for primary roads since its is interested in having high class, interstate highways. By reducing the maximum to $12,500 during the next fiscal year and after that to $10,000 per mile, many states will not undertake to build the roads because they cannot construct a durable road meeting federal requirements for $20,000 or $25,000 per mile. Since the states must maintain these roads for all times to come, they will be insistent that the road be of a substantial character to start with.

Senator Pittman has introduced an amendment to the House bill excepting from the limitation of payment all roads included in the 7-per cent interstate system. In another amendment he provides that the limitation of payments shall not apply to those public land states containing unappropriated public lands exceeding 50 per cent of the total area of all lands in the state under consideration.

Votes Funds for Narrows Tunnel

The Board of Estimate and Apportionment of New York City has approved the plan for a joint freight and passenger tunnel connecting Brooklyn and Staten Island as described in *Engineering News-Record*, April 13, 1922, p. 626, and has appropriated $580,000 for engineering expenses. Application will be made for the consent of the Secretary of War to the crossing under the navigable waters of the Narrows.

Hurley and Goethals Testify at Cement Trial

Trade-Association Activities Discussed From Many Angles—Economics Professor Also Witness

The influence that the Federal Trade Commission might have had on the organization and activities of trade associations in general was told last week by Edward N. Hurley, former chairman of that body as well as of the U. S. Shipping Board, when called as a defense witness in the criminal trial of cement manufacturers of the Eastern district before Federal Judge Knox and a jury in New York City. Other prominent witnesses called by the defense included Major General George W. Goethals, U. S. Army, retired, now a consulting engineer in New York City; Dr. Thomas Sewell Adams, professor of economics at Yale University, and John P. Fernsler, a public accountant long connected with the Department of Justice.

Hurley's Testimony

Outstanding in the testimony of Mr. Hurley was his assertion, born out by documentary evidence, that, upon the invitation of John R. Morron, president of the Atlas Portland Cement Co., he had addressed members of the Portland Cement Association, including some of the present defendants, in May, 1916, upon the necessity of the government's securing adequate industrial and commercial data from the manufacturers of the country. To that end the Federal Trade Association had sent broadcast a questionnaire, securing such information as aggregate capital stock, bonded and other indebtedness, accumulated surplus or earnings invested in the business, net sales and net profits. With such information it was believed possible to diagnose business troubles, and the Federal Trade Commission stood ready to offer remedies. That commission, Mr. Hurley said in his speech before the Portland Cement Association, was endeavoring to secure more uniform and better methods of cost accounting, indorsing standard systems of bookkeeping, improving conditions among the employees, etc. He also said that "trade associations that are putting forth a special effort to improve their systems of cost accounting, bettering their processes of manufacturing, obtaining credit information and endeavoring to improve the welfare of their employees will be important factors in our country's development in the next few years."

The testimony of General Goethals was largely in connection with bids received and contracts executed for furnishing about 5,000,000 bbl. of cement used in the construction of the Panama Canal. The apparent reason for his testimony was an endeavor to establish the fact that competition to secure such a large contract was most keen, and that the transaction was entirely reasonable from the government's standpoint.

The defense sought, through his expert testimony, to establish the fact that whenever competition in marketing a product was most keen there was a strong tendency toward uniformity of prices and merchandising methods, a principle that Dr. Adams often enunciated. However, he asserted that though that tendency toward uniformity of price was present it did not necessarily indicate that competition alone would produce such a condition.

Dr. Adams also testified to the fact that a minimum average return for industrial concerns on capital stock would be 12 per cent per annum. This figure would allow, he asserted, a distribution of eight per cent to stockholders that would both keep the capital stock at near par value and also aid in the flotation of new bond issues which might be needed for expansions.

Through Mr. Fernsler the defense introduced numerous charts such as those showing the actual prices received by the defendant mills over the 1913-1921 period as against the mill bases compiled by government statisticians, total net earnings (federal income tax deducted) of the defendant companies over the same period, etc. In one of these charts he showed that the average income in per cent of gross receipts of all the defendant companies was, for the following years: 1913, 12.47 per cent; 1914, 14.39 per cent; 1915, 3.5 per cent; 1916, 15.66 per cent; 1917, 8 per cent; 1918, 5.5 per cent; 1919, 10.41 per cent; 1920, 5.18 per cent, and 1921, 5.01 per cent.

Mr. Hurley had testified previously to the fact that during his investigation of business conditions while chairman of the Federal Trade Commission a general net return on capital stock for all business would not average three per cent over a five year period, whereas he considered fifteen per cent not unreasonable.

Regional Plan for New York

(*Concluded from p. 842*)

nomic and industrial, legal, social and living condition problems. The committee of the Russell Sage Foundation, Mr. Norton stated, proposes "no abnormal expansion of public expenditure," but believes that "with a wisely conceived plan public funds which will be expended in any event can be directed into projects of permanent constructive value," while "without a plan millions are likely to be wasted in desultory or ill-considered public work."

Immediately after the conclusion of the explanatory address by Mr. Norton, Secretary Herbert Hoover arrived and was greeted by applause and the rising of the whole audience. His remarks are given elsewhere in this issue. Brig. Gen. John J. Carty, vice-president the American Telegraph & Telephone Co., noted telephone engineer, dwelt on the value of surveys and plans for telephone service in various cities of the country that have been made under his direction during the past thirty years. Elihu Root laid stress upon the fact that a city is a growth, responding to conditions not wholly political or economic — particularly to the needs of the various individuals who make up the city.

New York Mayors To Confer

At the thirteenth annual conference of mayors and other city officials of New York State to be held at Poughkeepsie, N. Y., June 6 to 8, there will be sectional meetings for city engineers, health officers, purchasing agents and various other classes of officials in the administrative branches of city government. The city engineers will meet on the morning and afternoon of Wednesday, June 7.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Annual Convention, Salt Lake City, Utah, June 5-7.

NATIONAL CONFERENCE ON CITY PLANNING, Boston, Mass.; Annual Meeting, Springfield, Mass., June 5-7.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Annual Convention, Portsmouth, N. H., June 21-22.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, University of Pittsburgh; Annual Convention, University of Illinois, June 20-23.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual Meeting, Atlantic City, N. J., June 26-30.

PERSONAL NOTES

FRANK R. ALLEN has been appointed city engineer of Pine Bluff, Ark., succeeding J. H. Guest, resigned.

JAMES R. POLLOCK has resigned as assistant city engineer of Flint, Mich.

S. C. LIGGETT has been appointed assistant to T. F. LOUGHBOROUGH, district engineer for the Virginia State Highway Commission with headquarters at Staunton, Va. Mr. Liggett was formerly resident engineer in charge of state-aid work with headquarters at Richmond, Va. The new position is the result of recent reorganization which abolished resident engineers offices for both state and state-aid work and created eight districts with a district engineer in charge of all state and state-aid work in his district.

F. W. ULLIUS, JR., who has been village engineer of Shorewood, Wis., for nine years, has been appointed city planning engineer of Milwaukee, Wis., succeeding R. E. STOELTING, recently appointed commissioner of public works.

EDOUARD DE MEY, formerly chief engineer of Toupet, Beil & Conley, Inc., Pittsburgh, Pa., announces the severance of that connection and the formation of the firm of Conley & De Mey, contracting engineers, Pittsburgh, Pa. F. G. Conley, senior member of the new firm, was formerly secretary and treasurer of Toupet, Beil & Conley.

F. H. RICHARDSON has resigned as assistant engineer, Washington State Highway Department, to become field engineer with the Portland Cement Association, headquarters at Spokane, Wash.

FRED HORNSKOHL, JR., formerly designing engineer with the Lehr Construction Co., St. Joseph, Mo., has become designing engineer with Charles W. Shaver, Salina, Kan.

J. T. MARTIN, formerly water commissioner of Cleveland, Ohio, has become associated with the Frazer-Ellms-Sheal Co., engineers, Cleveland, as vice-president and treasurer.

JOHN G. HIRSCH, formerly supervising engineer for Lockwood, Greene & Co., Chicago, Ill., and for Stone & Webster, Boston, Mass., has become associated with the Benham Engineering Co., consulting engineers, Kansas City, Mo., as principal assistant engineer.

MURRAY SULLIVAN, general manager of the Chinese Engineering & Development Co., Peking, China, has resigned and will return to America in June.

JOHN KERWIN, superintendent of tracks for the Detroit United Railway, who has been with the company for thirty years, will shortly retire to private life. Mr. Kerwin is the patentee of several labor saving devices, among them the Kerwin portable crossover, the Kirwin rail grinder and a railway tie which has been successfully used on the Detroit United Railway for the past two years.

G. E. WRIGHT, formerly assistant engineer with the city engineering department of Bridgeport, Conn., is now engaged in a similar capacity at Gloversville, N. Y.

COLONEL S. W. FLEMING, JR., of Gannett, Seelye & Fleming, Inc., Harrisburg, Pa., who is a member of the Pennsylvania French and Belgian Battlefield Commission, will spend two months making a thorough study of the battlefields in both countries.

OLAF HOFF has been appointed consulting engineer of the bridge to be built by the New York Central & Hudson River R.R. across the Hudson River near Castleton, and also of the bridge across the Niagara Gorge to be built by the Michigan Central R.R.

E. E. MAYO, formerly division engineer for the Southern Pacific Co., with Headquarters at Portland, Ore., has been transferred to the same position on the Sacramento division, with headquarters at Sacramento.

JOHN MCCLEARY, Jr., who for the past ten years has been contracting engineer for the Virginia Bridge & Iron Co., with headquarters at Memphis, Tenn., has been made manager of the new plant for the company at Birmingham, Ala.

WALTER C. RUSSELL, sanitary engineer of Flint, Mich., has resigned and will accept a similar position with the city of Richmond, Va.

JAMES R. POLLACK, assistant city engineer of Flint, Mich., has resigned.

EVERETT W. NICE, formerly construction engineer of the Dort Motor Co., has been appointed city engineer of Flint, Mich., succeeding E. C. Shoecraft, resigned.

STEPHEN KEARNEY, who has been city engineer of Lowell, Mass., since 1911, has tendered his resignation [illegible] May 15.

OBITUARY

IGNACIO M. DE VARONA, who [illegible] ago as chief engineer of the Department of Water Supply, Gas & Electricity, New York City, [illegible] years in the service of the city, died in New York, May 12. He was born in Cuba in 1842 and graduated from the Rensselaer Polytechnic Institute in 1863. In 1882 he began the extension of the Brooklyn waterworks. In 1904 he installed a high-pressure fire system in Brooklyn and later in Manhattan. He also prepared the plans for utilizing the Catskill water supply after delivery into the mains of the city's distribution system.

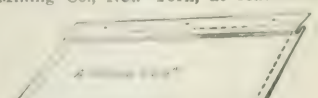
A. M. LOVIS, until a year ago first assistant engineer of the highway division of the Massachusetts Department of Public Works, died recently after a lingering illness. Mr. Lovis was a graduate of the Massachusetts Institute of Technology and subsequently worked on the relocation of the old Vermont & Massachusetts R.R., which is now the new Fitchburg Division of the Boston & Maine R.R. He entered the service of the State of Massachusetts in 1895.

COLONEL CLEMENT A. F. FLAGLER, commanding officer of the Eastern Division of the Corps of Engineers, U. S. A., with headquarters in Baltimore, died May 7 at Johns Hopkins Hospital, Baltimore, following an illness of three weeks. Col. Flagler was 54 years old. He was a native of Georgia and was the son of Gen. D. W. Flagler, Chief of Ordnance. He was a graduate of Griswold College, the United States Military Academy, the Engineering School of Application and the Army War College. In 1919 he was commandant of the Engineer School at Camp Humphreys. During the early part of the war he went abroad with the American forces. He was a member of the Board of Engineers for Rivers and Harbors. During the World War Col. Flagler, with rank of brigadier-general, commanded the Fifth Artillery Brigade and was Chief of Artillery for the Third Army Corps during the Meuse-Argonne offensive. He was promoted to be major general, commanding the 42d Division, and during the occupation of Germany was military governor of the Ahrweiler district.

EQUIPMENT AND MATERIALS

Copper Shingles

Copper shingles and other roofing units, such as ridge and valley flashings, verges and eaves starters, are being produced by the Anaconda Copper Mining Co., New York, at reasonable



costs by using a special thinly rolled copper made up in units which permit economical installation. By making the shingle with thickened butts and in moderate sizes the appearance of the roof is improved. Several colors are also available. It is announced that by manufacturing in standard sizes, simplified packing and transportation and provision for rapid application the cost of copper roofing is brought down to a level where it is available for ordinary residence construction.

Business Side of Construction

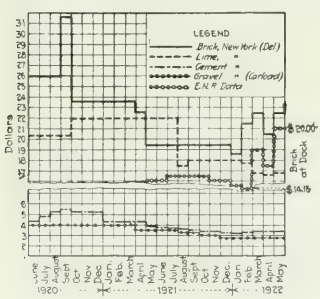
Facts and Events that Affect Cost and Volume

Brick Prices are Climbing Toward 1920 Peak

Price at New York Dock and on the Job—Record Gain of $5 in Last Five Months

That brick prices are climbing to peak quotations of 1920 is evidenced in this week's review of the brick market conditions and a general survey of *Engineering News-Record's* prices for the last three years. Curtailed production or natural shortage, with unprecedented demand, form the basis for the price boosting of recent weeks. The quotation of $20 for Hudson River common brick, wholesale, stands out in interesting comparison with the quotation of $15 per 1,000, alongside dock, New York, which prevailed throughout the last eight months of 1921.

Stiffened tendency of building materials prices has taken the brick market practically out of control, it is pointed out. With the total amount of brick burned available throughout the whole country on Apr. 1, at 60,000,000 less than the number on hand on Mar. 1, and orders increasing on the books in one month from 167,000,000 to 197,000,000, the present unprecedented construction program forces an embarrassing situation. This shortage, thus far, has been acutely felt in Boston and New York, while other districts are only beginning to feel the pinch.



BRICK SINCE PEAK COMPARED WITH OTHER MATERIALS

Spurred on by the growing demand for the product of their labors, the brick makers went on strike in two of the most vital centers of production. The Raritan district strike, however, was quickly adjusted by a 10 per cent advance in wages. In the Haverstraw center of the Hudson River district, where 1,400 brick makers are now on strike, conditions are unfavorable. Workers in this district demand an increase of $1, making the average pay $4.50 as against the present wage of $3.50.

Manufacturers state that the shortage is caused by labor troubles but the question arises as to whether the condition is naturally or artificially produced. Samuel Untermyer, chief counsel to the Lockwood Joint Legislative Housing Committee, believes that the dealers are not responsible for the brick shortage but charges the responsibility to the manufacturers. He has stated that the yards are not being operated to any thing like their capacity and that work was not started sufficiently early to accumulate adequate stocks before the yards closed for the winter months. Accordingly, the Lockwood Committee has requested Congress to provide emergency tariff regulations permitting the importation of foreign building materials into the United States. Imported common brick, for instance, under the proposed provision, could be sold at $14 per 1,000 alongside dock, New York. The present tariff is 10 per cent ad valorem.

Brick prices reached the highest point in Sept., 1920, quotations then being as high as $30.75 per 1,000 delivered on the job in New York City. Prices then dropped to $22.70, then to $21.70 during the second quarter of 1921, finally reaching a fairly stable basis of $18.40, in effect from May to Dec., 1921. Early in Jan., 1922, prices dropped to $17.40, rising again to $20.40 in Feb. and $21.40 in Mar., 1922. Apr. quotations dropped to $19.40 but have since risen with the increased demand to the present basis of $23.40 per 1,000 delivered. A margin of $3.40, comprising the cost of handling, haulage ($1.40@$1.50) and 10 per cent, realized by the dealers, leaves a price of $20 wholesale, alongside dock.

Dealers claim that profiteering cannot be justly charged to them, having added the $3.40 to the wholesale price they allow the blame to rest where it may.

Financial Paragraphs

Cost of money last week showed call loans at 3½@4½; time loans at 4¼. The previous week call was 3½@5; time at 4¼@4½.

Foreign trade figures for exports in March were $332,000,000 compared with $386,680,346 in 1921; imports $258,000,000 compared with 251,969,241 in 1921.

Gross railroad earnings for the first week in May for nine roads were $7,283,537 compared to $7,119,471 for the corresponding period of 1921.

Cement Up in the East

Higher-prices of coal has caused a general advance of cement in the East—20c. in the Lehigh Valley district, and 10c. per bbl. in the Hudson district. The new quotations to dealers (10c. more to contractors) are: $1.80 per bbl., without bags, in the Valley; $1.90 at Hudson, N. Y. Price alongside dock, New York, to dealers is $2.50 including bags, $2.10 net. Coal which cost $2 per ton at the mines, on contract, costs about $4 spot at present, and about 200 lb. of coal are required to produce a barrel of cement.

Week's Failures Fewer

Business failures were fewer this week as compared with that of last week, according to Dun's statistics. This week there were 408 insolvencies reported, while last week there were 491, and during the corresponding week in 1921, 333 defaults were shown.

The country's business mortality, as measured by Dun's insolvency statistics continues much above the average, but there has been an irregular reduction in number of failures during recent months. The April total of 2,167 is about 12 per cent below that of March and discloses a decrease of fully 20 per cent from the 2,723 defaults of January of this year, which was the highest point reached since the beginning of 1915.

Freight Loadings Gained 44,198 Cars in Week

A total of 758,286 cars of revenue freight were loaded during the week ended Saturday, April 29, showing a gain of 44,198 cars over the previous week, according to statistics compiled by the Car Service Division of the American Railway Association. Compared with the corresponding week in 1921, it is an increase of 43,590 cars but a decrease of 22,509 cars compared with the same week in 1920.

Although this is the fourth week of the coal miners' strike, the loading of all commodities has increased. Forest products increased 3,253 cars, and ore, 4,283 cars, the largest gains made in these commodities for some weeks past.

Serviceable surplus freight cars for the week ended Apr. 30 total 371,538, a decrease of 226 from the previous week. Classified, 94,653 were box cars, and 235,077 coal cars, balance miscellaneous.

SURPLUS AND SHORTAGE STATEMENT - APRIL 23 TO 30, 1922

Districts	Flat Cars — Surplus	Flat Cars — Shortage	All Box Cars — Surplus	All Box Cars — Shortage	All Coal Cars — Surplus	All Coal Cars — Shortage	Total All Cars — Surplus	Total All Cars — Shortage
Eastern	1,343	15	16,258	221	87,602		110,188	236
Allegheny	492		13,262		104,206		121,702	0
Pocahontas	157	54	814	91	4,415		6,353	0
Southern	2,513	15	9,122		7,945	324	23,699	474
North Western	873		22,651	55	2,813		31,846	15
Central Western	1,085		23,234	2	24,605	50	61,908	115
South Western	609		9,312		3,451		15,842	2
Total	7,077	84	94,653	369	235,077	374	371,538	842
Canadian Roads	2,085		28,035		1,710		38,665	0
Grand total	9,162	84	122,688	369	236,787	374	410,203	842
April 23, 1922	10,568	78	123,541	161	231,722	74	407,834	343

Steel Optimism by Gary

"Employment is always an indication of the business pulse of a nation," says Judge Elbert H. Gary, Chairman of the United States Steel Corp., interviewed by a New York newspaper. "Already we are beginning to feel a pinch in labor supply. This is essentially true of unskilled labor. . . . Iron and steel, it is said, are the barometers of the nation's business. Today the outlook in this industry is better than it has been since the early part of 1921 when the business boom following upon the close of the war collapsed. That boom, as is now appreciated, was unhealthy, built of the stuff that the war fever nurtured. The year 1922, it is my belief, will be a very great improvement on 1921 and very greatly superior, from the business point of view, to 1920. Today manufacturers of iron and steel report that they are selling more than double the quantity that they sold six months ago."

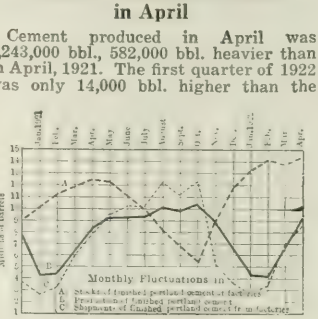
Building Construction on Pacific Coast at High-Water Mark

In the seven Pacific States constituting the Twelfth Federal Reserve District the value of building for which permits were issued in the month of March, 1922, was the largest ever recorded in an equal period, according to a report by John Perrin, chairman of the board, Federal Reserve Bank, San Francisco. March permits represented a value of $27,432,286, or 17 per cent more than October, 1921, the previous record month, and 47 per cent more than March, 1921.

In the first four months of this year San Francisco building construction reached a total value of $15,642,940. The city's total for the entire twelve months preceding was $22,244,672.

Cement Production Gained in April

Cement produced in April was 9,243,000 bbl., 582,000 bbl. heavier than in April, 1921. The first quarter of 1922 was only 14,000 bbl. higher than the



corresponding period of 1921. The chart shows the trend of production, shipments and stocks.

Bank Clearings Gain

In common with some other statistical barometers, records of bank clearings reflect the improvement in general business. Recent monthly exhibits have disclosed a widening margin of increase over last year's clearings, and the April gain at 110 cities in the United States is 12.4 per cent, according to Dun's statistics.

Heaviest Car Orders in Years

Against a possible car shortage, it is recorded that better than 31,000 freight cars were ordered during the month of April which marks the heaviest buying period of this character in years. Orders placed in April increases the total number of cars awarded this year to date to over 70,000.

Largest April Public Bond Sales Since 1893

Long-term municipal bonds sold during April aggregated $130,920,098, an amount in excess of any corresponding April total in the last thirty years; according to records of the *Commercial and Financial Chronicle*. March totals reached $117,072,378; sales for April, 1921, amounted to $86,691,392. The largest previous April figure was $103,224,074, in 1914, while the lowest recorded was $3,570,963 for April, 1898.

The largest issue for April, 1922, was $45,000,000 New York City 4½s gold corporate stock, sold to Speyer & Co. for 102.766, or a basis of 4.119 per cent. Among the most important issues in April were: North Carolina, $6,000,000 4½s at 100.10, a basis of about 4.49; Illinois, $6,000,000 4s at 98.875, a basis of 4.11; Ohio, $5,000,000 4½s at 101.76601, a basis of about 4.14; Newark, N. J., $3,503,000 4½s, or a basis of 4.25 per cent; Providence, R. I., $2,000,000 4s at 98.97, a basis of 4.05; St. Louis County, Minn., $1,500,000 5s at 103.2279, a basis of 4.55; South Dakota, $1,000,000 4½s at 101, a basis of about 4.63 per cent.

Short-term securities issued in April aggregated $37,965,000. A total of 471 municipalities issued permanent bonds during April, 1922, as against 463 in March, 1922, and 539 for April, 1921. Although the number of municipalities emitting permanent bond issues was over 12 per cent fewer, the total value of sales was 51 per cent higher in April, 1922, than for the corresponding month in 1921.

Of our list of thirty-seven representative issues thirty sold above par and three at par, the yield ranging from 4.08 to 5.97. The rates varied from 4 to 6 per cent. The eight 6s were in the South, Middle West and West.

REPRESENTATIVE BOND SALES OF APRIL AND MAY, 1922

State	Purpose	Amount	Maturities	Rate Per Cent	Basis	Sold For	Dated	Purchased By
North Carolina	Highway	$6,000,000		4½	4.49	$100.10	Apr. 1, 1922	Syndicate of N. Y. and N. C. bankers
Illinois	Highway	6,000,000		4	4.11	98.875	Apr., 1922	Hallgarten & Co.
South Dakota	Highway	1,000,000		4½	4.63	101.00	Apr., 1922	Continental and Commercial Trust and Savings Bank, Chicago, Ill.
County								
Bradford, Fla.	Roads	550,000	1923-52	6		99.01	May 2, 1922	Blanchett, Thornburgh & Vandersall, Cincinnati, Ohio
Duchesne, Mo.	Roads	600,000	1923-36	5	4.44	105.01	June 1, 1922	Logan Trust Co. [illegible] Mo. and others
Carlton, Minn.	Courthouse	120,000		4½		101.60		Caldwell, White & Co.; First Nat. Bank, Duluth
Curry, Ore.	Roads	60,000	1936	5		100.41	Jan 1, 1922	Ladd & Tilton Bank, Portland, Ore
Dona Ana, N. M.	Road and bridge	60,000	1952	5		96.66	May 1, 1922	Bankers Trust Co., Denver, Col
Hamilton, Ohio	Hospital	200,000	1924-43	6		100.00	Apr. 1, 1922	Sinking Fund Trustees
Hudson, Colo.	Road impt.	41,500	1923-28	5	5.13	101.82	Apr. 1, 1922	W. J. Shepard
Iosco, Mich.	Road	300,000	1923-36	5		100.00	May 1, 1922	Jackson City Bank, Jackson, Mich
La Fourche Parish Road Dist. No. 1, La.	Road	50,000	1949	6	5.625	102.70	Sept. 15, 1920	Hibernia Securities Co., New Orleans
Liberty, Tex.	Road	1,309,000				102.947		Guaranty Title & Trust Co., Cincinnati
Spartanburg, S. C.	Highway	200,000	1923-62	5	4.90	102.33	May 1, 1922	Stacy & Braun, Toledo, Ohio
Oak Park, Park Dist., Cook Co., Ill.	Park	50,000	1937-39	5	4.25	108.41	May 1, 1921	Oak Park Trust & Savings Bank
Sangamon County Highway Dist., Illinois Co., Ill.	Highway	25,000	1942	6		100.00	Jan. 1, 1922	First Nat. Bank of Mountain Home, Ida.
Traverse, Minn.	Bridge	18,000	1933-42	4½		100.20	May 1, 1922	Minneapolis Trust & Trust Co., Minneapolis
Washington, Pa.	Road and bridge	3,524	1937					
Wauwatosa, Wis.	Road impt.	500,000	1932-45	4½	4.08	105.027	May 1, 1922	Continental Commercial Trust & Savings Bank, Chicago, Ill.
Municipality								
Albert Lea, Minn.	Electric Lights	30,000		5		102.80	Apr. 1, 1922	Minneapolis Trust Co., Minneapolis, Minn.
Asbury Park, N. J.	Road and bridge	11,000	1923-33	6	4.91	100.45	Apr. 1, 1922	[illegible] Bank, Asbury Park, N. J.
Baltimore, Md.	Improvements	8,332,000	1930-52	4½	4.31	102.805	Mar. 1, 1922	[illegible] & Co., New York City
Bay City, Mich.	Street impt.	50,000	1923-32	4½	4.08	102.04	May 15, 1922	[illegible]
Childress, Tex.	Water	40,000		5½		101.00		W. A. [illegible] & Co., Dallas, Tex.
Clarendon, Tex.	Water	25,000	1962	6		104.52		[illegible] & Co., Dallas, Tex.
Des Moines, Ia.	Waterworks	250,000	1933-42	4½	4.32	101.50	Apr. 1, 1922	[illegible]
Dillon, S. C.	Public impt.	100,000	1924-41	6	5.97	100.37	Apr. 1, 1922	[illegible] & Co., Columbia, S. C.
Grand Island, Neb.	Sewer	200,000	1923-42	5		97.76	May 3, 1922	[illegible]
	Drainage	100,000						
Hammond, Ind.	Waterworks	250,000	1923-41	5	4.72	103.34	Oct. 15, 1921	[illegible] & Co., Cincinnati
Honolulu, H. T.	Waterworks	250,000	1923-41	5		107.14	Apr. 15, 1922	[illegible] & Co., Cincinnati
Johnstown, Pa.	Park	65,000	1923-42	4½		100.25		[illegible] & Co., Cincinnati
Kenton, Ohio	Bridge	38,000	1923-42	4½		100.00		[illegible]
Larchmont, N. Y.	Road	115,000	1927-52	4½	4.34	100.00048	Jan. 1, 1922	[illegible] & Co., New York City
Lexington, N. C.	Water and sewer	215,000	1923-42	5½	5.48	100.14	Feb. 1, 1922	[illegible] & Co., Columbia, S. C.
Mechanicsburg, Pa.	Municipal Bldg.	70,000	1923-42	4½	4.34	105.89	May 1, 1922	[illegible] & Co., Cincinnati
Mount Vernon, N. Y.	Drainage	175,000	1923-42	4½	4.22	103.35	May 1, 1922	Lamport, Barker & Jennings, N. Y. C.
	Drainage	100,000	1923-42	4½				
Northampton, Mass.	Highway	100,000	1923-41	4½	4.21	101.43	May 1, 1922	[illegible] & Co., Cincinnati
Orangeburg, S. C.	Street impt.	250,000	1925-44	5½	5.39	100.02	May 1, 1922	[illegible] & Co., Columbia, S. C.
Paterson, N. J.	School	785,000	1923-62	4½	4.27	102.54	Apr. 1, 1922	[illegible] & Co., N. Y. C.

Steel Merger Draws Senate Demand for Inquiry

Merger of the two largest independent steel producers in the United States is to be effected through the purchase by the Bethlehem Steel Corporation of the Lackawanna Steel Co. E. G. Grace, president of the Bethlehem Corporation, states that the acquisition of the Lackawanna Co. will give his company an entrance to the markets of New England and Eastern states and will otherwise supplement its manufacturing and marketing facilities.

The combined companies are reported to have an ingot capacity of about 5,000,000 tons of which the Lackawanna contributes 1,800,000 tons and the Bethlehem 3,200,000 tons. The United States Steel Corporation has a capacity of about 22,000,000 tons. On motion of Senator LaFollette of Wisconsin, the Senate has called upon the Department of Justice and the Federal Trade Commission to investigate the transaction and to inform the Senate as to what action has been taken "to protect the public interests." Information is requested also as to whether proceedings under the Sherman and Clayton acts may be desirable. The Lockwood Committee is to investigate.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted. Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section. The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of May 4; the next, on June 1.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$2.58	+$3.50	$4.00	$2.48	$2.76	$3.50	$3.10	$3.60	$3.75
Structural rivets, 100 lb.	3.50	+4.25	5.50	3.10	3.90	4.45	4.50	3.75	6.50
Reinforcing bars, ¾ in. and larger, 100 lb.	2.48	+3.50	3.50	2.38	2.66	+3.52½	2.55	3.60	2.75
Steel pipe, black, 2½ to 6 in. lap, discount	61%	61.15%	45%	59½%	61.9–5%	44%	56.1%	53%	30.00
Cast-iron pipe, 6 in. and over, ton	46.80@47.80	+48.00	48.30	44.10	+48.50	55.00	51.00	52.00	50.00
Concreting Material:									
Cement without bags, bbl.	+2.50@2.60	2.39	2.25	1.97	2.24	2.90	+2.83	2.94	2.48
Gravel, ¾ in., cu.yd.	1.75	1.85	2.25	1.80	1.50	2.50	2.25	1.50	1.50
Sand, cu.yd.	1.00	1.15	2.25	1.80	1.00	1.10	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd.	1.75	1.90	2.73	1.60	2.25	3.50	2.25	3.00	2.00
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	48.00	36.00	34.50	40.00	39.00	36.75	26.00	20.00	47.00
Lime, finishing, hydrated, ton	15.80@16.80	18.00	25.00	18.00	29.00	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	2.75@3.18	1.25	2.50	1.40	1.40	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000.	+23.40	9.00	11.15	11.00	15.00	12.00	15.00	14.00	16.00
Hollow building tile, 4x12x12, block	Not used	0795	.115	.0821	.0752	.08	....	.12	.09
Hollow partition tile 4x12x12, block	.11120	.072	.115	.0657	....	.08	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal.	.95	+1.05	1.09	+1.04	1.06	+1.18	+1.04	.86	.97
Common Labor:									
Common labor, union, hour	.75	.35	.....	80	.....	.50@.55	.56¼	.50@.60	....
Common labor, non-union, hour	.44@.60	.20	.25	72½	.40@.50	.35@.50	.47½@.50	.....	.20@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations are delivered except tiles, which are "on trucks." Common lump lime per 280-lb. net, both lump and hydrated quoted f.o.b. cars New York. Sand gravel and crushed stone are quoted alongside dock. Cement and steel pipe delivered to contractors on job. Gravel ready mixed $1.75 per cu.yd.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to contractors in yards at San Francisco. Lumber price is for No. 1 fir, common.

Seattle quotes on Douglas fir instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks.

Montreal quotes on fir instead of pine. Sand, stone, gravel and lump lime per ton. Lime and tile are delivered; cement, sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 98.62 cents). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net, 2½ in., $30; 6-in., $110.

Changes Since Last Week

All price changes upward; no declines. Steel shapes quoted in Atlanta at $3.50 as against $3.35 per 100 lb. at warehouse. Rivets also up 35c. and reinforcing bars 25c. per 100 lb. Bars quoted in Denver at $3.52½ as compared with $3.42½ per 100 lb., last week. Another week of brisk buying in the iron market has resulted in advanced prices of cast-iron pipe. Atlanta quotes $48 as against $42 and Minneapolis $48.50 as compared with $48 per ton, one week ago.

Cement quoted at $2.60@$2.85 per bbl., without bags, delivered on job, New York, as against $2.60, flat, last week. San Francisco warehouses quote $2.83, advanced from $2.73 per bbl., without bags.

Common brick quoted at $23.40 delivered; $20 per 1,000 wholesale, alongside dock, New York. Brick prices stood at $18@$20 per 1,000 wholesale, one week ago, but the quotation of $18 has entirely disappeared from the market. Turn to page 848 for a wider explanation of the New York brick situation.

Raw linseed oil up 3c. in San Francisco; 5c. in Chicago; 6c. in Denver and 9c. per gal., in 5 bbl lots, in Atlanta.

A total of 355 mills reporting to the National Lumber Manufacturers' Association for the week ending May 6, show 198,258,169 ft. cut; 208,703,877 ft. shipped and orders for 247,000,175 ft. b.m. Production stands at 7½ per cent and shipments at 3 per cent below while orders reach 14½ per cent above normal.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, President

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren, Editor

Volume 88 — NEW YORK, MAY 25, 1922 — Number 21

Metal Irrigation Flumes

SINCE the U. S. Reclamation Service is one of the largest users of metal flumes for irrigation purposes the results in design, construction and maintenance as given elsewhere in this issue by Julian Hinds are doubly valuable. The information on friction factors with various types of joints, limiting stresses on the design of supporting structure, protective coverings and preliminary experience with zinc plates could hardly be duplicated in any other single organization. Flume deformation data is available so that designers may know of clearances. As to life some engineers may disagree with Mr. Hinds' estimate of 15 to 20 years but he distinctly states that metal flumes have been in service too short a time to make an authoritative statement. In favorable locations, with tar paint and creosoted timber supports the period may reasonably be expected to be considerably extended. As to the hydraulics enough experimental data are now at hand to enable the designer to get the required quantity through flumes with a freeboard with a sufficient factor of safety to prevent slopping over even when carrying floating matter.

A Business Milestone

LAST week's meeting of the Chamber of Commerce of the U. S. A. marked the completion of the first ten years of the chamber's life. It was launched in 1912 under the inspiration of President Taft and his secretary of commerce and labor, Mr. Nagel. Hardly had it developed its machinery before the European war set in, bringing a host of problems that properly belonged to a national business organization. Under able leaders, it functioned well and vigorously, its strength growing rapidly, particularly after we entered the war. Today, though in its 'teens, it is a well matured organization—matured by the fire of war for the service of peace. It has wide support in the business world and is looked upon as an authoritative agency for the expression of the views of American business. Congratulations in generous measure are due those who have directed its growth and have given it its high ideals. The public's interest they have made paramount. On that sure foundation an enduring edifice can be erected.

Self Government in Industry

WE TAKE the title of this editorial from the *New York Times* of May 22, in which that paper comments on the organization of the American Construction Council as a "reassertion of our traditional belief in local self-government." The *Times* is right. It is a movement of self-government on the part of the construction industry—of self-government based on the theory that the industry exists for the service of the public and, therefore, cannot tolerate within itself any practices that are contrary to the public interest. Its launching is an appreciation, too, of what Secretary Hoover has emphasized—that industrial ills are not curable by legislation or jails. These are local palliatives. The true cure must come from a cleansing of the body from within. The reception which the movement has had at the hands of the press is an indication of public approval of business self-government when based on sound principles.

The Water-Works Convention

NEVER in the history of the American Water Work Association has a better program been presented than the one at Philadelphia last week and never has the printed program been carried out more closely to schedule. The variety of subjects and the number of topics presented were large. The papers were real contributions to available information, including even the more purely descriptive papers. Particularly commendable features of the program were the large number of committee reports and the many contributions by members of the Chemical and Bacteriological Section. The committee reports, resulting from the recent formation of the Council on Standardization, and its 17 sub-committees, were all progress reports, as would be expected from new committees dealing with complex subjects; but these reports all showed real progress instead of the time marking so common at many previous conventions of this and other associations. If the various committees keep up the pace set by their own action and by the Council on Standardization, the new impetus which the council and its committees have given to the association will produce results of great and lasting value.

Committee Problems

PROBLEMS presented by the rich promise of the standardization committees of the American Water Works Association include the finding of space and money to print the committee reports, whether in the association *Journal* or separately. These reports may perhaps be made fairly brief in themselves but the voluminous data of great potential value which some of the committees have already accumulated and others give promise of amassing will make their publication and wide circulation almost imperative. Would not the value of this committee work be enhanced and the chances of securing the private subscriptions that may be needed, if the reports are not to be buried from general view and use, be increased if all the standarization reports were published separately rather than scattered through the *Journal*? Another committee problem is the avoidance of duplication of the work of committees of other societies and the curbing of jealousies between these societies and committees. Already, it appears that the creation of a water works association committee on standards for water analyses is not welcomed by the like committees of the American Public Health Association whose standards, after several revisions, are widely used. Here there is perhaps more

than ordinary need for diplomacy—for reasons more or less obvious that need not now be discussed. Other of the American Water Works Association committees are already securing co-operation from the committees of sister organizations, or are continuing such co-operations previously established—notably in the case of the New England Water Works Association, where the need for co-operation is urgent and its benefits plainly evident. Standardization must proceed by unification rather than multiplication.

Municipal Ownership in Detroit

DETROIT has taken over its privately owned electric railway system and now possesses the largest municipally owned electric railway system in the country. We wish the city well. Under so virile and able a man as Mayor Couzens municipal operation gives high promise. Nevertheless we cannot enthuse. Possibly we are hopelessly old-fashioned. We find it difficult to get away from the conviction that the proper purpose of government is to protect the rights of individuals and to prevent their invasion by other individuals or groups of individuals. Under this theory government would take over other functions only when there was clear proof that they were necessities and that no other agency could be entrusted to carry them on. Eventually there may come a day when character and ideals will have so developed that large enterprises can be entrusted with assurance of efficiency to governmental management. American experience, however, does not justify us in believing that we have yet reached that stage in this country. Our municipal operations generally are not matters of legitimate American pride.

Specifying Results or Methods

AN EVENING'S discussion in the New York Section of the American Society of Civil Engineers recently on the subject of whether specifications should contain much or little detail brought to the front the old and yet ever active problem of how to specify. Shall the engineer specify the results that he demands, or shall he specify the methods by which the expected results are to be brought about? If he specifies methods, may he also specify results, either directly or by reserving the right to protest if the results are not as good as he expected? Essentially these questions have always been a prime source of trouble between engineer and contractor. We fear they will continue in this unhappy position. The difficulty is that some specification of methods is unavoidable in every piece of work, if only as a matter of describing what is really wanted; and, further, in a great many instances it is very much simpler to describe quality by stating the method of doing the work than by attempting to picture the result and tell how that result is to be measured. Suppose a wall is to be painted and suppose that the desired result is a certain color, finish, degree of protection, and durability; by far the easiest way to lay down these requirements is to tell the painter what paint to apply and how. Thus the specification of method obtrudes itself. The real problem, then, is not whether results or methods shall be specified, but at what point it is possible—and wise—to stop specifying method and state results instead. There is no problem or subject in the whole range of construction engineering, we believe, that penetrates so deeply into all ramifications of the art and its underlying sciences. Correspondingly, there is no subject which will better repay careful consideration and reconsideration.

Detail in Building Codes

POINTED questions of engineering responsibility are contained in the problem of safe building and regulation of building practice. Building codes are themselves engineering specifications, and the manner of specifying—by a result or method—affects the engineer's relation to his work in designing buildings. A building code confined to results desired and nothing more than fundamental requirements of engineering would necessarily place the responsiblity for all the detail working out of a building structure upon the engineer. The common type of building code does not do this, but aims to prescribe in detail just what construction shall be used in each element of a building. Current building-code practice, in other words, is headed in the direction of telling a man that floor slabs in the upper stories of loft buildings must be 4 in. thick and on a 6-ft. span, must have 0.82 per cent of mesh reinforcement, must be made of 1:2:4 stone concrete, etc., etc. Such a code tends inevitably to make structural engineering automatic, and leads to the result that a bad structure is blamed not on the designer but on the building code. The opposite type, which in the extreme would fix basic loads and unit stresses and then specify nothing more than that the completed structure must satisfy every requirement of first-class construction, has never been tried. Very likely it would prove just as unworkable in practice as an engineer's specification that aimed to prescribe results alone, but the fact remains that the detail-specification type of code has proved itself incapable of preventing bad construction or disastrous building failures. Its chief defense, in the face of these failures, is that codes are not adequately enforced. This very justification, however, constitutes something of an indictment of the whole system. A real solution of the building code problem ought to be discoverable by the route of placing full responsibility on the engineer for structural adequacy of buildings; with responsibility so placed, we need have no fear that the profession will fail to live up to its charge. Under the present system we are likely to proceed farther and farther in the direction of rigid check of plans and inspection of work.

What of Genoa?

SHALL we call the Genoa conference a success or a failure? Light is thrown on this question not only by the news from Europe but also by the statements of Secretaries Hughes and Hoover since the receipt by the United States of an invitation to attend the forthcoming conference at The Hague.

Success may be measured against either of two standards—what one wants, or what one needs. Measured by the first of these, Genoa must be written down as a failure, dismal and absolute. Each of the principal conferees went to Genoa with a purpose. That of the British Prime Minister was broadest, for he sought the re-establishment of economic relationships on whatever terms, so that trade could be resumed and England exchange her industrial products for things to eat. The German Chancellor went to Genoa in the hope that by trading on British needs he might lighten the repa-

rations burden, or, failing this, drive a wedge into the Entente and isolate France, Germany's principal creditor. The French Government, on the other hand, feared the conference and sought only to prevent any action what might relieve Germany of her reparations obligations and to forestall any attempt to limit the strength of the army on which it would rely, if necessary, to exact payment. France needs cash rather than trade. Soviet Russia sought two objects; de jure recognition and a loan.

None except France, whose purpose was negative, got what he was after. Europe is still an economic mess, the reparations have not been modified, the Entente is intact, although somewhat strained, and Russia is still a thrice-bankrupt pariah.

But, as viewed against the second standard, he would be blind who would call the Genoa conference a failure. It has shed much light and effected much disillusionment. All concerned appear to have learned something from their mutual contacts and reactions. Lloyd George has learned that other European governments are not inclined to sacrifice their national interests or pride to the commercial needs of Britain or the political exigencies of a British Premier. The French Government has learned that it is not likely to extract blood from a stone and that the world in general will regard coldly military reprisals on a bankrupt debtor. The German Chancellor must realize that Germany will have to pay to the limit of her ability and that his own diplomatic ineptitude has served to prevent the rift in the Entente that he so much desired and that at one time appeared to be imminent. The Bolsheviki have learned that it is easier to hoodwink the peasants of Russia than the governments of Europe and the United States.

So much for political lessons. But what is most valuable are the economic lessons that have been taught. We say "taught" advisedly, for whether they have been learned remains to be seen. One of these is that European national debts can be paid only out of earnings, that earnings are impossible without trade, and that trade consists of a mutual exchange of goods. Another is that financial stability depends on living within one's income, which, in the case of nations, means the balancing of budgets by spending less and producing more rather than by printing paper money to redress a debit balance. A third is that credit must rest upon confidence, which in turn follows upon the enforcement of property rights, the observance of contract obligations, and the preservation of the freedom of labor.

Whether France and Germany have learned these lessons we shall see at the reparations conference to be held at the end of this month. Whether Russia has learned them we shall see at the adjourned session of the Genoa conference to be held in June at The Hague. Until these lessons have been learned; until France is willing to listen to reason on reparations; until Germany, as a bankrupt debtor, is ready to have her finances supervised; and until Russia realizes that she cannot expect to sit in the game unless she subscribes to the rules; little can be gained by American participation. When these ends have been accomplished nothing can be gained without that participation and nothing is more sure than that it will be forthcoming. American investors have already shown their willingness to finance the honest and trustworthy borrower who would apply his credit to productive rather than destructive undertakings.

The Road Builders Association

IF THE turbulent annual meeting of the American Road Builders Association on May 15 were merely a matter of petty internal politics it could well be passed by without comment. For many years, however, dissatisfaction has been expressed with the management of the association. Before road building had developed into the great industry it has now become the kind of control common in a small local engineering organization might have been adequate. The feeling today is that the administration of the association has not measured up to its opportunities, that there has been a distinct lack of business method and vision. The contest at the recent meeting, therefore, was not so much one of personalities as of principles. The fact that the older faction apparently won, amounting to an endorsement of the past policies and management, has given a good deal of concern to those who would like to see the association handle its job more effectively. That is the real issue.

No one in touch with the association's affairs can have failed to detect the rumblings that have been current. Criticism has come not only from the members, but also from manufacturers who feel that the Good Roads Show can be handled far more efficiently than it has been in the past. In fact, this sentiment was brought to a head at this year's show in Chicago by the appointment of an Exhibitors Committee heading a manufacturers' organization and it is well known that manufacturers would welcome the opportunity of displaying their products at the annual meeting of the American Association of State Highway Officials. Another movement which is gaining ground and which, if consummated, would weaken the position of the American Road Builders Association is the proposed organization of a highway division in the American Society of Civil Engineers. Still another undercurrent is the proposal to revive the defunct American Highway Association, which was abolished a few years ago. It was thought at that time that the American Road Builders Association could be depended on to carry on the work remaining to be done. There is a widespread feeling now that this duty has not been adequately performed.

From what has been said it is clear that the American Road Builders Association must now demonstrate its position of real leadership or else have that position preempted by some new organization or an existing body in reorganized form. The executive control of the national road building association of the United States should be in strong hands, a position which it does not occupy under the present management. At this year's annual convention in Chicago those who had a broad outlook on the organization's possibilities secured the appointment of a nominating committee pledged to progressive principles. That committee's recommendations were defeated at the board of directors' meeting two weeks ago. Indications are that things will run along in the same old way. Under present conditions is it not conceivable that a small group of the leaders in the field will get together and plan some action, either through the American Road Builders Association or another body, which will make association management in the road-building field more nearly representative of the big place in national affairs which that specialty now occupies?

Design, Construction and Use of Metal Flumes

Semi-Circular Flumes Discussed from the Standpoint of Types, Supports, Stresses, Expansion, End Structures and Surface Coverings

By Julian Hinds
Engineer, U. S. Reclamation Service, Denver, Col.

METAL flumes of the non-riveted metal type were erected first in this country in 1902 by Pat Maginnis at Kimball, Neb. The device was later patented and is used extensively at the present time throughout the irrigated portions of the West for carrying water along steep hillsides and across topographic depressions of moderate depth. It is proposed in the present article to discuss the types of flumes from the earliest Maginnis to the latest non-ferrous metal flume, to note the essential features and limiting stresses in the design of the supporting structures and end structures, to give experience of the U. S. Reclamation Service with protective surface coverings and to give some unpublished information on friction losses.

Engineers of the U. S. Reclamation Service have probably had more experience in the design of metal flumes and knowledge of their service than any other group of men. This article, by a Reclamation Service engineer, represents their current knowledge on the subject. It is a most important contribution to irrigation engineering practice.

Essentially the metal flume consists of comparatively light sheets curved to semi-circular form and suspended from cross-beams or stringers by means of hoops or other supporting members. Fig. 1 shows diagrammatically the mechanical principles of the original Maginnis flume. The two overlapping sheets *a* and *b* are held between the rod *c* and the compression bar, or curved channel *d*. By tightening the nuts *e*, the rod *c* is put in tension, the curved channel *d* in compression, and the flume sheets are pressed together. The weight of the flume and its water load is transferred from the rod *c* through the washers *f* and carrier beam *g* to the stringers *h*.

The Maginnis flume presents a rough interior, which reduces the carrying capacity. Considerable effort has been devoted to the development of joints free from this objection, and a number of so-called smooth interior flumes have been designed and patented. A partial list of the types of joint in use at the present time is shown in Fig. 2. In all cases watertightness is secured by the principle first used by Maginnis. In certain types the inside compression bar is omitted, the compression being thrown into the inside sheet. In one type (not shown) both the compression bar and the tension rod are omitted, the inside and outside sheets being used respectively for the compression and tension members.

Each of the several types of joints possesses certain points of superiority and various advantages are claimed by the respective manufacturers. A satisfactory joint should be simple, secure and watertight. It should be easily assembled in the field, should offer as much circumferential rigidity as possible and should offer the least possible resistance to flow. Where galvanized sheets are used the angles at the beads should be made "easy" to avoid injury to the spelter in the forming operation.

Deeply-beaded types offer a maximum resistance to circumferential deflection, but require special sheets on curves and unless carefully manufactured are likely to show injury to the spelter at the joints. Flat or lightly-beaded types are easily erected and require no special work on curves. While such types offer less circumferential rigidity than the more complicated joints, certain of them have been found to be satisfactory for flumes up to 7 or 8 ft. in diameter, and it is claimed that they can be used for even larger sizes.

Standard sizes of flumes are determined by stock lengths of sheets from which they are made, and are designated commercially by "numbers" which are equal to the perimeter of the semi-circle in inches. The sheets may be of any suitable metal, and if of steel or iron, should be galvanized. The proper thickness of sheet to use for a given size of flume is not subject to mathematical computations. The Reclamation Service makes the following requirements as to thickness for steel or iron sheets: Up to No. 48 flume, 22-gage; to No. 96, 20-gage; to No. 132, 18-gage; to No. 168, 16-gage; to No. 204, 14-gage; to No. 252, 12-gage. Where metal of insufficient thickness is used the flume is flimsy, and galvanized sheets are rapidly destroyed by rust after the galvanizing is eroded away. Erosion is rapid where the water carries sand and gravel, especially at high velocities.

A specially rolled zinc sheet recently placed on the market by the Thompson Manufacturing Co., of Denver, under the name of Lastite, is being tested out for use in the manufacture of flumes and culverts. This metal is particularly adapted to flumes of the deeply-beaded types, since it is not subject to damage in the forming operation as is the case with galvanized sheets. Lastite is undoubtedly superior to iron or steel in point of resistance to corrosion, but is somewhat deficient in structural strength. This lack, it is claimed, can be compensated for by a closer spacing of the suspension rods. Several flumes of this metal installed in the vicinity of Denver last season (1921) appear to be entirely satisfactory. Lastite is somewhat higher in first cost than galvanized sheets, but it is expected that it will show a much longer life and that it will not require painting.

Supporting Structures—Trestles and trusses for supporting the stringers may be of timber or steel. Information for use in the design of trestles will be found in catalogs furnished by flume manufacturers. Knee-braces are usually used on trestles to give longitudinal stiffness and to reduce the effective length of stringer span. When used for the latter purpose they should

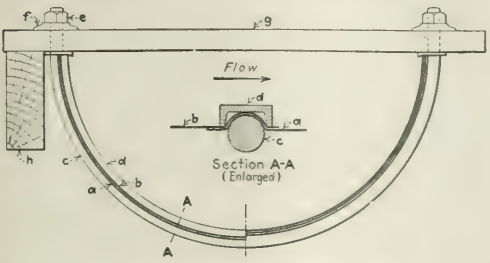


FIG. 1. ORIGINAL MAGINNIS FLUME

be of ample size and should be securely supported. If the stringer reactions are figured for a beam continuous over four supports it will be found that the knee-braces carry practically the entire span load. If the braces fail the stringers act as simple beams between the posts. Unequal settlement of foundation is likely seriously to affect stringer and knee-brace loads, and where settlement is likely to occur suitable allowance should be made. If stringers that are too small are used the heavy deflection opens the flume joints causing leakage.

The posts should be designed as columns to carry the maximum water and wind loads coming upon them. The lower end of the posts are usually anchored to concrete pedestals, which should have a sufficient weight to prevent the overturning of the empty flume by wind pressure, and sufficient base area to prevent undue settlement. In cold climates the alignment of the flume is likely to be disturbed by unequal frost action upon the pedestals. Trouble from this cause may be avoided by carrying the pedestals below the frost line. Where the pedestals are set in alkali soils proper measures should be taken to prevent deterioration of the concrete. Piles are sometimes used where foundation conditions are bad. The piles may be cut off near the ground and used as supports for framed bents, or they may support the flume directly.

Bridge Supports—Fig. 3 shows a No. 192 flume supported underneath the floor of a steel-truss highway bridge near Worland, Wyo. Fig. 4 is a twin flume

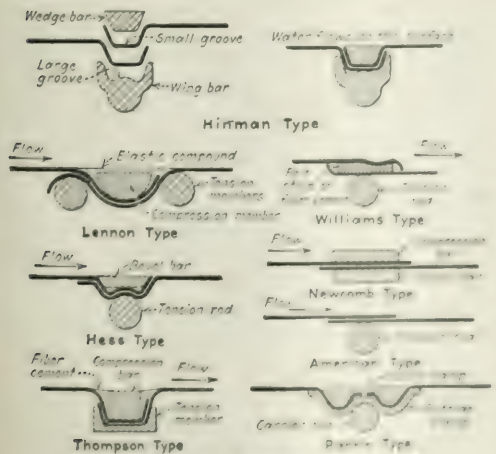


FIG. 2. VARIOUS FLUME JOINT DETAILS

erected by the U. S. Reclamation Service to carry the Garfield canal across the Rio Grande near Dona Ana, N. M. Each barrel of this flume is 8 ft. 3⅜ in. in diameter (No. 156) and the flume is carried on a three-truss suspended-span cantilever steel bridge. A cross-section of the flume and bridge is shown in Fig. 5, and expansion-joint details between the fixed and suspended spans are shown in Fig. 6. The uniform flume load is admirably adapted to the continuous bridge, but at this location the foundation was poor and unequal settlement was anticipated. The trusses were therefore articulated in alternate spans approximately at points of contraflecture to give the necessary flexibility. For large flumes this construction results in marked economy of materials, but where the loads are light the design is governed principally by minimum sizes of members, and the saving is not great. One

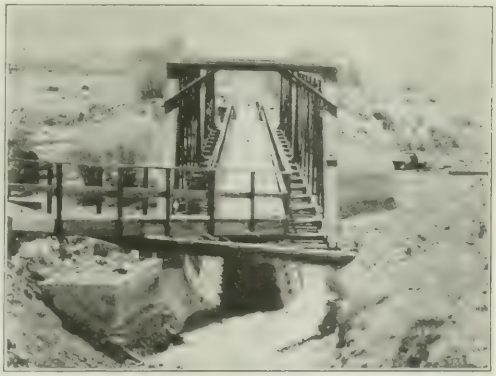


FIG. 3. FLUME UNDER HIGHWAY BRIDGE FLOOR.

barrel of larger size would have been more economical, both in cost of flume and of bridge, than the two No. 156 barrels used for the Garfield crossing, but the head room required for the larger flume was not available.

In calculating wind stresses it is usually considered conservative to assume the maximum pressure as acting upon twice the vertical projection of the trestle or truss (exclusive of stringers) plus one and one-third times the vertical projections of the flume. In long-span bridges for single-barreled flumes the wind stresses are usually high, due to shallow horizontal trusses, and it is often necessary to make the bridge wider than is otherwise required, to prevent an objectionable reversal of stresses in the chords under adverse wind conditions.

Flume Deformation—There is a tendency for the flume, when loaded, to depart from the circular form. If perfectly flexible and unrestrained, the loaded portion of the section would assume the form of an hydrostatic catenary supported between the two tangential ends above the water surface, the shape varying with the depth of water in the flume. The stiffness of the metal partially suppresses the distortion and the flume actually assumes a shape between the circle and the catenary. Measurements made upon a number of flumes in service gave the results shown in Fig. 7. In designing supports all crowding should be placed to clear the flume in its distorted form.

It is often necessary to construct a flume on curved alignment. The necessary curvature is secured by introducing slight angles at all or part of the joints between sheets. Interlocked joints, like the Lennon or Hess, require the sheets to be mitered properly in the shop before being rolled. The Williams and other similar types requires no special forming. The angle at any one joint should be made as small as possible. The U. S. Reclamation Service specifies a maximum of 4 deg. for the angle between any two adjacent sheets. Stringers on curves should be spaced to provide the additional clearance required.

Special attention should be given to the design of the carrier beams, rods, washers and shoes. In cinching up the bands to stop leakage stresses considerably in excess of the stresses due to the water load may be produced. For this reason the U. S. Reclamation Service has adopted a working stress in the carrier rods of 8,000 lb. per sq.in. The washers and shoes should be made proportionately strong. The necessary size of washer will depend upon the timber in the carrier beams. The ultimate tensile strength of steel is roughly 75 times the ultimate bearing strength of timber, and the diameter of the washer should accordingly be about 9 times the diameter of the carrier rod. Such a size is impracticable. A washer 6 times the diameter of the rod will give a working stress of 220 lb. per sq.in. bearing when the rod is carrying 8,000 lb. per sq.in. and may be accepted as a conservative standard. Standard size cast-iron or malleable washers have been found to be inadequate. If standard washers are used they should be one or two sizes larger than the rod, to give the area required. The shoes should be of approximately the same area as the washers and should be designed properly to distribute the thrust from the compression bar. The carrier beams should be of ample size to support the flume and water loads, and large enough to resist the warping action of the sun.

Manufacturers recommend the use of metal flumes set directly in the ground for ditch lining. The writer is not in possession of sufficient data to be able to make a statement as to the durability of the metal sheets in such installations. The flume lining, being low in first cost, readily available and easily transported and erected, is doubtless desirable under certain conditions, but on important work the substitution of concrete lining should be carefully considered. Flume used for lining is assembled with carrier rods, carrier beams and compression bars, as when supported on trestle. The stringers are omitted and the assembled flume is set in the trench and backfilled. Anchorages are sometimes required to prevent the empty flume from being floated by ground water.

Expansion and Contraction—Metal flumes supported on timber trestles require no special provision for expansion and construction. If the carrier beams are spiked to the stringers a small movement will occur at each joint, sufficient to care for variation in length due to temperature changes. Where the flume is carried on long steel spans the concentration of movement at the expansion ends of the span may require a special joint in the flume barrel. A common type of joint is illustrated in Fig. 8.

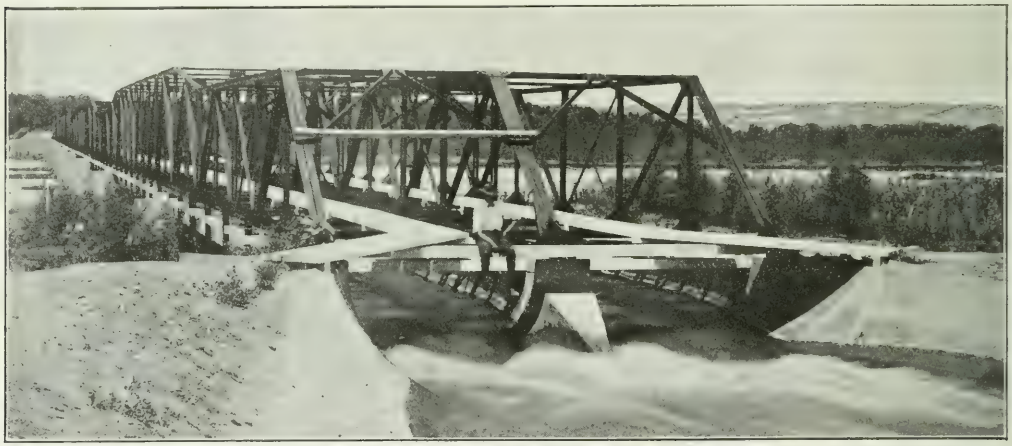


FIG. 4. TWIN FLUMES ON SUSPENDED-SPAN CANTILEVER TRUSSES OVER RIO GRANDE IN NEW MEXICO

End Structures and Sluices—The end structures, which join the flume to the canal, may be of timber, steel or concrete. When velocities are low and losses unimportant a plain timber or concrete headwall across the canal may be used, but for higher velocities and smaller allowable losses of head more elaborate structures will be required. Concrete structures should be used for all permanent installations. A very good form of concrete transition for low or moderate velocities in the flume is shown in Fig. 9. Sheet-metal inlets and outlets may be purchased from the manufacturer who furnishes the flume. An efficient attachment to a concrete headwall consists of a groove left in the concrete filled with a tar cement to receive the bead on the end of the flume sheet. The compression bar and sheet are forced into the groove by tightening the nuts on the anchor bolts. The opening in the headwall should be shaped approximately to the loaded form of the flume to prevent the opening of joints near the end when the flume is full of water.

Galvanizing and Painting—While some of the claims made for the rust-resisting powers of various special irons and steels may be true, it has been demonstrated that in an unprotected form, thin sheets of such metals are not suitable for use in flume construction. It is

imperative that all steel or iron sheets be galvanized, and the life of the flume will be prolonged if the rods, compression bars, shoes and washers are also galvanized. Where black rods are used it is claimed that a part of the zinc is transferred by galvanic action to the rods, weakening the galvanizing near the joints and allowing the sheets to corrode.

The galvanizing of the sheets should be done by the hot process and should consist of a uniform coating of commercially pure zinc, applied in such a manner that it will adhere firmly to the metal and be free from

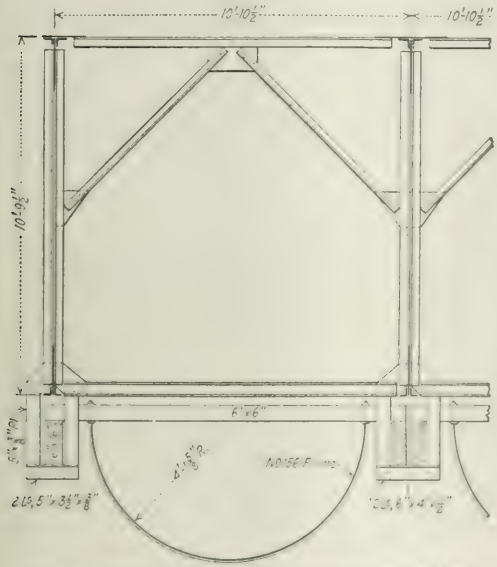


FIG. 5. CROSS-SECTION THROUGH MAIN TRUSS OF GARFIELD FLUME AND BRIDGE

abrasions, blisters, cracks, sal ammoniac spots and other injurious imperfections. The effectiveness of the galvanizing will be greatly increased if each square foot of sheet is given 2 oz. of zinc, instead of the customary 1½ oz. No sheet showing imperfections or injury to the galvanizing where the surface will be exposed to the water should be used. All breaks in the galvanizing, where not exposed to the water, should be repaired with solder or other suitable coating, without the use of acids injurious to the spelter, and in such manner as to leave the surface free from abrasions that might prevent a tight joint. Carrier rods, compression bars, shoes, nuts and washers should have a galvanized coating of not less than ½ oz. of chemically pure, or ¾ oz. of commercially pure zinc for each square foot of surface area.

In some localities galvanizing is a sufficient protection for metal parts, but it is sometimes found that due to chemicals in the water and abrasion from sand and gravel carried in suspension the zinc coating is rapidly destroyed and the iron or steel base is exposed to rapid deterioration. In such cases it becomes necessary to paint the inside of the flume. The service requirements for a paint for this purpose are very exacting, and most ordinary paints are practically valueless.

Some years ago the U. S. Reclamation Service con-

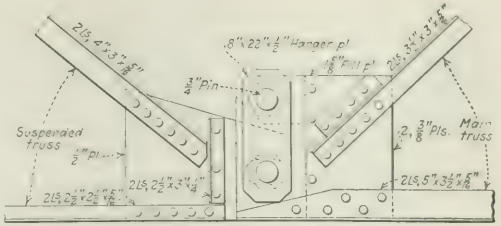


FIG. 6. EXPANSION JOINT BETWEEN SUSPENDED AND CANTILEVER SPANS

ducted a set of tests to determine, if possible, the paint best suited for this work. The experiments were conducted under service conditions in widely separated localities and by different engineers. Tar paint was found to be superior to any other paint tried. The only other paint that made a creditable showing was a bitumastic compound of unknown composition. A number of paints with asphaltic base, recently put on the market, give promise of satisfactory performance, and the use of a small percentage of cement in coal tar is claimed to give excellent results. The cement is said to neutralize acid in the tar and to give body to the paint, rendering it less likely to run in summer.

In a recent report on inspection of flumes, Uncompahgre Project, Colorado (*Reclamation Record*, November, 1920, p. 521), F. D. Pyle, formerly project manager of that project, comments upon the painting of the flumes inspected as follows:

Of the 69 flumes, 59 have received a coat of tar or paint on the interior in order to protect them against rust and erosion. The first tar was used in 1913, but proved to be too brittle and lifeless. In the spring of 1916 various kinds of paint were tried without success. Later several paint companies furnished small lots of paint to make tests. In no case have these paints proved equal to the coal tar placed during the past 3 years.

In the fall of 1917 and spring of 1918 a number of flumes were treated by applying a coat of water-gas tar followed by a coat of coal tar thinned with water-gas tar. This made considerable extra work, and in a number of cases the coating was too thin, either running to the bottom of the flume or checking and cracking on the side of the flume exposed to the sun. Since the summer of 1918 coal tar has been used without thinning, with very good results. The best results have been obtained when tar was applied before the flume had been used more than one season, and when tar was applied in warm weather. When applied in cold weather it would not stick to the metal, but blistered and peeled. In tarring flumes it was found essential to clean the surfaces thoroughly, removing all rust from the sheets and from the joints, and to have them perfectly dry and free from dust. The tar was applied hot with heavy brushes or burlap swabs.

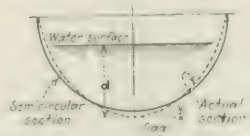


FIG. 7. SAG IN METAL FLUMES

Size	Type				Sag
[illegible]	[illegible]	[illegible]	730	1 96	1 10
[illegible]	[illegible]	[illegible]	710	1 11	0 10
[illegible]	[illegible]	[illegible]	730	1 87	0 12
[illegible]	[illegible]	[illegible]	710	1 22	0 13
[illegible]	[illegible]	[illegible]	276	2 72	0 17
[illegible]	[illegible]	[illegible]	276	2 50	0 20
[illegible]	Hinman	[illegible]	276	2 35	0 20
[illegible]	[illegible]	[illegible]	276	[illegible]	0 21
[illegible]	[illegible]	[illegible]	276	2 00	0 26
[illegible]	[illegible]	[illegible]	276	[illegible]	0 27
[illegible]	Hinman	[illegible]	276	[illegible]	0 23
[illegible]	Hinman	[illegible]	276	[illegible]	0 27
[illegible]	Hinman	[illegible]	276	2 28	0 18
[illegible]	Hinman	[illegible]	276	2 07	0 22
[illegible]	Hinman	[illegible]	603	1 69	0 05
[illegible]	Hinman	[illegible]	603	1 55	0 08
[illegible]	Hinman	[illegible]	603	1 98	0 06
[illegible]	Hinman	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Hinman	[illegible]	[illegible]	2 23	[illegible]
[illegible]	[illegible]	[illegible]	603	[illegible]	[illegible]
[illegible]	Hinman	[illegible]	366	[illegible]	[illegible]
[illegible]	Hinman	[illegible]	366	[illegible]	0 15
[illegible]	Hinman	[illegible]	366	2 46	[illegible]
[illegible]	[illegible]	[illegible]	366	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	823	[illegible]	0 35
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	823	[illegible]	0 34
[illegible]	[illegible]	[illegible]	823	[illegible]	[illegible]

Conditions indicate that the joints should be retarred every fall, and the entire flume every other fall. The tar coat fails by drying, checking, peeling and blistering. In some cases there is a tendency to erode from the bottom especially where gravel is carried by the water. A heavy coating of coal tar has proved to be the best method of protecting the flumes when properly applied.

Mr. Pyle's findings are substantially corroborated by other experimenters except as to his objection to a priming coat of water-gas tar. The life of the flume barrel will be largely determined by the diligence with which the painting is maintained.

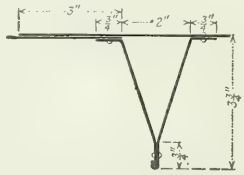


FIG. 8. EXPANSION JOINT FOR NO. 108 FLUME

It is not possible at the present time to make an authoritative statement as to the life of metal flumes, due principally to the comparatively short time they have been in general use. It is believed that a life of from 15 to 20 years may be reasonably expected for galvanized sheets, and under favorable conditions this period may be considerably extended. Lastite sheets or other non-rusting metal should have a longer life.

The painting of timber or metal supports should conform to standard practice for similar structures in the same locality. The same tar paint used on the flume is an excellent preservative for metal work. The life of timber may be prolonged by creosote treatment.

Hydraulics—Sufficient fall must be provided at the intake and throughout the flume to produce the necessary increase in velocity and to overcome transition losses and friction. With the type of inlet structure shown in Fig. 9, the drop at the entrance may be taken as 1.1 times the increase in velocity head. With a more abrupt transition a greater drop will occur, ranging possibly up to 1.5 times the change in velocity head for a plain headwall. Where velocities are high the head saved by a well-designed inlet structure is considerable. In addition to conserving head an efficient inlet structure tends to produce smoother flow in the flume, due to the elimination of contractions at the entrance. Long flumes with limited falls should always be provided with good inlets. Where the flume is short it may be economical to use a simple inlet structure and to increase the size of the flume to compensate for the simpler design.

At the outlet a part of the drop in velocity head, due to reduction of the velocity, is recovered, and under ordinary circumstances the water surface in the canal stands at a higher elevation than in the flume. The recovery will be less than the total decrement in velocity head by an amount depending upon the form of the outlet transition. The outlet shown in Fig. 9 will probably recover not less than 0.75 of the change in velocity head. If it is desired this recovery may be counted upon to reduce the total fall through the flume, but in the design of small flumes it is usually ignored to allow a margin of safety against fouling of the canal below.

The slope required to overcome friction losses may be computed from any formula for open-channel flow. Kutter's formula is quite commonly used. Few measurements have been made under actual operating conditions for determining the frictional resistance of metal flumes. The coefficient of friction will vary widely with the type of joint, condition of surface or paint, the alignment and profile and with the general condition in which the flume is maintained. The results of a limited number of observations made by the U. S. Reclamation Service are given in the table on p. 860. Additional experiments made by F. C. Scobey, irrigation engineer, Department of Agriculture, and V. M. Cone, Colorado Agricultural College, are recorded in Bulletin 194 of the Agricultural Department. It will be observed that for smooth flumes n ranges from 0.0139 to 0.0097, the average value for twenty-one experiments being 0.0114. For the Maginnis type the average is 0.0185, and for the Newcomb, 0.0128. A value of $n = 0.012$ is believed to be conservative for smooth interior flumes on tangent or easy curves properly maintained. On badly-curved or poorly-maintained alignment n should be taken as 0.013 for smooth interior flumes. It has been claimed that poorly-applied paint increases the value of n. Care should be taken to see that the paint as applied leaves a smooth surface, as free as possible from sags and runs.

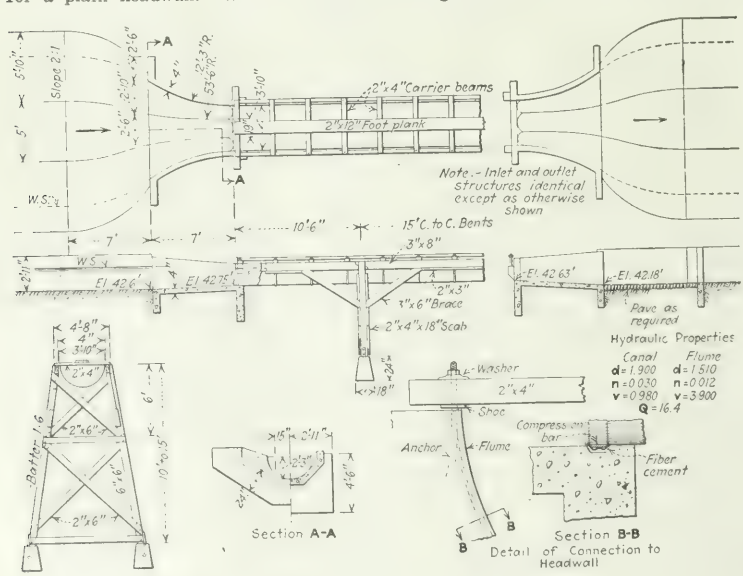


FIG. 9. TYPICAL DESIGN FOR NO. 72 FLUME SHOWING END CONNECTIONS

The selection of the proper size of flume for a given set of conditions is greatly facilitated by the diagram, Fig. 10. Let it be required to select a flume to carry 120 sec.-ft. on a slope of 0.001, with $n = 0.012$.

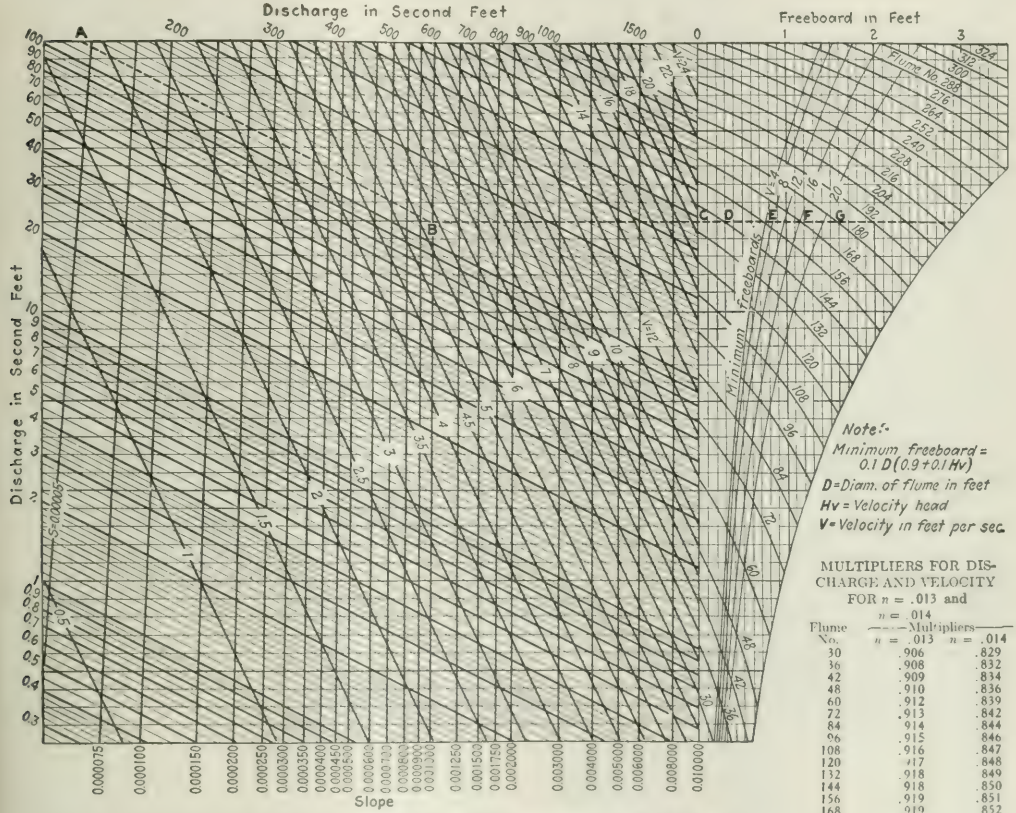


FIG. 10. DISCHARGE DIAGRAM FOR SEMI-CIRCULAR FLUMES WITH $n = 0.012$

MULTIPLIERS FOR DISCHARGE AND VELOCITY FOR $n = .013$ and $n = .014$

Flume No.	Multipliers $n = .013$	Multipliers $n = .014$
30	.906	.829
36	.908	.832
42	.909	.834
48	.910	.836
60	.912	.839
72	.913	.842
84	.914	.844
96	.915	.846
108	.916	.847
120	.917	.848
132	.918	.849
144	.918	.850
156	.919	.851
168	.919	.852
180	.919	.853
192	.920	.853
204	.920	.854
216	.920	.855
228	.921	.855
240	.921	.856
252	.921	.857
264	.921	.857
276	.922	.858
288	.922	.859
300	.922	.859
312	.922	.860
324	.923	.860

Enter the diagram at *A*, with the required discharge and pass diagonally downward to the right to intersect the given slope at *B*, and note the approximate velocity. Passing horizontally to the right from *B*, the required size of flume (fractional in this case) flowing full is found at *C*. Passing still farther to the right through the point *D*, *E*, *F*, *G*, etc., it is found that the given discharge may be carried by a No. 144 flume with a freeboard of 0.3 ft., a No. 156 flume with a freeboard of 0.75 ft., a No. 168 flume with a freeboard of 1.2 ft., and so on. The smallest flume that will carry the discharge with a safe freeboard should be selected.

The freeboard should be sufficient to provide for the passage of floating matter under the cross-beams and to allow for decrease in carrying capacity due to improper maintenance. It should also provide a margin of safety against slopping over. The standard freeboard lines on the diagram are platted from the U. S. Reclamation Service standard equation for freeboard in metal flumes, which is given in the notes accompanying the figure. In the example under consideration the correct size of flume is found at *E*, where the velocity corresponds approximately to that noted at *B*.

The diagram is general, except as to value of n, and procedure for conditions other than those illustrated will suggest themselves. The flume-number lines in the right-hand part of the diagram are not platted for freeboards greater than one-half the depth of the flume, but may be extended down to zero depth if desired. Freeboards are used in preference to depths for convenience. Velocities taken from the left-hand diagram are exact for a freeboard of 0.1 of the diameter, but are approximate for other freeboards. All other quantities are exact within the accuracy of the diagram. Theoretically the flume-number lines in the right-hand part of the diagram, if platted to cover all combinations of discharge and slope, are bands of measurable widths rather than true lines, since with Kutter's formula sections of dissimilar shape equivalent on one slope are not equivalent on another. It is found by trial, however, that the width of band is small, and can only be detected by carrying computations to an accuracy beyond the scope of published tables and diagrams for Kutter's formula. The unavoidable mechanical inaccuracies of the diagram overbalance the theoretical errors, and the diagram is exact within its limits. The velocities given are sufficiently accurate for use in determining the freeboard. If great accuracy is required, the velocity may be obtained by dividing the discharge by the area.

A table of multipliers is given in Fig. 10, to be used

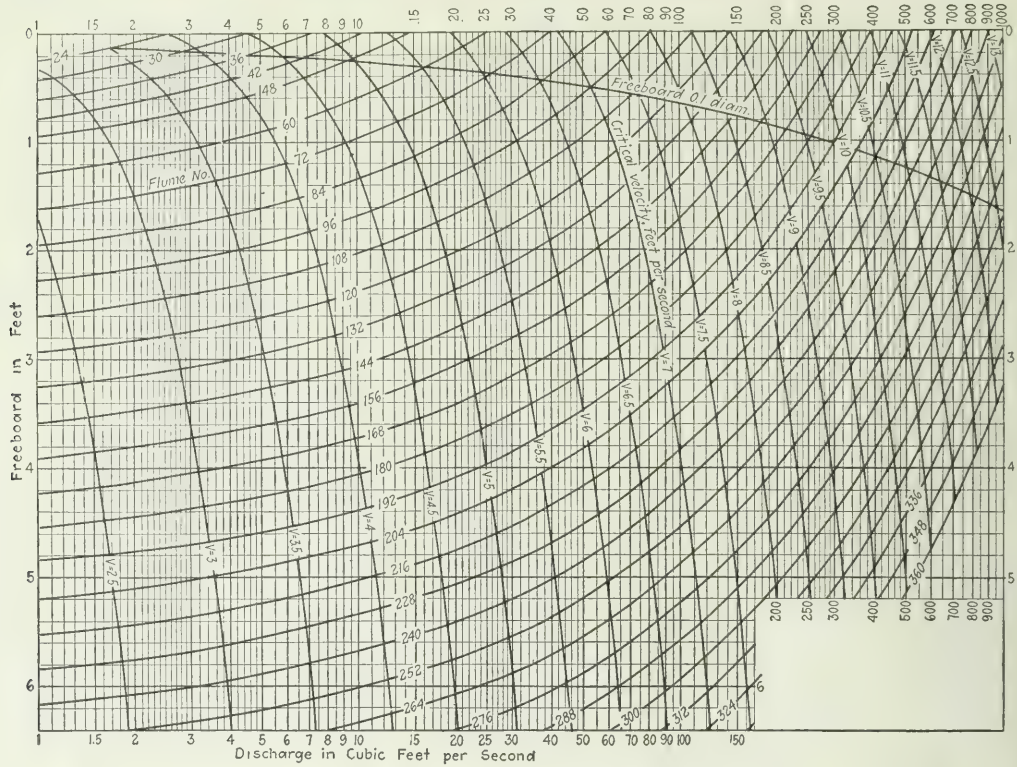


FIG. 11. CRITICAL VELOCITIES AND FREEBOARDS FOR CRITICAL DEPTH IN SEMI-CIRCULAR FLUMES

where the value of n is 0.013 or 0.014. The velocity and discharge taken from the diagram should be multiplied by the proper coefficient from the table to get the correct values for the higher friction coefficient. These multipliers are accurate for a freeboard of one-twelfth the diameter of the flume, and are close for other reasonable freeboards. They are extended from Table I of a paper on the "Discharge Capacity of Semi-Circular Steel Flumes," by E. A. Moritz, *Engineering News*, Jan. 22, 1914, p. 192.

Influence of the Critical Depth—The semi-circular flume is especially susceptible to the influence of the critical depth and the hydraulic jump. A typical example of the fluctuations resulting from flow at approximately the critical depth is given in the *Engineering News-Record* for Jan. 3, 1918, p. 38, in an abstract from the *Reclamation Record* of a paper by J. S. Longwell on "Flow Conditions, Congo Low-Line Flume, North Platte Project." A theoretical discussion, by the writer, of the "Hydraulic Jump and Critical Depth in the Design of Hydraulic Structures" will be found in the *Engineering News-Record*, Nov. 25, 1920, p. 1034.

The diagram, Fig. 11, has been prepared for the determination of the critical depth in semi-circular channels. Suppose that it is found in a given case that with the available fall a No. 168 flume with a freeboard of 1.10 ft. will be required to carry 200 sec.-ft. Following the 200-sec.-ft. line in Fig. 11 down to the No. 168 flume it is found that the critical depth corresponds to a freeboard of 1.01 ft. Flow under the given conditions will, therefore, be only slightly below critical, and

EXPERIMENTAL VALUES OF KUTTER'S n IN SEMI-CIRCULAR FLUMES

Test No.	Project	Location	Length Tested in Ft.	Size of Flume	Discharge Sec.-Ft.	Vel.	n
		Lennon Type					
1	N. Platte	Hope Creek	300	204	105	5.91	0.0123
2	N. Platte	Hope Creek	300	204	99	5.56	0.0130
3	N. Platte	Hope Creek	300	204	150	5.91	0.0129
4	N. Platte	Wild Horse	600	156	78	6.46	0.0107
5	N. Platte	Wild Horse	600	156	95	7.00	0.0105
6	N. Platte	Wild Horse	600	156	64	5.98	0.0101
7	N. Platte	Wild Horse	600	156	68	5.96	0.0106
8	N. Platte	Wild Horse	600	156	44	4.77	0.0121
9	N. Platte	West Water	400	132	56	6.83	0.0087
10	N. Platte	West Water	400	132	45	5.11	0.0105
11	N. Platte	Red Willow	690	120	40	4.37	0.0117
12	N. Platte	Red Willow	690	120	18	3.00	0.0121
13	N. Platte	Middle Creek	525	108	39	5.74	0.0097
14	N. Platte	Middle Creek	525	108	14.5	4.29	0.0097
		Smooth Type					
15	Uncompahgre	King Lateral	197*	120	62.5	8.04	0.0122
16	Uncompahgre	Happy Canyon	350*	192	36.5	2.40	0.0117
17	Uncompahgre	Spring Creek	300†	168	20.8	2.04	0.0139
18	Uncompahgre	Happy Canyon	250	204	177	6.23	0.0131
19	Uncompahgre	Happy Canyon	250	204	184	6.30	0.0121
20	Uncompahgre	Happy Canyon	230	204	127	5.06	0.0125
21	Uncompahgre	Happy Canyon	220	204	73.9	4.17	0.0103
		Maginnis Type					
22	Uncompahgre	King Lateral	140*	108	42.1	4.85	0.0175
23	N. Platte	Lat. 21-M	590	132	38.5	3.91	0.0188
24	N. Platte	Lat. 21-M	590	132	23.0	3.34	0.0178
25	N. Platte	Lat. 21-M	590	132	17.0	2.98	0.0180
26	N. Platte	Lat. 21-M	490	132	75.8	4.53	0.0202
		Newcomb Type					
27	Huntley		100	108	15.26	2.39	0.0135
28	Huntley		100	108	15.26	2.22	0.0133
29	Huntley		100	108	15.26	2.10	0.0129
30	Huntley		100	108	15.26	2.015	0.0123
31	Huntley		100	108	15.26	1.83	0.0130
32	Huntley		100	108	15.26	1.755	0.0123
33	Huntley		100	108	15.26	1.625	0.0128
34	Huntley		100	108	15.26	1.505	0.0130
35	Huntley		100	108	15.26	1.475	0.0122

* Tangent. † Tangent and curves.

objectionable fluctuations are likely to result. If the slope cannot be changed, a larger flume should be used to provide a greater freeboard.

Where flow in the flume is below the critical depth, special consideration must be given to the inlet and outlet structures. A discussion of the design of transition for this condition will be found in the paper above referred to on the hydraulic jump and the critical depth.

Costs—It is difficult at the present time to predict in advance the cost of any class of construction work, and estimates, even of a comparative nature, should be based upon actual quotations wherever possible. In general a metal flume will cost less for first installation than a concrete siphon or concrete flume, but comparison with wood flume or wood-stave or light-steel pipe will depend upon local conditions. In making any cost comparison due consideration should be given to maintenance and replacement costs.

Roughly, the cost of erecting the metal work of the flume barrel will amount to about 10 per cent of the purchase price. Freight and hauling should be added. The cost of erecting flume trestles is comparatively high. For small and medium-sized flumes the cost of furnishing bolts and nails and erecting structures will be approximately equal to the cost of the timber. The cost of the concrete pedestals should be figured separately. The field cost of the metal work in place, as constructed by the U. S. Reclamation Service in 1919 and 1920 was from 15c. to 20c. per pound.

Motor Vehicle Registration and Revenue in 1921

THE U. S. Bureau of Public Roads has issued the figures given in the accompanying table covering the registration of motor vehicles in the United States and the revenue received from them during the year 1921. The total passenger-car and motor-truck registration was 10,465,995 and the total revenue from registration and license fees was $122,478,654. Gasoline taxes in 12 states contributed an additional revenue of $4,968,971.

Of the total vehicles registered 9,432,844 were passengers cars, 982,604 were motor trucks and commercial cars, and 50,547 were taxicabs and buses.

TABLE I—MOTOR VEHICLE REGISTRATIONS AND REVENUES FOR THE YEAR 1921.

State	Total Car And Truck Registration	Passenger Cars	Trucks and Commercial Cars	Taxis and Buses	Trailers	Motor Cycles	Total Gross Motor Vehicle Registration And license Revenues	Gross Revenues From Gasoline Tax	Motor-vehicle Revenue Available for Road Work By or Under State Highway Department	Under Direction of Local Authorities
Alabama	82,366	69,422	9,110	3,834	.....	810	$1,147,265		$917,812	.....
Arizona	35,611	31,069	3,980	562	.....	440	195,970	$87,928	195,970	.....
Arkansas	67,408	66,480	928b	.....	4	174	856,544	170,000-	256,963	$599,581
California	680,614	645,522	35,092	.....	.....	17,729	6,834,090		3,018,192	3,018,192
Colorado	145,739	136,336	9,403	.....	45	2,868	906,059	559,472	410,158	410,158
Connecticut	134,141	108,692	24,112	1,337	.....	5,282	2,129,861	176,489c	2,129,861	.....
Delaware	21,413	21,413a	.....	.....	67	541	375,469		375,469e	.....
Dist. of Col.	40,625d	33,654	5,177	1,794	.....	1,101	209,583			.....
Florida	97,957	83,111	14,846	.....	.....	1,296	734,845	283,86.	570,402	.....
Georgia	131,976	131,976a	.....	.....	.....	1,232	1,705,941	302,156f	1,705,941	.....
Idaho	51,294	46,935	4,359	.....	.....	744	841,213		210,303	630,910
Illinois	663,348	583,441	79,907	.....	.....	8,898	6,803,556		6,776,781c	
Indiana	400,342	357,025	43,317	.....	1,851	7,524	2,422,227		2,281,276	
Iowa	461,084	430,118	30,966	.....	344	3,897	7,719,127		7,217,384h	
Kansas (i)	289,539	267,891	21,648	.....	.....	2,271	1,400,000		1,400,000	
Kentucky	126,802	110,602	15,025	1,175	.....	.....	1,771,887	411,939	1,771,887	
Louisiana	77,885	67,311	10,574	.....	.....	479	453,276		453,276	
Maine	77,527	67,591	9,936	.....	.....	1,525	1,004,750		496,461k	
Maryland	136,249	120,231l	11,597m	4,421	.....	5,271	2,460,162		1,750,000	
Massachusetts	360,732	305,471	55,261	.....	472	12,048	4,717,389		4,717,389i	
Michigan	476,452	426,687	49,765	.....	4,330	6,195	6,751,925		3,135,040	3,126,456
Minnesota	323,475o	299,100	24,375	.....	820	3,150	5,672,425		5,672,425	
Mississippi	65,039	65,039a	.....	.....	.....	.....	751,947		640,545	
Missouri	346,437	346,437a	.....	.....	.....	3,609	2,505,354		2,505,354	
Montana	58,785	58,785a	.....	.....	.....	472	594,520	228,799-	274,017	274,017
Nebraska	238,704	219,781	18,923p	.....	322	1,866	2,824,811		2,116,747	705,582
Nevada	10,821	10,000	821	.....	.....	131	102,800		97,200-	600
New Hampshire	42,039	36,994	5,045	.....	.....	2,358	876,322		790,129	
New Jersey	272,994	248,477	24,517	.....	857	9,724	3,974,064		3,733,686	
New Mexico	22,559	21,155	1,404	.....	.....	132	198,633		194,052	
New York	812,031	656,291	148,553	32,687	3,213	26,998	10,288,858		7,716,644	2,572,215
North Carolina	148,627	134,884	13,743	.....	.....	1,274	2,259,240	506,019-	2,259,240	
North Dakota	92,644	90,221	2,423	.....	.....	811	683,052		201,526	201,526
Ohio	720,634r	622,044	98,590	.....	4,801	17,203	6,804,160		3,250,125	3,456,355
Oklahoma	221,300	221,300	.....	.....	.....	1,013	2,619,714			2,354,549
Oregon	118,198	103,735	14,360a	103	290	3,164	2,334,931	935,126	1,665,000	555,000
Pennsylvania	689,589	632,941	57,048		951	21,111	9,420,174	885,326-	9,470,174	
Rhode Island	54,608	43,662	9,693	1,253	41	1,751	848,724		764,483	
South Carolina	89,836	83,993	6,843		59		744,115		587,056	
South Dakota	119,274	111,297	8,277				720,587			648,528
Tennessee	117,025	102,795	14,230			1,043	1,387,870		661,655	661,655
Texas	467,616	467,616				3,905	3,806,395		1,865,080	1,852,562
Utah	50,165	40,542	9,623			309	441,360		433,360	
Vermont	37,265	33,778a	3,487			965	664,288		618,288	
Virginia	139,200	121,900	17,200			2,100	2,021,146		1,920,703	
Washington	185,359	174,859	10,500	1,381	797	3,913	3,140,731	421,848	2,800,031	
West Virginia	94,000	77,397	16,543			1,539	1,250,526		1,250,526	
Wisconsin	341,841	320,577	21,264			6,423	3,671,645		2,568,109	556,036
Wyoming	26,866	23,966	2,900			322	288,122		288,122	
Totals	10,465,995	9,432,844	982,604	50,547	22,925	197,418	$122,478,654	$4,968,971	$94,181,241	$21,423,924

a Includes motor truck registrations.
b Trucks registered after May 1, others reduced under possession rate.
c To pay interest and principal of state highway bonds.
d Does not include 8,439 non-resident passenger cars and 1,021 non-resident trucks.
e For period May 1 to December 31, inclusive.
f For period August 10 to December 31, inclusive.
g For period September 1 to December 31, inclusive.
h To state primary road fund.
i For period July 1 to December 31, inclusive.
k To state primary road fund.
l Includes 1,000 trucks registered in Baltimore City and 1,000 in Baltimore County.
m Trucks registered in Baltimore City and Baltimore County.
n Includes 1,000 trucks registered in Baltimore City and 1,000 in Baltimore County.
o Includes 1,000 trucks registered in Baltimore City and 1,000 in Baltimore County.
p Includes 1,000 trucks registered in Baltimore City and 1,000 in Baltimore County.
q Includes 1,000 trucks registered in Baltimore City and 1,000 in Baltimore County.
r Includes 1,000 trucks registered in Baltimore City and 1,000 in Baltimore County.

FROM JOB AND OFFICE

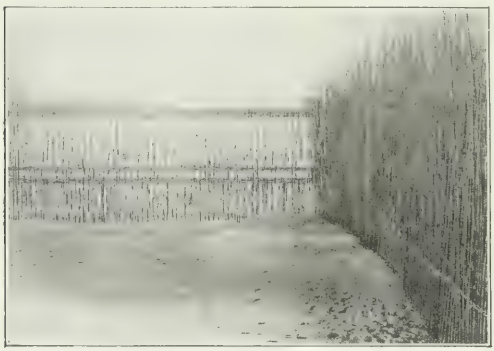
Hints That Cut Costs and Time — *For Contractor and Average Engineer*

Bamboo Dikes Aid Land Reclamation and River-Channel Control in China

LAND reclamation by permeable dikes which cause accretion is practiced by the Chinese on some of their shifting rivers which carry large quantities of sand and silt during freshets. These dikes are built by working sharpened bamboo stalks into the sand or mud of the river bed, the stalks being from 6 to 12 in. apart.

The bamboo used varies from 5-ft. tips no larger than a man's little finger to stalks 1¾ in. in diameter and 20 ft. long. If the current is not too strong the larger bamboo can be planted in water as deep as 10 ft., but most of the native work is done in shallow water. In the vicinity of Foochow, these dikes are from 6 to 12 ft. wide, of lengths up to several thousand feet, and are generally placed with the direction of the current.

In one or two seasons such a dike will cause the formation of a long sandbank with the surface well above low-water level. In the tidal portion of the



BAMBOO DIKE IN MIN RIVER, CHINA

river as soon as the sandbank gets above half-tide level a coarse grass will take root. The natives encourage this growth by planting the grass in tufts 5 or 6 ft. apart. It then spreads rapidly and by collecting the silt from the water that flows over it at every tide, it gradually builds up an island, unless the river in one of its frequent changes of channel washes the island away. Formation of new land is encouraged along the convex side of a channel by bamboo spur dikes. To protect an eroding river bank a dike may be built in such a position above the point of attack that the resulting sandbank will tend to divert the current.

In the improvement of the Min River for navigation this type of dike with slight modifications has been used with considerable success and at small cost. On this work the bamboo stalks are planted from 3 to 4 ft. deep and 6 in. apart in rows 12 in. apart, from ten to fifteen rows of the larger bamboo forming a dike, as shown in the accompanying illustration.

In order to prevent the waving of the bamboo under the action of the current which often causes the stalks to break off just above the mudline, pieces of ½-in. split bamboo about 20 ft. long are woven between the stalks in each row, two or three lines of split bamboo being carried continuously throughout the length of a dike. The bamboo is cut off at about average high-water level to avoid the collection of floating material.

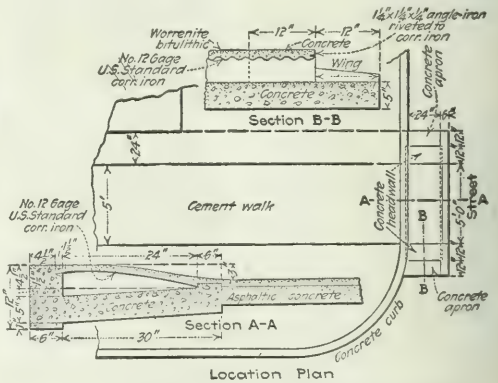
Bamboo permeable dikes have been used for several longitudinal training walls on the concave side of the channel to build up a new shore or bank for the improved channel.

This adaptation of native methods to important modern river improvement has been developed by J. R. West, engineer in chief of the Min River Conservancy, at Foochow, China. Its cost in that district, where bamboo is plentiful, is about $1.50 local currency (75c. U. S. currency) per lineal foot. The life of bamboo used in this way in the Min River is about three years, but if the dike is properly located sufficient accretion takes place to justify the expense.

Corrugated Iron and Concrete Used for Crosswalks

By W. S. Farley
City Engineer, Paso Robles, Cal.

SATISFACTORY replacement of wooden crosswalks and drainage structures has been made in Paso Robles, Cal., through the use of corrugated iron embedded in and covered with concrete. In our paving program during the past year, we used Armco part-circle culverts. Properly installed, these are a solution



PLAN AND DETAILS OF DRAIN INSTALLATION

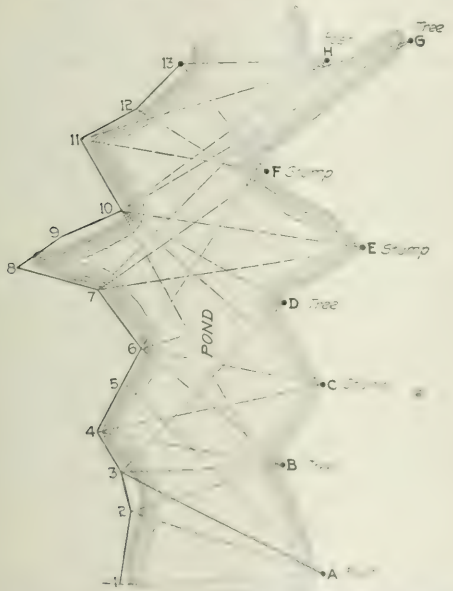
of many problems of railway and street drainage. Where sufficient headroom cannot be obtained to install a full circle, a heavy-gage arch of corrugated iron, installed between iron angles, in a well-built concrete base, and with a few inches of closely-packed covering, will satisfactorily and permanently fill the place of a far more expensive structure. This method of construction gives ample width for all purposes, with adequate waterway, and provides a smooth walk that is pleasing and artistic.

Survey Checked by Taking Side-Shot Angular Measurements

By George C. Love
Chief Engineer, Newport News Light and Power Co.

THE sketch shown herewith indicates a fair check of the accuracy of a survey traverse along the shore line of a pond. The traverse is run by azimuths along the shore and checked by intersecting lines noted to prominent objects such as trees or stumps on the opposite shore. Traverse points are indicated by the consecutive numbers 1 to 12 and the check points by consecutive letters *A* to *H*. Azimuths from three or more traverse points are necessary to check the location of any of the points on the opposite shore.

In the case illustrated the traverse along points 1 to 13 is plotted as usual. Then the azimuths turned from



LAYOUT OF TRAVERSE AND ITS ANGULAR CHECK

points 1, 3, 5 and 10 should intersect at *A*. Those from 2, 3, 4 and 6 should meet at *B*. Those from 4, 6 and 10 should intersect at *C*; those from 3, 6 and 10 at *D*. Those from 7, 10 and 12 at *E*; those from 7, 11 and 13 at *F*; those from 10 and 11 at *G*; and those from 6, 7, 10 and 13 at *H*.

A form of notes for traverse and check method is suggested below. It is better to record from the bottom of the page upward.

Set-Up No.	Survey Station, T.	Object or Station	Distance	Azimuth	Remarks

Azimuths should be carried on the plat [illegible] with the line of zeros always oriented into the meridian. If the plate is suitably numbered [illegible] convenient to carry the bearings along as courses in the various quadrants to correspond with the needle readings.

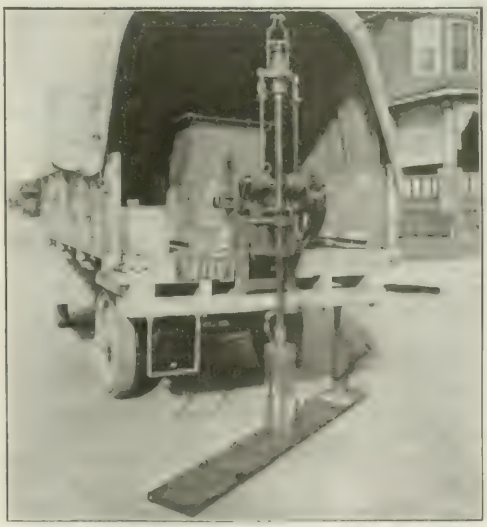
The method outlined above has these advantages:

1. Any considerable error will be apparent when the lines fail to intersect at a common point.
2. If there is an error, it is a simple matter to determine about where it is so that the whole traverse need not be run again.
3. It is a sufficient check for many purposes and will often give assurance that a traverse is substantially correct without the labor of closing a circuit on the ground or checking over angles and measurements.
4. It is adaptable to many circumstances where there is unobstructed view of prominent objects to check on.
5. In cases like the one illustrated it serves to locate the outline of the opposite shore.
6. It need not delay the progress of the party materially for the transitman can generally find time for the "side shots" during delays caused by clearing brush or the like.

Drill Averages Eight Cores per Day on New Jersey Pavements

By J. C. Bragg
Senior Testing Engineer,
New Jersey State Highway Commission

IN MAY 1921 the New Jersey State Highway Department purchased a Calyx core drill such as is described in *Engineering News-Record* of January 12, 1922, p. 53. This outfit has since been used quite successfully, not only for the purpose of investigating completed projects, but in a number of instances to determine location



IMPROVED SCHEME OF [illegible]

of reinforcement or depth of pavement on projects under construction.

In a general way there is fair agreement between the figures presented by Messrs. Dunn and Coolidge and those compiled by this department. However, we find a marked difference in the rated capacity of the drill compared with actual data kept by the New Jersey drill corps. Altogether 724 borings were made in concrete ranging in age from 7 days to 8 years. The depth of cores cut was from 4 to 12 in. and while most of the

borings were made in comparatively rich concrete, quite a number were cut from base concrete of 1:2½:5 proportions. The coarse aggregate used in these pavements is fairly well divided between trap-rock and gravel, with a few dolomitic limestones. The average depth of all borings is 7.5 in. and an average day's work (not including moving from one job to another) is 8 cores with a maximum of 10 cores per day.

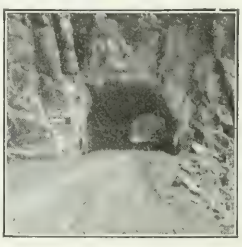
Messrs. Dunn and Coolidge state that this outfit averages 16 cores per day. They further state that from 15 to 25 min. are required for cutting each core. From these figures we may assume an average of 20 min. per core. Obviously, the drill cannot be moved ½ mile and the set-up made in less time than that time. At this rate the total time required for drilling 16 cores becomes 10 hr. 40 min., and no time has been allowed for running to and from storage, filling with gas and oil, replenishing the water tank, etc. Our drill operator reports 35 min. as a minimum for the time necessary to drill through 8 in. of good quality trap-rock concrete, and estimates as an average, 45 min. actual drilling time per core.

The New Jersey drill corps consisted of 3 men, a junior engineer in charge, assisted by a truck driver and his helper. All data relative to location of cores, condition of slab, etc., was attended to by the engineer. When time was available he also assisted in the filling of core holes. In most cases the core holes were filled with concrete to which an accelerator had been added, and which was mixed while the core was being drilled. In some cases, where it was desired to examine the subgrade at a later date, the core holes were filled to within 2 in. of the surface with stone, the remainder of the hole being filled with top-course Amiesite. The actual cutting of the core was done in the manner described by Messrs. Dunn and Coolidge with as much pressure applied to the drill as is possible without stalling the drill motor or appreciably decreasing the speed.

While no exact figures were kept as to the amount of water used we find that the estimate of 3 lb. of Calyxite per core practically checks our own figures. When taking a sample of the subbase material from the core hole such shot as had not been ground to pieces was recovered. This shot, amounting to about 25 per cent of the total used for cutting each core, was later washed and sieved to remove foreign material. The sprung weight of the drill outfit shown on p. 864 is raised by means of a jack which rests on one end of the guide board. This method eliminates the necessity of using a timber to keep the weight of the outfit off the truck springs. The drill can be set up in much less time than when the guide-board is held in position by the back wheels of the truck resting on planks, the ends of which are placed on top of the guide-board.

Rock Tunnel on Arizona Road

A Federal-aid road being constructed by the State of Arizona will shorten the distance from Superior to Miami from approximately 100 miles to 20 miles. Much difficult work has been encountered on the job, including a tunnel 277 ft. long, being constructed through solid rock.



FROM JOB AND OFFICE

Hints That Cut Costs and Time

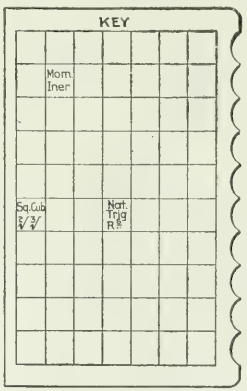
New Method of Thumb Indexing Books

By A. C. Hewitt

Office of Chief Engineer, Way and Works, Government Railways, Perth, West Australia

TIME-SAVING, where possible, is the order of the day. The time saved by using thumb reference indexes compared with alphabetical indexes is considerable, but one of the disadvantages of thumb indexes lies in the fact that they are not comprehensive enough. The latest edition of Trautwine, for instance, with over 1,500 pages, has sixteen thumb references, whereas there are about seventy sections in the book to which rapid reference is desirable on the part of those using it frequently.

The writer has successfully used as many as 70 references on a 1,200-page Trautwine in the following manner. It was decided at the outset that the largest number of thumb holes which could be satisfactorily placed in the length of a page was ten. Therefore to get seventy references it became necessary to work down the pages from top to bottom seven times. The average number of pages per reference was therefore about seventeen. This gave approximately 170 pages between reference 1 and reference 11, reference 11 and reference 21, etc., which were immediately underneath each other.



KEY-SHEET USED IN INDEXING BOOKS

To allow convenient insertion of the thumb about eighty pages required to be cut through in the usual segmental form. After planning the references required (Trautwine divides into convenient sections very readily), it was not difficult to cut the thumb holes with a sharp gouge, never cutting through more than 80 pages.

The usual method in thumb indexing is to print an abbreviated title of the section in the thumb hole. With as many as seventy references this became impossible, and a key-sheet was prepared and placed on the blank page immediately preceding the title page. A copy of this key-sheet with but one or two references filled in is shown herewith.

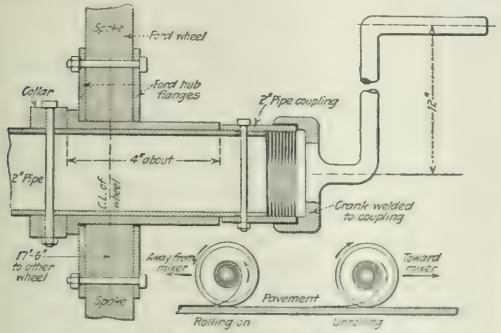
In using the index the book is opened at the key-sheet, and the eye is run over the titles, which are carefully chosen to catch the eye quickly, while being as short as is consistent for the purpose. Suppose we are seeking moments of inertia. Place the thumb in position at the edge of the book opposite the reference "Mom. Iner." While doing this the fact that the reference is in the second column, or the second down in the thumb-hole rows, is noticed and we rapidly drop the thumb onto the required thumb hole. The reference is made much more speedily than it is described.

FROM JOB AND OFFICE

For Contractor and Average Engineer

Homemade Device for Placing Burlap on Fresh Concrete

THE PRACTICE of covering fresh concrete pavement with burlap to prevent too-rapid drying out and consequent surface checking before the concrete can set sufficiently to permit of covering it with dirt was commenced on state highway work in California about a year ago. California highway commission specifications now require that green concrete shall be



CONSTRUCTION OF WHEEL HUB AND HANDLE

The bushing is turned to fit the 2-in. pipe and is welded to the hub flange. Small scale sketch indicates most convenient method of rolling and unrolling burlap.

so protected. Since this requirement has been adopted there has been no further difficulty with surface checking, such as had previously become quite common particularly where the pavement was exposed to hot sun or dry air. As a means of facilitating application of the burlap immediately after the concrete is poured a reel spanning the pavement has been devised with which two men can speedily and easily unroll burlap onto the concrete or roll it up again.

The reel consists of two Ford wheels supporting a shaft of 2-in. pipe. For handling burlap in strips 16 ft. wide an 18-ft. length of pipe is used. The pipe rests in closely fitting bushings which are welded to the hub flanges, as shown in the accompanying sketch. The ends of the pipe project through these bushings and removable handles are used to turn the shaft in the bushings when rotation of the reel is desired independently of the wheels.

One advantage of this construction is that it allows burlap to be wound or unwound without turning the wheels or when the wheels are turning, as may be desired. Also, the reel can be rolled forward or backward as a whole without allowing the axle to turn.

Two reels are ordinarily used and about eight 50-ft. lengths of burlap. This is enough to cover the ordinary half-day's run. Two men handle a reel and another sprinkles the burlap as it is unrolled. It is essential that sprinkling be done at the same time as the burlap is unrolled, using a spray nozzle to prevent pitting the concrete. If kept wet the burlap will not stick to the concrete. Under ordinary conditions the burlap is kept on for three to four hours. When the burlap is removed the pavement is immediately covered with dirt and prepared for the regular curing process. As rolled up the burlap is usually more or less wet and in this condition a 50-ft. roll is estimated to weigh from 200 to 250 lb.

The burlap is wound carefully to keep it straight on the reel and free of wrinkles so that it will unroll evenly. In unrolling the handles are used to regulate



CLOSE-UP OF THE REELS

the desired rate of turning the shaft so as to avoid the necessity for pulling or stretching the burlap after it is laid, which might cause irregularity in the concrete surface. Experience of the California highway commission indicates that the burlap should be discorded and replaced after being used on about 3 miles of pavement.

Earlier methods of placing burlap were by hand, usually taking 6-ft. strips of a length slightly greater than the pavement width. The use of 20-ft. lengths was tried but was abandoned as too expensive when it was found that about eight men were required to properly handle such large pieces.



PLACING BURLAP ON FRESHLY-POU[illegible]

Iron Ball Bulldozes Foundation Rock

IN SHOOTING drill holes for excavation work in New York City the schist encountered often splits into too large sizes to handle easily. Bulldozing shots are rather dangerous. To break this rock to convenient sizes the Clarence L. Smith Co., Inc., foundation contractors, uses a 1-ton iron ball, fitted with an eye-bar. This ball is handled by the derricks, which drop the ball on the rock, crushing it into sizes which are easy to handle.

Portable Trestle Horses for Concrete Forms

IN THE construction of the new concrete bridge across the Connecticut River at Springfield, Mass., standard horses are used to carry the forms for the floor construction. The accompanying view shows some of these in place. They are of trapezoidal sections cut with the long and short legs to fit the rise of the arch and



HORSES FOR FLOOR FORMS ON SPRINGFIELD BRIDGE

of equal length legs but of varying heights for the transverse horses which span between the adjacent arch rings. These horses are set up in place on the arch ribs and the floor forms placed upon them. After the floor is poured they are moved over to the next arch.

The work is being done by the H. P. Converse Co. and the engineers are Fay, Spofford & Thorndike of Boston.

Whitewashing Structures Along State Highways

By P. E. Burroughs
District Engineer, Maryland State Roads Commission

DURING the winter of 1921 the writer made some experiments and observations to determine a good inexpensive wash for whitewashing public service poles, culverts, headwalls, and other structures along highways. The formula finally used was: ½ bag hydrated lime, 6 lb. common table salt, 1 pint molasses, 3 oz. ground alum, and 10 gal. hot water about 1,750 deg. F.

Molasses renders the lime more soluble and causes it to penetrate the surface to be painted. Alum gives an added adhesive power to the wash. Hydrated lime or a factory slaked material is preferable to a hand or field-slaked lime. These ingredients thoroughly mixed give a yellowish paint that whitens upon drying. Best results were obtained on poles that had stood two years. New poles bleed and will discolor any wash after the first year's application. Again the kind of wood has a great influence upon the results obtained. Cypress and chestnut give the best results with a slight preference given the former.

FROM JOB AND OFFICE

Hints That Cut Costs and Time

The best results were obtained with the use of the following equipment and organization. 1 G.M.C. ambulance truck, 1 50-gal. heating kettle or tar pot, 2 bbl. for mixing, 6 3-gal. pails, straps and brushes, one foreman, and four painters.

Enough material was carried out in the morning for the day's work. The heating kettle, trailing the truck, was used for heating the water. The kettle was filled every time water was easily obtainable. Two mixing barrels were used. In this way the foreman and chauffeur had ample time to keep enough hot water and mixed wash on hand. A very high-grade brush was found to be the most economical.

One pail of wash would paint about ten poles. The painters were separated about ten poles apart and transferred ahead by truck in leap-frog fashion. In case of a double line of poles, two painters were assigned to each side of the road. Each painter was supplied with a leather strap that was lashed around the pole about 4½ ft. from the ground to insure a neat line at the top of the painted section.

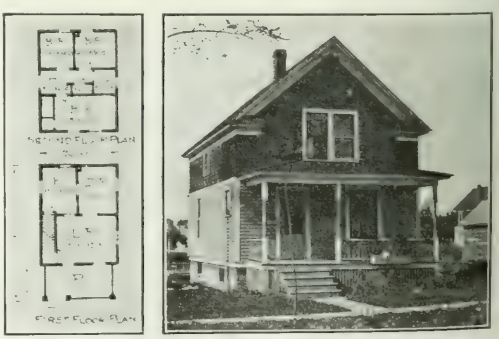
Each man was required to wash headwalls and all protecting fence posts, trees, etc., that fell in his span, and everything was finished as encountered. All culverts and bridge walls up to 25-ft. spans were washed on the road side and two ends, the outside face being omitted except where the headwall fell on the inside of a sharp curve.

That this work can be done at a very low cost can be seen by the fact that we covered 220 miles at an average of $2.71 per mile, including all materials, labor and incidental expenses, except the chauffeur's salary. This average per mile cost was distributed as follows: Labor, $1.48; straps and brushes, $0.06; lime, $0.48; salt, $0.08; molasses, $0.06; alum, $0.12; truck expenses, $0.43.

Plan and Photograph of House Shown on Same Print

By Norman G. Ray
Civil Engineer, Massona, N. Y.

IN THE endeavor to make more effective a house-selling campaign, a system was devised whereby both the plans and a print of the house were included on the



PRINT CONTAINS HOUSE PLANS WITH PHOTOGRAPH

FROM JOB AND OFFICE

For Contractor and Average Engineer

same photograph. By such means the prospective buyer was able to get a better idea of what the house was like and therefore need waste no time in visiting houses that did not suit his ideas.

A wooden frame the size of the space required for the title and plan was inserted in a camera directly in front of the ground glass and the exposure of the house was made. The title and plan were drawn on a piece of tracing cloth the size of the plate or film. An opaque mask slightly larger than the exposed part of the film was placed in a printing frame and the tracing placed over it with the printing exposed. The film was then placed over both mask and tracing. Care had to be taken in transferring the film to keep the exposed part covered by the mask. The back of the printing frame was then clamped on and the film exposed.

For any person using this method the first time it would be best to take several pictures of the same object so that should the first exposure of the tracing come out badly, a second one could be made.

When the film has been exposed to the tracing the usual method of developing it is then followed. When printing it is best to use an opaque mask to give a white border and a division between the picture and the plan. If the negative has the same density all over, one exposure will give a print, otherwise the whole is exposed and then the light cut off from the center portion and the balance exposed for the proper length of time.

Highway Underpass Has Central Curb as Guide to Traffic

By B. H. Faber
Engineer, Colorado County, Texas

TO PREVENT motor-vehicle accidents at an underpass below the Southern Pacific R.R. tracks at Weimar, Texas, where the view of the driver is obstructed at a reverse curve by the concrete abutments of the bridge structure, a special type of construction involving a central curb as a guide to traffic has been employed, as shown in the accompanying photograph. The length of the underpass equipped with curbing is 200 ft. and in addition there is a 200-ft. length of concrete-paved approach.

The width of the underpass paving is 20 ft., divided by the central curb into two 10-ft. lanes. The curbs are 8 in. high and at each end there is an 8-in. square reinforced-concrete post carrying the warning, "Keep to the Right." The pavement proper is 7 in. thick, reinforced with ¼-in. round bars on 12-in. centers both ways.

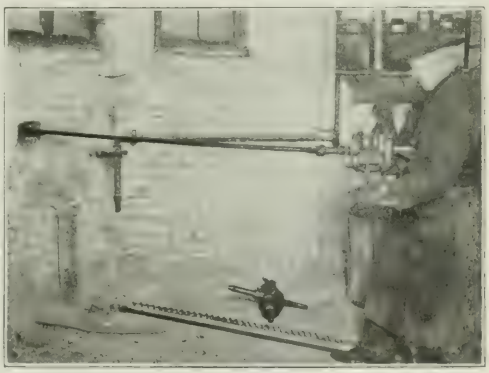


CENTRAL CURB PREVENTS COLLISIONS OF VEHICLES

The highway portion of the underpass cost about $5,000 to construct. At the point of crossing under the railroad tracks the alignment called for 30-deg. curves.

Air Drill Eliminates Trenching For House-Service Pipes

TESTS MADE by boring or drilling from cellar to curb using air drills disclose a considerable saving over the trenching method in installing house-service pipes. Fifty-three services aggregating about 1,000 ft. of pipe were recently installed in New York City. In installing a service the cellar wall was first cut through with a chipping hammer. Then an air coal drill completed the boring, coal augers and three lengths of extension bars being used. The illustration shows the first drilling operation which carried the hole 10 ft.



INSTALLING HOUSE SERVICES WITH COAL DRILLS

On the floor are the long auger and extension bar for the final drilling operation.

According to the tests (which were made in installing electric services) a saving of over $8 a service was shown in comparison with trenching and back-filling and removing and replacing sidewalk flags. The tests were made by the Brooklyn-Edison Co., Brooklyn, N. Y., using Boyer hammers and Little Giant reversible coal drills.

Track Scales Showing Wheel Loads

Track scales for locomotives, to indicate the weight carried by each wheel, are used by several English railways, according to the *Railway Gazette*, London, in commenting upon the large track scale for this purpose described in *Engineering News-Record* of Nov. 17, 1921, p. 808. In the English design, each rail of the scale table is divided into several independent sections, each of which is mounted upon an independent scale. Thus with a locomotive on the scale, separate dials show the weights upon the several wheels. This arrangement is satisfactory for individual railways, but for locomotive works building engines of extreme variety in size and wheel arrangement it probably would be difficult to divide the scale satisfactorily.

Flood Water Conditions on the Lower Mississippi

Crevasses at Three Points Have Reduced Predicted Crests—None to Be Closed—Tying Ends—Loose Earth for Topping

By W. W. De Berard
Western Editor, *Engineering News-Record*

THERE were three crevasses in the Mississippi River levee system below the Louisiana-Arkansas line during the high water of April; one opposite Natchez in Louisiana at Weecama Plantation near Ferriday, a second at Poydras in the east levee 12 miles below New Orleans and a third at Myrtle Grove 35 miles below New Orleans in the west levee. The dates are April 25, 27 and 23 respectively for the three breaks. They occurred at or near the highest stage of the river ever recorded at New Orleans, 22.7 on April 28. The crevasses have given sufficient outlet to check the rise to the predicted 23.5-ft. stage, although with the falling river upstream it is doubtful whether that stage would have materialized even though the levees had not broken. All three crevasses have been sudden collapses of such magnitude as to make any immediate measures futile and nothing will be done at any one of them to close the openings until the high water recedes.

Early ineffectual attempts were made to tie the ends of the Weecama break. Nothing has or will be done with the Myrtle Grove crevasse, but the lower end of the broken levee at Poydras by May 6 had been protected by a single row of wood sheetpiles driven 400 ft. away from the slowly crumbling end. The upper end in slack water was not washing; however, it was the intention to tie it when the writer inspected the crevasse on May 6 in company with Major J. T. Butler, Corps of Engineers, temporarily loaned from Wilson Dam to Major R. T. Coiner, Corps of Engineers, district engineer in charge of the Fourth District of the Mississippi River Commission.

As in the Third District of the Mississippi River Commission, noted in the *Engineering News-Record*, May 18, the same energy has been displayed in the expansion of the skeleton military organization of the Fourth District. The same co-operation has been effected with the local levee boards, state and municipal officials and relief agencies.

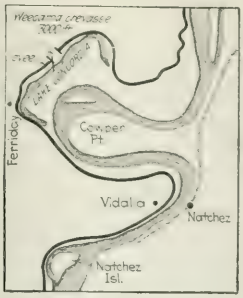
Low places in the levee for 60 miles have been topped with sacks or the crowns built up with loose earth behind timber bulkheads. Boils and back-slope protection has been similarly handled. More use has probably been made of highways because in general well-graveled trunk lines follow the toe of the levees. The loose earth has been handled by wheelbarrows, by teams and by barges. Wherever possible the earth has been taken from abandoned levees. Moving teams up the back slope was not desirable but the necessity of speed has at times made it imperative. Major Coiner had recently obtained levels of all the levees in his district so that the location of low places was known and plenty of time elapses before rises in the upper river show below. A Cairo crest appears at New Orleans in about four weeks. In general the lower levees are not so high as those farther upstream. The natural river banks have been built up to comparatively higher elevation near the outlet. This fact is fortunate for in some places the material will not support high embankments.



POYDRAS CREVASSE, 800 FT. LONG, AT AN EARLY STAGE

Weecama Crevasse—The crevasse at Weecama Plantation is 4 miles above Ferriday and was preceeded by a sand boil in the highway 20 ft. from the levee toe. A ring of sacks was being built around the boil but before it could be raised high enough to reduce the velocity below the silt-carrying point undercutting was sufficient to permit about 40 ft. of levee to subside and blow out. This opening rapidly extended to several hundred feet in width as the available embankment material in this locality is a sandy loam which crumbles fast. By May 7 the crevasse had widened to 3,000 ft. Closure has not been attempted nor have the ends been tied. The levee was 15 ft. high, had an 8-ft. crown and 1 to 3 slopes on both sides. The site is along the bank of an old cut-off lake where there was little current, the main channel being nearly a mile to the east. No particular anxiety had been felt over this point because

of the distance from deep water and swift current. Little relief was to be expected at New Orleans from this crevasse because the escaped waters finally find their way back to the Mississippi through the Red River. It is estimated that the area flooded will total 1,000 square miles, although much of this acreage was already covered by back water from local sources.

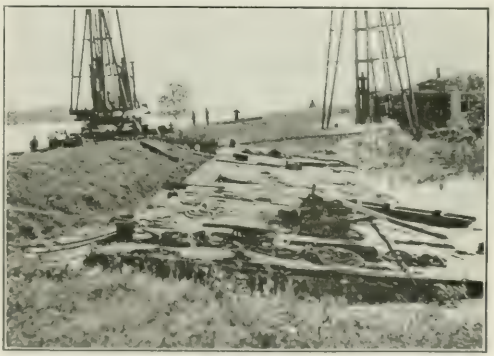


WEECAMA CREVASSE ABOVE NATCHEZ

Poydras Break—The failure at Poydras Plantation occurred on the outer side of a large horseshoe turn and was caused by undercutting of the 200-ft. batture and the levee by the main river current. This is one of the few water-side breaks in a levee brought up to standard grade. The section is practically that of the Mississippi River Commission, with the exception of the banquette. The break occurred at 2 a.m., a few minutes after a guard had passed. It is estimated that from 300 to 400 ft. slid into the river. Before assistance could be obtained the river had cut away the tough "buckshot" embankment to the ground surface and the velocity due to the 14-ft. difference in head was cutting away the ends of the levee. A decision to delay closure until the high water receded was reached because of the excessive cost. Further it was considered that about as much damage had been done to the truck farms which are inundated as would occur if the break were left open. If the backwater is not stopped at the new industrial canal below New Orleans there is a protection levee below the city.

Tying Ends of Poydras Break—A contract for tying the ends of the Poydras crevasse was entered into with W. M. Wren, contractor. The procedure was to drive 30-ft. patented locked tongue-and-groove, triple-lap wood sheetpiles in the form of a bridge abutment, 30 ft. across the crown, 70 ft. in a wing down the slope on the river side and 100 ft. on the land side. The point chosen for the lower end was about 750 ft. back from the original break. Before the work was completed about 400 ft. had been eaten away. Work started May 1 and was completed May 6. The upper end is in slack water and although it is not cutting it will be protected.

Two pile drivers on barges with 10,000-lb. steam hammers were pulled through the 500-ft. stretch of timber between the river and the levee by anchoring

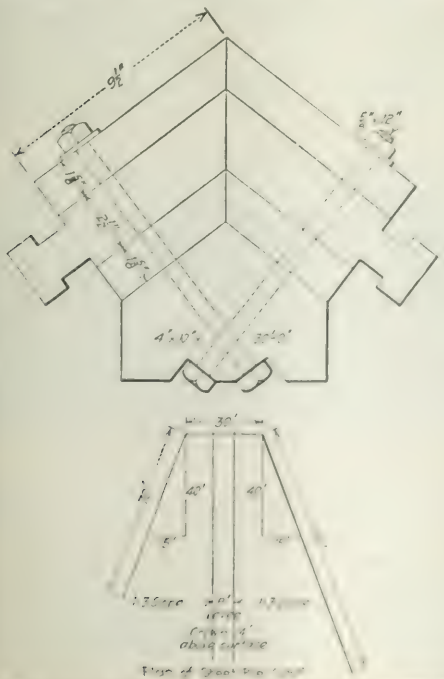


DRIVERS WORKING ON PILE "TIE" AT POYDRAS

to a deadman in the levee. Willows as large as 6 in. in diameter were pressed down as the barges passed over them. One of the barges was old and the contractor sunk it on the river side just above the line of piles after rolling the driver it carried onto a pile platform along the levee. It required three days to set up and two days to drive the 200 ft. of piles.

Barges carrying material and supplies, loaned by the commission were anchored in the willows on the river side. A way through the willows was cut by running a small boat back and forth several times. The sheetpiles were "snaked" in end to end, being fastened together by a 3-ft. board and 20 d. spikes.

The sheetpiles are made of a central 2½ x 9-in. plank and two outside plank 1¼ in. thick. As they arrived on the job they were spiked every 18 in. with 60 d. spikes, clinched on the far side. Some of the piles were shattered in driving and had a tendency to buckle, so an additional row of spikes was driven, making the spacing 9 in. c. to c. Near the water line the 10,000-lb. hammer would force the piles down the first 8 ft. without driving. The last blows effected but 2 or 3 in. penetration. The lock in these piles is designed to swell 4 per cent and make a watertight joint. Special angle pieces were designed as in the sketch. The piles were tied together near the top by a 4 x 6-in. walk on each side, held in place by ¾-in. bolts every 3 ft. The contractor's crew was quartered in government tents set up on one of the supply barges.



PILES DRIVEN TO "TIE" END OF [illegible]

Marble Grove Crevasse—The break at Marble Grove

Plantation occurred in the middle of the night in an 8-ft. levee and was due to a sand-boil blow-out as at Weecama. The flood water now flows across a strip of comparatively high land averaging a mile in width and then across flat sea marshes into bayous and lakes connecting with Barataria Bay. No attempt will be made to do anything with this break until the flood subsides.

Earth Topping—In the Fourth District the practice of raising the crown with loose earth rather than with sacks is based on the theory that sacks are hard to make watertight, especially at the tops and bottoms. Further sacks are hard to get and expensive to fill. The loose earth is easy to handle in wheelbarrows from the fields or from barges, by teams with slip scrapers or by truck over the highways if necessary to haul from a distance.

In constructing the timber bulkhead a 2 x 4-in. stake is driven about 1 ft. from the water edge of the crown and one, two or three 1-in. boards 12 in. wide are nailed to the land side of the stakes. The bottom board is set into the ground an inch or two. If straight-edged boards cannot be obtained and cracks show, strips of burlap or sacks are split down the sides, laid on the ground and tacked against the boards before the earth is dumped against the bulkhead. The top width of the added earth is made sufficient to meet the continuation of the original back-slope on the levee, if the height is 2 ft. or more

Locomotive Operates Vicksburg Water-Works During Flood

ALTHOUGH the high-water level in the Mississippi at Vicksburg during the recent floods was sometimes at least 30 in. above the floor of the water-works pumping station—up to the grates of the boilers and near the tops of the filter walls—operation of the pumps and filters was continued without interruption. When notice of the highest-of-record stages was received, J. A. Steele, Jr., general manager and superintendent of the water-works, had brick and concrete bulkheads placed in all of the doorways and sack bulkheads laid along the water side of the settling basins and filters. In consequence the operators worked in the dry whereas in the 1916 flood they had to wade around the station in 2 ft. of water.

After the 1916 experience Mr. Steele waterproofed the brick walls of the pumping station by plastering with concrete on the outside. The concrete floors were also waterproofed and all cracks repaired to eliminate seepage. The walls of the filtered-water and settling basins were raised 2 ft. and the walls of the former were waterproofed.

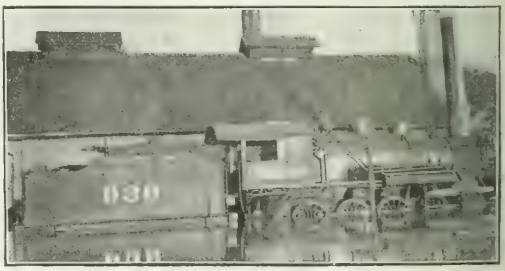
In case one of the bulkheads had given way, or seepage gotten beyond the control of the various sump pumps temporarily installed at various points, the fires in the regular boilers would have been extinguished. To guard against such a contingency the Illinois Central loaned the city a locomotive with an 800-hp. boiler. A coal siding alongside the station was raised 2 ft. and the engine run in before the flood reached the crest, as there is a low place between the station and the main switch yard. The water had receded but a few inches when the accompanying views were taken by a representative of *Engineering News-Record.* At that time the water came up on the engine about 30 in. The firebox was then about 2 ft. out of water. On account of annulled train service due to high water (for 30 miles north of Vicksburg backwater covered the tracks) plenty of engines were available. After making a steam pipe connection from the locomotive to the pumps a test of 48 hours was run to make certain that everything was in working condition. Up to May 5, when the water was slowly receding, no regular use of the locomotive had been required. To furnish it and the station with fuel, several cars of coal were brought in behind the engine.

Two sets of new boilers have been ordered to replace the old ones, which had stokers set too low and also which burned pea coal formerly costing 35c. per ton and now $6.50. The new boilers will be set for flood stages of 40 ft. which is more than 2 ft. above the present crest elevation of the flood.

Water Supply for Bermuda Golf Course

A CONCRETE paved catchment area of 3½ acres and storage basins with a total capacity of 1,250,000 gal. have recently been completed for the greens of the new mid-ocean golf course at Tucker's Town, Bermuda. The catchment area is on the sloping hillsides adjoining the course. Here concrete has been laid to the depth of 6 in. Baffle and guide walls of coral blocks have been built to break the velocity of the water and lead it to a "catch basin" and five concrete storage tanks. A daily water supply of 10,000 gal. is required for the 18-hole course. The 52 in. of annual rainfall is well distributed through the year, which simplified the problem of providing water. The catchment area was paved and the other work done by The Foundation Company, New York City, under the superintendence of C. W. McInnes.





FLOOD BULKHEADED OUT OF VICKSBURG PUMP STATION—LOCOMOTIVE READY FOR EMERGENCY STEAM SUPPLY

Practical Regulation of Highway Transport

By E. J. Mehren,
Editor, *Engineering News-Record*

An Address Before the Highway Transport Session of the Chamber of Commerce of the U. S. A., Washington, D. C., May 16, 1922

As recently as two years ago discussion of regulation as applied to highway traffic would have been confined largely to such topics as the restriction of weight, speed and size of vehicles. Those topics are still important, but there has entered a new phase—the regulation of vehicles operating for hire as common carriers. I propose, therefore, to divide the subject—highway transport regulation—into two major divisions, the regulation (1) of motor vehicles generally, and (2) of common carriers. I fully realize that the first division has had lengthy consideration. However, this seems an appropriate occasion for summing up, for taking stock, for finding where we stand on vehicle regulation and whither we should go.

Regulation in General—Let me call your attention to the wording of my subject. I was asked to discuss not vehicle regulation, but highway-transport regulation. The distinction is significant. It marks the change from the conception that the motor vehicle is an interloper on the highway or an instrument of pleasure, to the settled conviction that highway transport is an essential part of our social and economic life. It is not so long ago that highway officials and large sections of the public resented the new mode of locomotion. That time seems now far removed. Possibly the great war record of the highways marked the change in thought. Today we all accept the highway as a great economic instrument. Far from desiring to discourage its use, we encourage it, so that the benefits of economic transport may be extended as much as possible; so that the people, through savings in the cost of carriage, in time of transport or in comfort and convenience may get dividends on their highway investment.

These considerations may seem academic, but from them flow the basic principles which should control motor-vehicle regulation. If the highway be an economic agent of the public, the regulation should be such as to encourage its greatest use. Rules or laws which restrict its use unreasonably or make that use uneconomic run contrary to public interest. These economic truisms lead to the following principles:

1. Regulation should not be punitive.
2. It should prevent abuses by individuals who would invade the rights of others and make the use of the highway dangerous, uncomfortable or expensive.
3. It should be kept to a minimum consistent with maximum economic use of the highway.

It will be found that all sane regulation now on our statute books conforms to these principles. Excessive speed, for example, if general would drive away those whose regard for safety is normal. Excessive loads would break up the roads and thus prevent or curtail their use. Unusually great widths of vehicles interfere with passing and cut down the number of vehicles that can be put over the road in a given time.

It will be agreed that we have gone far in vehicle regulation—in some cases in a wrong direction—but the end is not yet. In the interest of the maximum economic use of the road there are needed in many states amendments to present law, first, for the sake of the state uniformity, and, second, in the interest of traffic that passes over state boundaries.

As to all such matters needing revision we have in the Uniform Vehicle Law an excellent guide. Only one feature of it failed to get the unanimous approval of the competent authorities who drafted it, namely, the question of maximum weight. This happens, too, to be the most important feature affecting interstate business. Nevertheless, it is the point where we must expect divergence of views, on account of difference in road experience and conditions. Considering the results of road-traffic counts it does not seem to be wise to insist too strongly on the 28,000-lb. limit, unless it be hedged with a provision allowing restrictions on certain routes.

Revisions Needed—If a vehicle law is to accomplish its purpose of promoting the maximum use of the highway consistent with safety, economy and convenience its mandates must be obeyed. We must be a unit for vigorous enforcement. Of special importance is the enforcement of weight restrictions of trucks. There was inclination, at first, to regard the Maryland method of dumping overloads on the highways wherever violating trucks were apprehended as too drastic. Its justice, however, was never challenged. Now there is a conviction that that is the only way in which weight restriction laws can be enforced. It may well have general adoption.

Tied up with weight restriction and its enforcement is the need for giving highway authorities power to limit loads to less than the legal limit, or to rule them off certain roads entirely, during the spring softening period. This is a generally accepted regulation that works to the benefit of the road-using public and of the public generally. The right to do this should be included in every motor-vehicle law.

There are other adjustments desirable in present laws. The horse-power and gross-load basis for assessing fees proposed by the uniform law should be generally adopted instead of the sixteen other ways found in present statutes. Where reduction in fees for pneumatic-tired vehicles is not allowed, such provision should be made.

These comments suggest that there is need right now for a new consideration by both interested and impartial parties of the present laws, to the end that there may be prepared for the meetings of the legislatures next winter sound conclusions as to present statutes and the desirable lines of revision.

Common-Carrier Regulation—Let us turn now to the regulation of common-carriers motor vehicles. The same principles obviously apply here as in the case of general regulation, namely:

1. That regulation should not be punitive.
2. That it prevent abuses that would invade the rights of others, and
3. That there be a minimum of regulation consistent with maximum economic use of the highway.

It is possible to make a strong theoretical case against regulation of motor-vehicle common carriers. There are sharp differences between the business of motor-vehicle transportation and that of steam and electric railways. Since the motor vehicle operates over a publicly-provided track, and the necessary private investment is small it is easy to introduce competition. Steam and electric railways, on the other hand, require a large capital investment; the introduction of competition is difficult. Again there is less to be gained, at least on the surface, by giving monopolistic privileges to motor-transport operators than to electric light, gas and telephone companies. Duplicate telephone systems are an inconvenience and an added expense to the public. So, too, are duplicate electric power and illuminating gas systems. In motor-transport duplicate investment is likely and a burden to the public, but the plant is mobile and if in operation the resulting inecconomies begin to pinch it is easy to move the equipment elsewhere. The duplicate plant investment is not an irremovable burden on the public.

But however strong the theoretical arguments against regulation there are practical considerations that outweigh them.

1. The public has long since determined that regulation of common carriers is necessary, and it is not likely, no matter how strong the theoretical argument, to make an exception in favor of highway transport.

2. Sufficient evidence has already been offered to show that where motor transport is heavy, the public is better served by regulated than by unregulated service.

3. Regulation offers the possibility of stabilizing the highway-transport business—saving it from the destructiveness of uninformed, fly-by-night competition.

Already there is strong sentiment both for and against common-carrier regulation. Where fly-by-night operators who do not know their costs have brought substantial operators into or near bankruptcy there has been a cry by operators for regulation and for the granting of monopolistic franchises. Where the public's interests have been made secondary to profit by those who sought to skim the cream, the public, in turn, has demanded supervision of service and of rates.

On the other hand, there have been those who have fared well in the motor-transport business so far, particularly over routes that would not justify common-carrier franchises. They object to the prospect of regulation. They are, in part, of the class who are willing to jump from place to place, picking up business while the going is good—in summer peaks for example—and leaving a local trustworthy operator to take the lean business.

Despite prejudice against it, however, it is likely that common-carrier highway transport regulation is here to stay. It has the advantages already cited, but it holds, also, the danger of checking development. It is possible that public regulatory commissions without adequate thought as to its applicability may slap onto motor-transport in its infancy much of the regulatory practice that has developed during twenty-five years of railway and other public-utility regulation. That this fear is not groundless is illustrated by the action of the Nebraska State Railway Commission. It took jurisdiction over highway transport and promulgated rules. After two years of trial it relinquished of its own initiative the control it had taken. It concluded that motor-transport in Nebraska had not advanced to the point where common-carrier regulation was necessary, that the cost data available were not sufficient for an intelligent determination of rates and that the commission lacked revenues for effective enforcement of its regulations. In other words, the commission concluded that it was dealing with an infant industry and that the nature of the child has not developed sufficiently to allow of intelligent direction. There is here a suggestion to other regulatory bodies that they accept the fact that this is an infant industry; that it is an industry different from other common-carriers; that it deserves study before regulation, to the end that the regulation may, broadly, be in the interest of the public.

Competitive Considerations — Two critical elements in motor-transport regulation are the rates to be charged by common-carriers and the fees to be paid by them. Some contend that highway transport rates should be set higher than cost plus a fair return in order to offset the advantage which the motor vehicle has because the public furnishes the track. This is proposed on the theory that it is the duty of regulatory bodies to offer some degree of protection to the steam and electric railways, which furnish their own track.

The argument is unsound. We are not unmindful of the cost to the railways of building and maintaining their own track, nor of the advantage to the motor vehicle of having its track furnished by the public. But we recall, also, that everyone has free use of the highway. A common-carrier motor truck transporting my goods for pay does nothing, in essence, but what I as an individual have a free right to do. I choose merely to employ an agent. To penalize him is to penalize me over and above a fair cost for service because I choose to take advantage of the economies or conveniences of an alternative type of transportation.

If we consider transport on inland waterways we find an analagous case. River and canal navigation require the dredging and maintenance of channels, which are done at government expense. We have at times charged a toll to help pay for the improvement, but we have not assessed a penalty to bring the rates on water-borne carriage up to those of the railways. On the contrary, we have gloried in the fact that water rates were lower than rail rates; in fact we have actually used water rates as a club to secure lower railway rates, and we urge that each type of transportation—rail and water—find the commodities it is best suited to transport, believing that thereby the nation will be most economically served.

Indeed, if the penalty theory is to be adopted what shall we do in the day when air transport becomes a formidable rival of land and water carriage. Shall we hobble it by penalty rates in the interest of the earlier forms of transportation?

Obviously, sound economics demands that we allow each type of transport to develop its utmost economies and to find its place in the transport system in accordance with the advantages it offers the public. If an earlier form suffers thereby, that cannot be helped. Every day in industry a new machine tool sends old ones to the scrap heap; new power units replace the old before the old are worn out. Waterway transport gave way in part to the steam railway; in turn the steam railway suffered a loss of business when the electric railway was developed. Now it is the turn of the steam and the electric railways to lose some business to the highways, but mind you that they will lose not all but only what the motor-vehicle can more economically or conveniently transport. They will retain what will be to the advantage of the public for them to retain. Also it is clearly foreshadowed that highway transport will prove to be a valuable adjunct and benefit to the railways. Already the motor truck is relieving them of the unprofitable short-haul business.

Naturally, the motor-vehicle engaged in common-carrier service must pay for the use of the road just as a privately owned and operated vehicle does. A tax graded by extent of use of the road is the preferable one, and where that does not exist a somewhat higher tax on the common-carrier is warranted because of the certainty of greater use of the road. Furthermore, since it has become a fixed principle of our system of taxation that individuals and corporations shall pay for the privilege of doing business on public streets, the common-carrier operator must expect to pay a franchise tax. At present this tax is in most states assessed in the form of a fixed fee, which is generally determined for passenger vehicles by the seating capacity. In levying these additional taxes the principle already laid down of not being punitive should apply. The benefits of motor-transport should be returned to the public directly in the rates rather than through taxes.

Conclusion—It is apparent then that the field of motor-transport regulation, whether of private or common-carrier vehicles, has many problems to which the minds of American business men need to be addressed. It is not enough that those with a business or professional connection with highway transport—the vehicle manufacturers and owners, highway engineers and highway officials—take interest in the subject. It touches too closely the welfare of American business and the American people to allow them to be indifferent towards it. The views and conclusions of the specialists need the endorsement and support of the public and particularly of the business community—which has the background to judge soundly of the solution of economic questions. It is well therefore that this Chamber of Commerce of the U. S. A. has given its attention to the matter. Its deliberations and conclusions should have an important influence. It may well advocate, in my judgment, the following broad principles of highway transport regulations:

1. That regulation be encouraging to highway transport and not punitive.

2. That it protect the rights of road users and prevent abuses.

3. That there be a minimum of regulation consistent with maximum economic use of the road.

4. That there be rigid enforcement of motor-vehicle laws.

5. That it is desirable, when the traffic warrants, that highway carriers engaged in regular transport service be designated and treated as common carriers, and be subjected to common carrier regulation, to the end

(a) That the public may be better served, and
(b) That the business of highway transport may be stabilized.

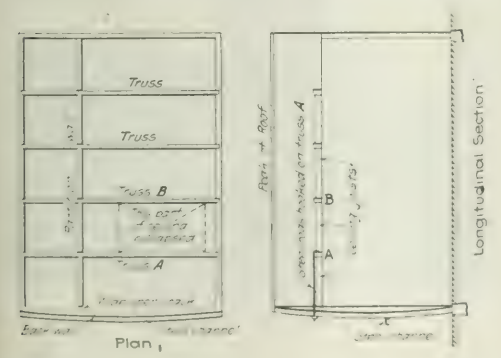
6. That common-carrier regulation, where adopted, should not be punitive but should permit highway transport to develop its own inherent economics and particularly that it be not artificially penalized and handicapped in favor of competitive forms of transportation.

Buckling Wall of Theater Causes Ceiling Collapse

Accident in Pittsburgh Movie House Made Out of Old Church—Bulge in Wall Imperfectly Held by Channel Backstay

By Edward Godfrey
Structural Engineer, Pittsburgh

ON MAY 15 an accident occurred in the Majestic Theater, Pittsburgh, which missed being a calamity only by reason of the small attendance in the theater at the time and the unpopular character of the front seats. As it was, a number of people were injured and taken to the hospital. The accident itself was nothing more than a ceiling collapse, but it resulted directly from structural weakness and incipient failure of the building itself.



DEFECTIVE CONDITIONS IN MAJESTIC THEATER, PITTSBURGH

The theater occupies two-thirds of an old building which was originally a church. The church was simply a big box of an affair about 60 x 75 ft. in plan, with four wooden trusses spanning the 60-ft. direction. The old brick walls are about 50 ft. high; they are 13-in. brick walls in poor lime mortar. A partition or wall was erected, separating the theater portion from the remainder, which is occupied as a store. The ceiling of the auditorium is wooden lath, plastered, on 2 x 6-in. ceiling joints resting on 1 x 3-in. strips nailed on the side of the bottom chord of the roof truss, the joists being notched. The joists are also toenailed into the truss chord.

The end brick wall is bowed out nearly a foot. This condition is not recent. It evidently existed at least in a large measure, when in the course of converting the building into a moving-picture auditorium the ceiling was put in; had the bow developed subsequently, the ceiling would have dropped long ago.

A long steel channel anchored at the ends and with web horizontal was introduced on the outside of the wall. Its evident purpose is to prevent the wall from spilling out entirely. There is a long sweep in this channel as well as a vertical bow in the wall. Anchor rods connected the end wall and the first truss, but stopped here.

The sketch herewith illustrates the construction (measurements are only guessed at). The end wall has gradually bowed out further and further and pulled truss *A* with it by means of the anchor rods which were hooked onto it. This widened the space between trusses *A* and *B*, and the ceiling joists in panel 3 simply dropped out. The crashing down of this lumber smashed the theater seats to splinters; fortunately they were empty.

The rubble wall at the back of the end wall has very little mortar in the joints. The mortar in the brick wall can be picked out easily with a knife. The partition wall is cracked away from the end wall with a wide-open crack. Large cracks appear in the side walls near the end of the building, evident both inside and outside of the building; they are old cracks, for they are full of dirt.

The foregoing are all discoverable and easily discerned signs of impending failure. The building is said to have been examined two weeks before the disaster and pronounced safe

Life of Buried Steel Oil Tanks

AN INVESTIGATION recently carried out by the Factory Mutual Laboratories and reported in the quarterly of the National Fire Protective Association regarding the life of buried fuel oil tanks indicates that underground storage need not seriously impair the conditions of steel tanks. The investigation covered tanks which had been in service from 18 months to 26 years and were buried from 10 inches to 9 feet. Soils were sand, gravel, loam, clay or cinders or mixtures of these and in some cases ground water was present and in a few cases, salt tidewater. The tanks varied in capacity from 1,100 to 22,000 gal.

The investigation showed the following conditions:

(1) Cinders stimulate corrosion probably because of the electrolytic action between the steel and the carbon in the cinders. (2) The best soil coverings given in order of protective quality are: oily sand, sand, gravel, clay, loam and cinders. (3) Red lead followed by asphalt gives the best results as protective covering. (4) Tidewater and ground water do not stimulate corrosion to any great extent. (5) If a tank is buried below the zone of active oxygen it is usually below the zone of corrosion. (6) Steel tanks buried under favorable conditions should last more than thirty years. In damp ground they will last from 15 to 20 years.

To resist corrosion best steel tanks should be coated with red lead and asphalt and buried in clean sand 3 ft. or more below the surface, avoiding ground water and tidewater if possible.

Home Treatment of Lumber for Mill Roof with Creosote

Experiences Recounted in Roof Replacement Job—Green Lumber Successfully Treated by Hot-and-Cold Method

By William E. Rudolph
Engineer, Chile Exploration Company, Chuquicamata, Chile, South America

PRESERVATION of roof deck lumber of the A. P. W. Paper Co.'s Liberty Mill No. 2, Albany, N. Y., was carried out on the job by the "home-treatment" or open-tank method during 1920 when materials and labor were at peak prices. Experience with treating green lumber, cost of treatment and labor and difficulties encountered are here given.

Conditions in machine and beater rooms of paper mills are unavoidably most favorable to the rapid development of decay in wood roof decks and it becomes necessary either to choose a material that is not susceptible to this form of deterioration or to protect the wood, if one would have an economical structure. Wood lends itself so readily to simplicity in design and construction, that if proved means of making it resistant to decay can be employed, that is evidently the material to use. Such reasoning determined the decision to creosote the lumber for the roof deck over portion of Liberty Mill No. 2.

The experience of this company with the roof deck over its original tissue paper mill, Liberty Mill No. 1, lent emphasis to the need for preservative treatment. Erected in 1918 decay had seriously affected the lumber in 1920, and at this writing, after not quite four years, replacement has already become practically necessary. The deck had, as is customary, been carefully painted with the usual mill white, but that soon began to peel. Painting is almost valueless as a protection against decay under such conditions of humidity and when applied to green wood it accelerates rather than retards the decay. Careful study was given to both the preservative to be used and method of treatment to be employed. A refined coal-tar creosote oil and the open-tank process were chosen. The character and grade of creosote were important as it was obviously desirable to avoid excessive loss by volatilization during heating of the preservative in open tanks and also to have the treated lumber as clean as possible and of good appearance. As the purlins had to be framed and the roofers cut to size at the job treatment could not well be applied until after framing. This necessitated a home-treatment or the open-tank process.

Green Lumber Caused Trouble—The first difficulty was encountered upon arrival of the lumber. In the summer of 1920 material and labor could be secured only with difficulty and at high cost. It was the period when purchasers were fortunate to secure supplies irrespective of quality or suitability. Lumber especially was high in price and the better grades were not readily obtainable. As construction neared the point where the roof planks should be on hand—this was a time-limit job—arrival of the first car of lumber was an occasion for joy. But the disappointment was equally keen when upon inspection it developed that the lumber, merchantable pine, had been sawed green from the log, probably on the day of shipment, and was covered with sap-stain fungus. Of course it was not up to the grade of the owners' specifications nor of the contractor's order, but to reject it would delay completion of the building. The loss of a few days' production would have far overshadowed that which might ensue from using the lumber, even as it was.

Several means of remedying the situation were considered. One was to build a kiln around the lumber and steam it. A conference was arranged among the engineers of the contractor, the owner and the preservative manufacturer. The lumber could not be used green; it would not take creosote and was not worth the labor of placing it untreated. It was thought that to treat it at high enough temperatures to expel the moisture would cause severe checking. Finally, a few of the 3 x 6-in. roofers were placed over the paper machine hoods to dry, where they were subjected to 120 deg. F. for 72 hours. They lost 15 per cent in weight or approximately 45 per cent of the estimated moisture content without a sign of checking. This experiment gave hope to the suggestion that the moisture in the lumber might be boiled out by a prolonged hot treatment. A charge was placed in the treating tank and for 72 hours the temperature of the oil was



FIG. 1. SHEET METAL LINED TREATING TANK

alternately raised to 215 deg. and cooled to atmospheric temperature in cycles of 12 hours to each hot-and-cold treatment. The result was completely successful. The 3 x 6-in. planks were entirely saturated with the creosote and no checking occurred. It was decided to conduct the treatment of the entire 80,000 ft. b.m. of roofers by the hot-and-cold method.

Equipment and Procedure of Treatment—Through a misunderstanding and perhaps unintentionally erroneous advice it was at first considered sufficient to immerse the roof planks and the 26,250 ft. b.m. of 4 x 12-in. and 6 x 12-in. purlins for 10 min. in creosote heated to about 150 deg. F. With that advice in mind a wooden tank, 3 ft. wide, 3 ft. deep and 24 ft. long was built. The joints were well leaded and packed, but when used the tank leaked badly, proving the need of a tight metal lining. After fitting the tank with steam coils another trouble developed. The coils were connected with the steam supply pipe through the tank wall and had been carefully tested. A bad leak developed, creating considerable nuisance by adding hot water to the creosote and also eliciting much bad language directed quite generally at creosoting and new-fangled notions that were being added to the already severe burdens of good union workmen. However, this



FIG. 2. ROOF PLANKS RACKED READY FOR TREATMENT

taught another valuable lesson, namely, that it is best to carry the coils over the tank so that in the event of leakage the coils can be removed readily without bailing or siphoning out the creosote. The experience cost $135, but the small expense items chargeable to experience were quite out of proportion to the eventual saving.

Upon starting treatment it was quickly discovered that 10 min. immersion was not sufficient to secure the desired impregnation. An engineer of the manufacturer from whom the refined creosote was purchased advised that the usual specifications for lumber of that grade called for an immersion of 30 min. first in the hot bath maintained at about 200 deg. F. followed immediately by immersion for a similar period in a cold bath, maintained at less than 100 deg. F. But this expedient also proved insufficient. It was then that the uselessness of attempting to treat green lumber without first expelling sufficient moisture to allow penetration of the oil was fully demonstrated. The experiments previously described were subsequently undertaken. The solution reached saved rejection of the green lumber. In similar instances it would be worth the extra cost to employ kiln-dried material where thoroughly air-seasoned stock cannot be secured. Mills should take the initiative in this respect, because if consumers cannot protect wood against decay it is far better to employ some other material for roof decks over machine rooms of paper mills.

Hot-and-Cooling Method Treatment Successful—Approximately two weeks remained before the laying of the roof deck would start and the 106,000 ft. b.m. of timber had to be creosoted without delaying construction; obviously the small tank would not do. A larger tank was then built. The dimensions were 3 ft. deep, 14 ft. wide and 22 ft. long. This tank was most carefully lined with sheet metal and tested before filling with oil. Steam coils were placed in the bottom and the connecting pipe carried over the top of the tank. The coils were covered with a grating of timber. (See Fig. 1.) A derrick was also obtained to handle the lumber in the required volume, the roofers being racked after framing as shown in Fig. 2. The capacity of this tank was nearly 10,000 ft. b.m. per charge.

After treating a few charges of timber at the rate of one charge per day—half of the time for the hot bath during which the oil was heated to 215 deg. F., and the other half for the cold treatment when the creosote and charge were permitted to cool to atmospheric temperature—it was found that the planks absorbed 289 gal. for 2,750 ft. b.m. or around 100 gal. per 1,000 ft. b.m. As this amount was decidedly too much, the time of treatment was lessened to give an absorption of about 59 gal. per 1,000 ft. The revised schedule resulted in treating 5,000 ft. b.m. per day in two charges.

Schedule and Cost of Treatment—The schedule in this operation was as follows: 8 a.m. work started by removing charge left in the tank from the previous night; 10:30 a.m. the tank was reloaded with a new charge and steam turned on: 2:30 p.m. steam turned off: 5 p.m. unloading begun; 8 p.m. tank again charged, steam turned on: 12 midnight, steam turned off by night watchman.

The crew of workmen consisted of a "strawboss" carpenter in charge at $1.12½ per hour; two or three carpenters at $1 per hour (these were not needed during the treatment of purlins); seven laborers, two on the hoist, two on lift hooking on, two on lift taking off and one on guy line. The laborers received 70c. per hour and were employed 5½ hours per day on creosoting of which 3 hours was at overtime pay. The carpenters were used for racking lumber for 4 hours each day. Both carpenters and laborers received double rate pay on Sundays. This was exorbitant pay for this class of work which can readily be done by the most common of common labor, but these were the halcyon days for labor and this was a "closed-shop" job. The result was a cost of treatment totaling $67.65 per 1,000 ft. b.m.; divided $27.42 for creosote and $40.23 for labor and numerous incidentals. The separate items making up this cost are discussed further on. Incidentally 3 x 6-in. shortleaf yellow pine, merchantable grade, cost $90 per 1,000 ft. b.m. in place, and the purlins, No. 1 longleaf yellow pine, $115 per 1,000 ft. b.m. in place. Under normal conditions with properly seasoned lumber, the cost of treatment might have been $18 to $20 per 1,000 ft. b.m., divided $11 to $12 for creosote, $3.50 for labor and $3.50 for equipment.

The treatment obtained was much better than could have been secured by 30 min. hot-and-cold immersion, but in the absence of all mechanical wear on the lumber after being placed the brief treatment and lesser absorption should readily have tripled the life of the roof deck. As it is, 20-years' life of this roof will probably be realized; 12 years' service will show a considerable annual saving, even at the $67.65 figure for treatment.

Some of the Details—After racking the lumber it was forcibly submerged as shown in Fig. 3. Had time been available mechanical means for bracing the charge fully submerged would have been developed to better



FIG. 3. LUMBER SUBMERGED BY [illegible] AND OIL BARRELS

economy; but as previously stated this was a time-limit job. After treatment, the lumber was placed on a platform to drain with the object of drying it sufficiently to handle. That procedure also did not work out as planned for lack of time, and instead the lumber was held for a few minutes over the tank to drip. Although a hot creosote tank is no place for a dress suit and white kid gloves, during normal times certain troubles encountered on this job would not have occurred. Men were provided with rubber gloves and one or two even with rubber suits. They received $10 each for damage to clothing.

Placing the treated material was more costly than the untreated boards due especially to its greater weight. The extra charge for laying treated plank appearing on the record is $8.22 per 1,000 ft. b.m.; or $11.13 for the untreated planking and $19.35 for the creosoted roofers. The extra cost of erecting the treated purlins was little if any. Some of this extra cost could have been saved had time for thorough drying after treatment been allowed.

The ceiling was not painted. Creosoted wood cannot be painted. The resulting dark brown color was not displeasing to the eye nor did it materially lessen the light.

Costs—The following figures are taken from the records and indicate the expense and the details that must be anticipated and watched to keep down costs.

TABLE I. MATERIAL, LABOR, EQUIPMENT AND MISCELLANEOUS

Preservative, 7070.5 gal. of creosote oil	$3,332.39
Freight	169.44
Building small tank (discarded)	103.50
Iron racks for dipping lumber	26.10
Lumber for large tank	100.35
Labor for building large tank (half at double wage)	56.37
Steam coils for large tank	119.98
Metal lining for large tank (emergency sub-contract)	190.56
Steam line connecting tank with mill (including coils for small tank)	84.26
Grating over steam coils in large tank	42.40
Material for draining platform	22.51
Material for cover for large tank	44.02
Hauling and erecting derrick	49.20
Rental on derrick (40 days)	50.00
Labor for treating planks and purlins	2,083.00
Experiments	55.10
Incidentals: nails, gloves and expense account	52.11
Contributions for damage to clothes of workmen	90.00
Involuntary bonus for workmen	90.00
Additional cost of laying treated roof planks	656.31
Overhead and insurance	444.95
Steam furnished by owner gratis	.....
Total gross cost	$7,860.55

CREDITS

Preservative remaining on hand, 840 gal. creosote oil	$400.00
Sale of empty barrels	200.00
Salvage of lumber from tanks, piping, etc.	100.00
Total credits	$700.00
Net cost of treatment	$7,160.55

TABLE II.

COST COMPARISON OF TREATED AND UNTREATED ROOFS

Labor and materials	With Creosoted Deck	With Untreated Deck
Purlins (25,250 ft. b.m. at $115 per M)	$3,019	$3,019
Roofing planks, (79,600 ft. b.m. at $90 per M)	7,164	7,164
Creosoting lumber	7,161	
Painting (27,000 squares at 5c.)		1,350
Roofing (216 squares at $16.90)	3,650	3,650
Contractor's profit, approximately 10%	2,100	1,518
Total cost	$23,094	$16,701

The contractor on the work was the H. K. Ferguson Co., Cleveland, Ohio; for which T. H. Birmingham was superintendent. The wood preservation engineer was Kurt C. Barth of the Barrett Co. The author acted as engineer for the A. P. W. Paper Co.

Industrial Sidings That Impede Grade Separation

How Litigation and Waste Result from Failure to Provide for Future Grade Changes—Detroit Tackles Problem

PROGRESS in carrying on grade crossing elimination in Detroit has been much complicated by the interference of industrial railroad connections that have been installed without regard to the possibility of later changes in the grade of the railroad line. So many difficulties have arisen that John W. Reid, engineer of grade separation in the department of public works has suggested the adoption of general plans and profiles for all railroads and intersecting streets. If this can be done it will fix future railroad conditions sufficiently to admit of systematic and co-ordinated railroad, industrial and civic development. Occasional amendments may be necessary to meet changed conditions, but in the main the plans would be permanent. Such a definite and permanent condition would evidently be to the advantage of both the railroads and the property development, and consequently to the city as a whole.

Special privileges for laying sidetracks across public streets at grade in order to obtain railroad connection, are frequently granted to industries by city authorities and are likely to cause future complications. Although these grants are usually temporary and revocable, their holders are prone to regard them as conferring permanent rights and to claim damages when separation of grades comes to be considered. Mr. Reid's opinion is that such grants are reasonable, but that the public should not be taxed for necessary interference with the grants, even though such interference should result unfavorably to their holders.

That industrial concerns sometimes fail to recognize the superiority of public rights in such a situation is indicated by the two examples that follow. In the first case the owner had a tract of land without railroad frontage located on a street where the grades have now been separated. Before the separation he had obtained railroad connections by means of a permit from the city to build a sidetrack across this street at grade. This special privilege broadened the usefulness of his property and consequently enhanced its value. To retain these railroad facilities after grade separation, it became necessary to construct a bridge over the street. The city council granted this privilege. Now the owner asks the city to make good to him the cost of this bridge as an item of the damage he claims to have suffered as a result of the public necessity for a change in street conditions that happens to involve his special sidetrack privilege.

In the second case, the property has about 600 ft. of frontage on the railroad and fronts on two streets in which grade separation is in progress. Sidetrack facilities could be obtained within the limits of this property, and before the separation of grades the owner's sidetracks crossed the streets at grade. One of the tracks led off from tracks on railroad property (not right-of-way or yard) located on the opposite side of the street. This particular track arrangement was made possible only through a permit to build a track across the street. Changes due to grade separation necessitate his either abandoning the present track layout or building a bridge across the street at a cost of about

$20,000. The owner has now filed a bill to restrain the city from further prosecution of the work pending determination of the question as to who shall pay for the bridge. His claim is based on the damage done to his property as a result of changing street conditions in such a way as to interfere with the revocable privilege he enjoyed.

In presenting this subject at a meeting of manufacturers, Mr. Reid explained the situation as follows:

Industries sometimes do things that seem difficult to explain. Witness the situation which has been created adjacent to the Detroit Terminal R.R., between Jefferson and Mack Aves. and Hart and Connors Aves. The congested industrial condition there is already serious. With three east and west streets, (Kercheval, Waterloo and Charlevoix) crossed by the main tracks of this railroad and several sidings, and with constantly increasing train and switching movements, it is difficult to see how the public interest is going to be met when the city is built up to the east of this district.

During the past three years plant investments running into millions have been made in that district without any thought of physical conditions ever being disturbed, although it has been evident that such change or disturbance must come in the near future. When this location is considered with reference to the city's railroad gateway at the extreme southwestern end of the city, ten or twelve miles distant, this choice of location is difficult to explain. Is there any consideration due the public interest in the matter of locating industries? Does this sort of thing have any bearing on the question of a fair division of grade separation costs and the measure of damages to be fixed? There are those who claim that damages paid should include some portion of the cost of plant re-adjustment to the new or changed railroad conditions, in addition to the damages resulting from changes in the grade of the street.

Another tendency that is quite commonly met with is that of compromising a plan of grade separation to meet some particular industry's condtions. Within certain limits this may be necessary but it never should be done to the detriment of the general public good. It should be kept in mind that the city is a permanent institution in a sense that permanence cannot be attributed to industries or commercial interprises or even to a railroad. Saying this does no violence to the fact that society, or the city, is dependent largely on both of the latter agencies. Because of this greater permanence of the city, and in spite of this dependence, no plan for grade separation should be determined upon by giving undue weight to present railroad or industrial interests, as against what fairly appears to be the best public interest.

The longer these improvements are deferred the greater the problem to all interests: public, railroad, and manufacturer. Railroad roundhouses will continue to be located as was the Wabash R.R. roundhouse at Harbaugh Ave., just west of an important street. Certain streets were vacated and it was agreed that grade separation would not be required for ten years. This time limit has expired, but the railroad now wants a grade separation plan suited to the roundhouse location, regardless of the effect which such a plan would have on the city streets. Team track yards will be set down across newly opened streets, as was done at the Farnsworth Ave. yard of the Grand Trunk R.R. Or an industrial railway line extension may be thrown across 15 streets and 14 public alleys, as was done in the case of the extension of the Detroit Belt Line from Harper Ave. north to a connection with the Michigan Central R.R. and the Detroit Terminal R.R.

Frequent requests are being made of the city council by adjoining owners for grants of sidetrack privileges and the closing of alleys. In granting such privileges the city is put in the position of assisting to create conditions that must soon be involved in grade separation. Acts like those mentioned must be kept in mind [illegible] the question of: "What is a fair division of the cost of grade separation as between the railroads and the city?"

Tests of Twelve Large Columns

RESULTS of failure tests on twelve large riveted steel columns, carried out at the Lichterfelde government testing laboratory near Berlin, are reported by F. Voss in "Der Bauingenieur" of Jan. 15. The purpose of the tests was to give a guide in the design of new large bridges over the Kiel canal; eight of the columns were paid for by the canal administration, and four additional ones were supplied by the Deutsche Eisenbauverband, a fabricators' association.

A summary of the column forms and sizes tested, and their results, is given in the attached table. Five of the columns were tested in duplicate. In the case of four of these, the agreement of the two separate tests is very close. Column VII shows a large difference, but here the two specimens were not precise duplicates. The batten plates in the first were 9½ in. wide and had two rivets in each angle, while those of the second column were 14 in. wide and had three rivets; shearing of the batten-plate rivets of the first column limited its capacity.

It was aimed to get a check on the suitability of the column formula and the detail design practice adopted for the design of the canal bridges. The formula $14{,}200(1 - 0.00005\, l^2/r^2)$ was used for lengths up to about 78 radii, and the Euler formula with a factor of safety of 5 for greater lengths. Latticing was proportioned for a shear of 1 per cent of the column load; for columns as heavy as the test specimens it was required to be made of angles. A diaphragm was provided near the ends of the test columns, but two sets of columns were provided also with additional diaphragms. The value of a central longitudinal diaphragm was to be investigated as such construction has been adopted for the canal bridges for members exceeding about 440 tons total stress.

Two columns, I and II, were built to throw light on the latter point, Col. I without central web and Col. II with central web. Other columns were designed for the same load (392 tons) and of the same length (37 ft.) but with various details modified. Col. III was built with a central web like II, but with the latticing on the outer faces replaced by battens and transverse diaphragms. Cols. IV and V were made two-rib columns, similar to I, but with additional transverse diaphragms, the two columns differing only in their rivet spacing (7 in. for Col. IV, 5¾ in. for Col. V). Col. VI, also similar to I, had the transverse struts omitted from the latticing, while Col. VII was fitted with battens in place of the lattice, the battens being respectively two-rivet and three-rivet plates in the two specimens of this column.

While all the material was accepted on mill test (specified qualities, 53,000 to 63,000 lb. per square inch ultimate strength, 20 per cent elongation), the subsequent check tests on waste ends of the plates and angles revealed a large variation of the yield point, from 29,500 in the plates of Cols. I to III to 45,000 in the angles of Col. VII. Further, the material of lowest yield point had an ultimate strength of only about 47,000 lb., while the material of highest yield point reached nearly 67,000 lb. ultimate at back of angle, with an elongation of 15 per cent, showing that the mill tests had not indicated the properties of the material correctly.

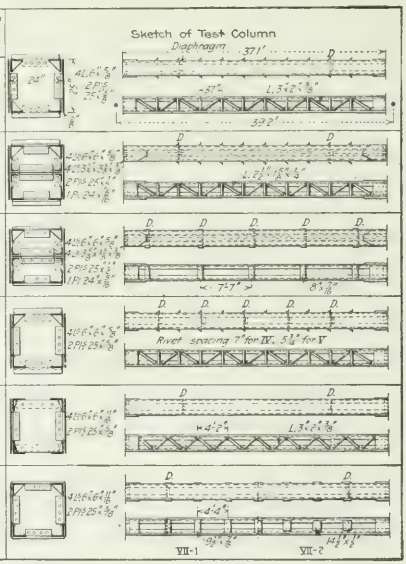
It appeared from the column tests that the ultimate

loads depended on the yield-point strengths of the material. The theoretical capacity of each column was therefore computed (5th column of table) from the tests of the material, the respective areas of angles and plates being multiplied by their yield-point values and the total divided by the total area, to give the average yield-point value in pounds per square inch.

Comparing the fourth and fifth columns of the table, it will be seen that these theoretical capacities agree remarkably well with the test results, except in the case of the first specimen of Col. VII, the one which failed in the batten conditions.

It was deduced from the tests that strong latticing gives the same column capacity as the use of a central web; that the transverse struts in Col. I account for the slight decrease in capacity as compared with Col.

Col. No.	Area of Cross-Section sq. in.	Breaking Capacity in 1000-lb. Units	Failure Stress lb. per in.²	Average Yield Pt. of Material lb. per in.²	Ratio Mtlc. Col.	Length Ratio $\frac{l}{r}$
I-1	63	1865		31,200		51
I-2		1860 Av. 1862	29,500		095	
II-1	70	2,300		34,000		58
II-2		2,430 Av. 2,365	33,750		099	
III-1	70	2,325		34,000		58
III-2		2,260 Av. 2,293	32,600		096	
IV	60	1875	31,400	33,450	094	52
V	60	1867	31,250	33,450	093	52
VI-1	64	2330		37,600		51
VI-2		2,395 Av. 2,362	37,100		099	
VII-1	64	2,195	34,500	40,500	085	51
VII-2		2,445	38,500		095	



RECENT TESTS OF LARGE BUILT-UP COLUMNS AT LICHTERFELDE TESTING LABORATORY

VI; that the additional transverse diaphragms and the closer rivet spacing tried out in Cols. IV. and V gave no advantage; and that the columns tested, which had length-ratios of 51 to 58, showed no recognizable influence of length-ratio on capacity.

Mr. Voss suggests that column strength appears to be practically constant between length ratios of say 35 and 70, and in this range is equal to the yield point of the material, while above this range the Euler buckling formula begins to become controlling. He also suggests that it is important for proper efficiency to require material of high yield-point strength (34,000 for ordinary bridge steel, and 43,000 for high steel).

Finally, he calls attention to the fact that in spite of the mill-acceptance testing, material of inadequate strength found its way into the test columns, and that better methods of acceptance-testing may be necessary.

Irish Water-Power Resources

By R. Johnstone Taylor
Underdale, Shrewsbury, England

The English Board of Trade has recently issued an interesting report on the water-power possibilities of Ireland. The report points out that there are available 500,000 hp., all capable of economical development. The report goes on to show the comparative cost of coal and other details and give hydrographs of the principal rivers. The falls though low appear well worth developing, but the committee seems to have ignored the large rise of the tail water that the writer knows from personal observation is bound to occur in flood tide.

High falls are available in the mountains of Kerry, Wicklow and Donegal. They are not very extensive, but are well worth development for factory uses. High falls obtained by dams, long supply canals, and other artificial means do not appear to be commercially possible in Ireland. Apart, therefore, from these high-level lakes and possibly some tidal power, the large rivers are the main sources of energy. They would be developed as low-head plants.

Of these rivers, the Shannon, Erne, Bann, and Liffey have been reported on by the committee and suggested as ready for development, but it is rightly pointed out that an organized system of rainfall recording is desirable throughout the country for the purpose of obtaining more reliable data. It is noted that there are no data at all on evaporation, which is assumed as being at 16 in. per year.

Other rivers such as the Lee, Blackwater, etc., have not been investigated in detail, but they appear to be worth investigation. It is suggested that the water power could be sold at a profit of one penny (2c.) per unit. At present there is no public power supply in Ireland which sells under twopence (4c.) per unit.

The proposal to utilize the power of the Shannon River is no new idea. A syndicate was formed in 1901, but went out of business without doing anything, the restrictions by vested interests being too strong. The river has for several years been carefully studied and appears to offer a favorable opportunity as a supply to the midlands with ample power at a cheap rate. Coupled with this is the possibility of river transport. It is suggested that there could be four power stations of a total output of 66,000 hp. which would cost £43 per horsepower. The River Erne developed on similar lines would supply 71,000 hp. and at £29 per horsepower, and the Bann 12,000 at £62 per horsepower.

Water-Works Field Surveyed from Many Viewpoints

Abstracts of Paper and Reports Before
American Water Works Association

The Water-Works Superintendent—Presidential Address

By Dr. Edward Bartow
Head Department of Chemistry, State University of Iowa, Iowa City

SUPERINTENDENTS of large plants must have many assistants and their work must be primarily that of executives. They must rely on specialists to take immediate charge of the various divisions. Superintendents of small plants must take responsibilities for all kinds of work. The duties of the superintendent's office of the large water-works include divisions of engineering, records and revenue. These may be subdivided into receipt and storage of supplies, pumping, purification and quality control, distribution, extension of system, repairs, maintenance, service connections, meters, accounts, revenue control, applications, extension of customers, consumer's accounts, collection of rentals, information, complaints and purchases. Of primary importance is a complete record of all constructions and all installations.

The superintendent must maintain co-operation between the water department and the fire department. The fire department is responsible for the extinguishing of fires but is powerless without an abundant supply of water.

Public Relations—In his relations with the public the superintendent must be a diplomat. Nothing should be done, no action taken, that will offend the public, who are directly or undirectly his employers. He must at all times be courteous, and moreover make his assistants courteous. He must see the viewpoint of the other fellows and when complaints are made do his utmost to remedy any ills, whether real or imaginary. In order to have satisfactory relations with the public, the relations of the employer and employees must be most cordial and there should be mutual confidence. The superintendent must enforce discipline but in a fair and reasonable manner.

The superintendent should be a member of the local chamber of commerce or commercial club and take part in work for civic improvements. He should be a member of local associations where he can show interest in the welfare of the community. He should become identified with state or national water-works associations, and should receive the support of his trustees or board in attending these meetings and should, wherever possible, see that the board members attend the convention also. The underwriters in their reports on management of water companies always note whether the manager is connected with water-works associations. Such connection is an indication of a progressive spirit. The intercourse with other superintendents at meetings and the perusal of the proceedings of the association keep the superintendent out of a rut.

Superintendents Should Be Well Paid—The man who undertakes the responsibilities herein outlined should be well paid. A city should not employ a superintendent because he will work more cheaply than someone else who is more competent. Training and experience should determine a man's qualifications and then the salary should be made to fit the position.

Every well-planned, well-run water-works is a monument to the man who successfully constructed and operated it. I know of but one statue erected in honor of a water-works builder, that for D'Arcy at Dijon, France. In that city grateful people have erected a statue and dedicated a park to the honor of the water-works builder. Though such special cases may be rare, yet in every community where a successful water supply has been planned and executed, it serves as a monument to the faithful builder and operator.

Twenty Years' Filtration Practice at Albany, N. Y.

By G. E. Willcomb
Supervising Chemist, Division of Water and Sewage Treatment, Albany, N. Y.

DURING the 22 years of operation of the Albany filters, four distinct epochs are clearly marked: (1) The slow sand period from 1899 to 1908; (2) double filtration, commencing with 1908; (3) the introduction of chlorination in 1909 with the subsequent tendency towards decreased filter efficiency; and (4) finally the employment of coagulation followed by the by-passing of the preliminary filter effluent around the slow sand units. These successive steps, from the standpoint of pure filtration, might be considered to be retrogression; but when looked at with a full understanding of the conditions, they are logical enough.

For ten years the plant was operated as a slow sand filter and furnished approximately two thirds of the water required by the city. In 1908 the decision was made to filter enough water to supply the entire needs of the city. Experiments indicated that preliminary filtration would double the output of the original eight slow sand filters at a minimum of expense. After a few years of operation, organic penetration into both preliminary and slow sand units became very marked. The preliminary filters had to begin supplemental washes by ejecting all sand outside the beds, once or twice a year; and the slow sand beds had to have the top 10 to 18 in. of the sand ejected and replaced every other year. It became most difficult to regulate the beds such that not more than one would reach a 4-ft. loss of head at one time. At times during the winter months, six filters would go out of commission at a time, necessitating taking large amounts of gravity water of doubtful sanitary quality to make up the deficit. With the introduction of chlorination and coagulation, water from the preliminary filters became available. As the ultimate capacity of these filters was approximately 40 m.g.d. ample water was at hand at all times for by-passing.

Before the resort was made to by-passing, everything that was practicable was attempted with the slow sand beds to keep the sand free of subsurface clogging and the filters in operation. The beds were forked once a year. The Brooklyn method of surface washing was experimented with. The Nichols method of sand washing was introduced. Varying rates were tried and extra heavy scrapings taken off. But all of these efforts failed to keep the beds in a normal condition until finally the emergency became so acute as to necessitate by-passing immediately.

It will be seen that what really has happened, has been the gradual change of the slow sand process into the rapid sand type. All of the steps have been logical ones based upon economy and expediency. The introduction of the scrubber units became the potential source of a much larger supply of water. The slow sand units, due to outside conditions, eventually became unable to furnish all the water required. The preliminary filters stepped into the breach, and by means of coagulation and chlorination, not only were able to make up the deficit, but were also capable of furnishing a much more attractive water in addition.

As to the future, it is very likely that changes will be made to the basin and to the rapid filters such that they will become typical mechanical filters. This can be accomplished at a reasonable cost and then the money now expended for labor in connection with the operation of the slow sand filters will be saved.

Today, after nearly 23 years' use, the physical condition of the slow sand plant is excellent and stands as a testament to its designer.

The Improved Financial Condition of Water-Works

By Leonard Metcalf
Of Metcalf and Eddy, Consulting Engineers, Boston, Mass.

Data have been submitted to this association at previous conventions to show the effect upon the expenses and net revenues of water-works in the United States, of the higher costs and lesser efficiencies resulting from war conditions. Data for the years 1920 and 1921 considered in this paper are based on the records of about 45 plants, both publicly and privately owned, serving a gross population of 9,000,000 in the year 1920.

The records indicate that, speaking in general terms, the water-works of the country are past the period of acute distress due to the war, and that their revenues available for depreciation, interest, dividends and surplus, are approaching what would have constituted a normal basis *under pre-war conditions*, but they have not yet reached the higher level corresponding to post-war conditions, nor have they been permitted to make good the cumulative losses of the war period, nor has it been possible for them to make the deferred betterments to meet adequately the growing demands of the service. The results accomplished have been attained in part by increasing the rates charged customers, in part by natural growth, in part by increasing efficiency and decreasing cost of operation as the effects of the war have been gradually overcome, and in part by deferred maintenance and deferred betterments, and an undesirable reduction in margins of safety.

The accompanying table shows the cost of unskilled labor and of materials used in the construction, maintenance and operation of water-works from 1915 to 1921. The cost of contract labor, such as ordinarily used in construction, was of course much higher during the war period than that of the permanently employed labor used in maintenance and operation. It is to be borne in mind, too, that the maximum reduction in efficiency was probably at least 50 per cent at the peak or worst period.

* * *

Cast-Iron Pipe Prices—Two years ago, prices of cast-iron pipe were practically three times normal pre-war prices. In 1920 they rose somewhat further. The average for 1921 was a little more than twice pre-war prices, and at the present time the price is probably a little less than twice that which prevailed before the war. It appears to be abnormally high still and out of line with pig-iron and steel prices and with the price level of other manufactured products as well as of labor, seriously retarding the betterment of water works. Valves and hydrant prices never reached so high a plane during the war as that of other materials, and the fluctuations here were much less marked than in th ecase of cast-iron pipe.

* * *

Chlorination Before Filtration

By Norman J. Howard
Bacteriologist in Charge Filtration Plant Laboratory, Toronto, Ont.

TO FACILITATE operating conditions, increase output, and reduce operating cost, chlorination before filtration was successfully used with the drifting-sand filters of the water-works of Toronto, Ont., during the past year. The chlorine was employed merely as a substitute for alum, leaving disinfection to be done after filtration.

Increasing water pollution at Toronto had made it necessary to raise the alumina from 1 grain per Imperial gallon, for which the plant was designed, to as much as 2½ grains

COST OF UNSKILLED LABOR AND MATERIALS TO WATER-WORKS IN THE UNITED STATES, 1915-21

Item	Number Years	Prices per Unit 1915	1916	1917	1918	1919	1920	1921	Per Cent. Increase Over 1915 (Pre-war Basis) 1916	1917	1918	1919	1920	1921
Unskilled labor, cents per hour:														
(*a*) Eastern Group	15–18	23 0	26.7	30.4	40.2	43.8	52.5	43.4	16	32	75	91	128	87
(*b*) Central Group	17 12	21.7	25.3	26.9	37.2	36.8	47.1	40.9	17	24	71	70	117	88
(*c*) Southern Group	6–12	17.9	20.6	24.5	34.3	34.4	42 1	35.7	15	37	92	92	135	99
(*d*) Western Group	7– 8	27.0	28.5	31.4	41.8	46.4	54.7	53.5	5	16	55	72	105	98
(*e*) Average		22.4	25.3	28.3	38.4	40.4	50.0	43.5	13	27	71	80	123	94
Cast-Iron Pipe per 2,000 lb., approx	17–44	$24.23	$30.70	$51 60	$67 74	$69.20	*76.53	52.30	27	113	179	184	216	116
6-in. valves	11–40	11.18	12 64	19 13	19 13	20.73	24.72	21.93	13	71	71	85	121	96
12-in valves	3–38	34.78	41 53	65 22	65.02	59.66	68 90	62 13	19	88	87	72	98	79
2-way hydrants	6–38	26 69	32.04	43.13	51.80	47.16	52.30	47.10	20	62	94	77	96	77
Coal per 2,000 lb.:														
(*a*) Eastern Group	13–15	$2.98	$3.80	$5.96	$6 00	$5.41	7.34	5.81	27	100	101	82	146	95
(*b*) Central Group	8–12	2.41	2.77	3.75	4 53	4.55	5.84	5.69	15	56	88	89	142	136
(*c*) Southern Group	7 12	1.92	2.01	3.03	3 89	3.78	5.35	4.45	5	58	102	97	179	132
(*d*) Western Group**	5– 4	3.97	4.37	6.31	7 92	4.70	5.60	5.29	10	59	99	18**	41	33
(*e*) Average of Groups		$2.82	$3.24	$4.77	$5.57	$4.61	$6.22	$5.43	15	69	97	63	121	92
Fuel oil, cents per gal., South	1– 3	1.80	1.80	2.00	4 28		2 35	2.93	0	11	138		30	62
West	1– 4	1.38	1.50	2.57	4.05	4.09	4.16	4.16	9	86	193	197	201	201
Alum, per lb.:														
(*a*) Eastern Group		1.12	1.72	1.48	1 45	1.66	1 90	1.75	54	33	29	48	69	57
(*b*) Central Group		.91	.91	1.25	1 50	1.40	2 66	1.86	0	37	65	54	192	104
(*c*) Southern Group		1.08	1.38	1.48	1 78	1.56	2 17	1 81	28	37	65	44	101	67
(*d*) Western Group		1.14	1.21	1.51	1.53	1.79	2.04	2.23	6	32	34	57	79	96
(*e*) Average		.06	1.30	1.43	1.56	1.60	2.21	1.84	22	35	47	51	108	73

* Range $50. 60 to $83. 50 per ton.
** Small number makes record of doubtful value.

Bacterial results with chlorination before filtration compared with those given by alum, making allowance for the fact that when alum was used the water was at its worst stages, show that pre-chlorination was more efficient than alum treatment. In 1920, when alum only was used before filtration, the cost for chemicals was $60,963. In 1921, alum, for use only when the water was turbid, cost $18,155; chlorme, $2,343; extra labor, $5,975; total, $26,473, or a saving of $34,489. To this should be added a saving in filter men on other work when not chlorinating, the two making wash water and also a credit for the use of the extra chlorine some $5,000, or a total of $35,490 from prechlorination. No trouble was experienced from tastes and odors due to prechlorination.

* * *

Tastes and Odors and Other Papers on Quality of Water

Chlorination Control By Excess Chlorine Method—Recent New York City practice in controlling the amount of chlorine used was reviewed by Dr. Frank E. Hale, New York City. In July, 1921, the Wolman excess-chlorine [or residual chlorine] method was adopted. Since then, B. Coli have been absent at all four of the city's main chlorination plants except for two determinations. The average dosage was increased from 0.08 to 0.27, taking periods of about 24 weeks each before and after the change. The additional cost of chlorine for treating some 650 m.g.d. was about $30,000. The increased dosage requires increased care to prevent tastes and odors. It is possible that chlorine will

be substituted for copper sulphate to prevent trouble from algae growths. The excess chlorine seemed to have no marked effect on the typhoid curve in 1921 but for the first quarter of 1922 there was a drop compared with 1921 which may be due at least in part to increased activities of the health department as regards oysters, food handlers and the retest of persons who have had typhoid fever. In 1921, 24 new typhoid carriers were found, as compared with 3 or 4 for earlier years.

Recent Chlorination Developments—The outstanding feature of the year in this field, said W. J. Orchard, of Wallace & Tiernan, was the control of Synura and other taste producing organisms in the New York water supply by the excess-chlorine method. [This was also touched upon by Dr. Hale and reviewed by W. W. Brush in a separate paper.] Recently chlorine has been used at Champaign and one or two other places to control chenothrix. In the past two years injectors have been installed in a number of instances for introducing chlorine to water under pressure—notably at the Chicago water-works. These has been successful where the chlorine pressure was three times that of the water. Swimming pool disinfection with chlorine is rapidly increasing.

Water Softening by Base Exchange—Experimental data from a laboratory study of the various zeolites on the market were reported by Dr. Edward Bartow and Gerald C. Baker, In the discussion, point was made of the fact that the nominal zero hardness is really 3 to 5 p.p.m.

Effect of Oil Refinery Wastes on East Chicago Filters—H. E. Jordan said that at both East Chicago and Whiting, oil refineries discharge large quantities of oil wastes into Lake Michigan. In summer, little odor is caused, but the odor increases with cold weather and is at its worst when ice forms. Five bills for the control of oil waste discharges are now before Congress; also a bill or resolution providing for an international investigation of the subject. The matter is of enough importance to be taken up by the government in connection with rivers and harbors. A member from Chester, Pa., reported that experiments on the removal of oil odors by nozzle aeration are proposed there. Paul Hansen stated that small-scale experiments with Spraco nozzles had shown considerable removal of oil odors.

Tastes and Odors from Organic Matters—Studies of the river supplies of Cincinnati, Columbus and Toledo, Ohio, from the viewpoint of odors caused by the decomposition and putrefaction of organic matters, were summarized by F. H. Waring, of the Engineering Division of the Ohio Department of Health. A rise in the Ohio River at the Cincinnati intake is likely to be followed by tastes and odors but there have been few complaints from this cause. There is a close relation between river stage, turbidity and oxygen consumed, all of which go up, while dissolved oxygen falls. At Columbus, tastes and odors generally go up and down with the Scioto River stages, but rarely is there an accompanying disagreeable taste from decomposition—perhaps because of storage and aeration. Lately the alum dose has been increased in flood time to control the earthy taste in the Columbus water. The Maumee River supply of Toledo has given much trouble from tastes and odors and has been the subject of several expert reports from 1912 on. Conditions are particularly bad when the river is low and icebound. Aeration has been advised but not adopted. Apparently both aeration and coagulation are needed—the latter to remove organic matter.

Discussion: Charles P. Hoover, Columbus, Ohio, said there have been four floods in the Scioto River since Jan. 1. Excess-alum, once at the rate of 12 grains a gallon, has been used to get a "white" water without an earthy taste. G. E. Willcomb, Albany, N. Y., stated that although the Hudson River above the Albany intake receives the sewage from 300,000 people, 125,000 of whom are not ten miles distant, yet there has never been a characteristic sewage odor in the slow sand filter effluent. Prof. C. G. Hyde, of Berkeley, Cal., remarked that practically all the reservoirs below 6,000 ft. elevation in California sometimes have algae growths and require treatment. Algae control is of great importance in climates like California.

Topical Discussions and Other Features of Superintendents' Day

TWENTY-TWO subjects for topical discussion, some with a number of sub-heads and other suggestions, were sent to members prior to the convention and given space on the program for Superintendents' Day. Half or more of these brought no response and some of the others little or nothing of significance. As usual, substitutes for lead as a jointing material resulted in a spirited discussion, chiefly on leadite and for the most part favorable to that material, both as to tightness and money saved.

Much interest was shown in a special seal designed to prevent tampering with water meters but not always proof against water thieves, at least in New York City. The seal is made by the International Seal & Nut Co. As to who should pay for service connections, there were some strong expressions of opinion that not only the service all the way to the meter but also the meter should be put in place and paid for by the water department or company. The disinfection of new water mains before being put into use seemed to be considered as standard practice, or one that should be made such. W. W. Brush said this has been done in New York City for 10 or 15 years past. Chloride of lime at about double the usual rate for ordinary water chlorination is introduced in the new pipe. After the water has been blown out, the pipe is refilled and the water tested. If coli are found, the disinfection is repeated.

Water Chlorination Control in Virginia—The use of a simple outfit for making the orthotolidine test for chlorine was demonstrated by L. N. Enslow, of the Virginia State Board of Health. The outfits are mailed to water-works needing them. They include standard color solutions to indicate 0.2 and 0.8 doses of chlorine; a bottle of orthotolidine; an empty bottle for the water to be tested; a dropper; and directions for use.

Cause of Failure in Cast-Iron Pipe—F. A. McInnes, Boston, stated that of 19 failures in 16 to 48-in. cast-iron pipe in Boston during the past 12 years, 9 were due to settlement at points of unyielding supports introduced after the pipe was laid; 3 to blasting; 2 each to freezing and bad ground; 1 to imperfections; and 2 unexplained.

Maintenance and Shop Equipment at Rochester—George E. Cripps, superintendent of water-works repairs at Rochester, N. Y., recounted some of his experiences of the past 38 years. From small and crude equipment, the city has advanced to 26 automobiles and trucks and a large meter and general repair shop. A boiler mounted on a truck has proved very useful in thawing away snow and ice over gate boxes and in assisting the fire department in cold weather. A valve-opening and -closing machine, mounted on a truck, saves time and money. One piece of shop equipment is a home-made device for holding and welding hydrants broken by automobiles. Acetylene burners are used for cutting large mains.

Purification of Water for Industrial Purposes—A detailed review of water treatment for a variety of industrial purposes was presented by S. T. Powell, of Baltimore. The Consolidated Gas, Electric Light & Power Co. of the city named has installed settling basins and filters to treat water for its boilers—or rather for the 10 per cent of "make up" water required to supply the loss in condensation and re-use. Water softening is on the increase. Zeolite, first used for laundry waters, is coming into use for power plants, but it cannot be used for turbid waters or for very hard waters unless they are previously treated. Degassing to prevent corrosion is receiving attention. Robert S. Weston, in commenting on this paper, expressed the opinion that it was unequalled in our language. A separate paper on zeolite for water softening was read by A. S. Behrman, who also reviewed the use of lime and soda ash as an alternative. The latter has the advantage of not requiring removal of turbidity and of causing less loss of head.

Turbo-Centrifugal Pumps—Richard Waller presented a paper in which he expressed the belief that money would be saved if 75 per cent of the triple-expansion pumps were replaced by turbo-centrifugal. He thought the life of the latter had been overestimated.

Reports of Council on Standardization and Some of its Sub-Committees

Council on Standardization—The committee expects each of its 17 sub-committees to submit to it a quarterly report. It is intended that such parts of these reports as are approved by the council will be summarized in the *Journal*. A committee on steel pipe has been formed. Eight committees submit progress reports to the 1922 convention.—George W. Fuller, chairman.

Industrial Wastes in Relation to Water Supply—Questionnaires have enabled the committee to make a list of 248 water supplies, located in 25 states and provinces, affected by industrial wastes. The chief causes of pollution are: Coal mining (washery and acid mine drainage), 107; coal distillation (gas and coke making), 48; metal pickling and galvanizing, 14; chemical (acid wastes), 9; oil wells, 9; pulp mills, 9; oil refining (oil wastes), 7; tanneries, 7; sawmills (sawdust), 6. Methods of attacking the various wastes are: (1) treating the polluted water; (2) treating the wastes before discharge (3) eliminating the wastes from sources of water supply. Control, by reasonable methods, should be vested in state boards of health, provided with ample authority and with adequate appropriations for field and laboratory work. In many states existing policies should be broadened. The Federal Government should assist in the case of interstate and widespread problems—Almon L. Fales, chairman.

Watershed Protection — [Portions only of conclusions under ten heads]. The committee as a whole is of the opinion that it is hopeless to undertake a standardization of the basic (watershed protection) law in the several states, although it has been brought home to more than one member that this variation in fundamental legislation has worked, and probably will in the future, to the disadvantage of public water supplies.

Under water-borne diseases, the committee is in agreement that for populated watersheds the usual precautions taken by health authorities for the control of sources of infection may properly be supplemented by additional safeguards, to be undertaken by the water-works management, in the direction of early identification of the diseases, through disinfection during illness and convalescence and a "follow up" designed to keep track of such cases as may develop into carriers.

Except where the supply is drawn from a river of some size the committee membership is in general agreement that ownership of marginal strips about reservoirs and along principal streams, particularly in the vicinity of the intake, is desirable as one of the means of maintaining a safe water supply, even though such marginal areas are relatively so small that the waters may not be safely used without purification. Such areas should be at least sufficient to preclude bathing, boating, fishing and ice cutting in the vicinity of the intake and, dependng upon relative costs of land and purification, such areas should be extended to the utmost that the economics of the particular case warrant.

The crux of the whole matter of watershed protection is so to operate and maintain the entire collecting system that the amount of pollution reaching the reservoir, or reservoirs, is reduced to a minimum, thereby lessening to the utmost the load to be carried by that great purifying agent—storage. When success attends this undertaking, even under adverse climatic and stream flow conditions, the problem of a clean surface water has been solved. When, under these adverse conditions, doubt exists as to the outcome, the practices here outlined should be supplemented, not supplanted, by an appropriate purification process.—Theodore De L. Coffin, chairman.

Standard Form of Contract—The committee submits for printing in the *Journal* and for discussion a universal agreement (already printed by other societies), for use with a few verbal changes, for any kind of construction contract having a provision for arbitration—the particular form submitted having been adapted to railway construction. This form has resulted from conferences of representatives of the American Institute of Architects, American Railway Engineering Association, Associated General Contractors, American Society of Civil Egineers, Engineering Council, and other organizations, including the American Water Works Association, with the co-operation of Herbert Hoover, Secretary of the Interior. No attempt has yet been made to prepare a universal form of agreement for waterworks or any other public works' contracts.—J. Waldo Smith, chairman; John M. Goodell, secretary.

Standard Specifications for Cast-Iron Pipe—No decision has been made as to adopting uniform outside diameters, a point on which the users are about evenly divided while the manufacturers are against the proposal. If centrifugally-cast pipe becomes a commercial success, as now seems likely, then the change may come. The event of the year was the report of Dr. Richard Moldenke on test pieces and other matters. Dr. Moldenke opposes chemical requirements, except as to sulphur. The committee has reached no conclusion on this subject but it is not improbable that it will follow Dr. Moldenke. The manufacturers have agreed to finance additional studies by Dr. Moldenke. Due to lack of funds for the purpose, no progress has been made in the study of pipe coatings. — F. A. Barbour, chairman.

Physical Standards for Distribution Systems—Progress has been made on terminology. Little has been done on hydraulics and economics of the subject. The major function of the committee will probably be to collect and classify data. Feeder mains, secondary feeders, and distributors are suggested as terms for the main pipe system—G. Gale Dixon, chairman. Discussion: Allen Hagen suggested that for "distributors" the committee substitute "reticulation"—the generally used and self-explanatory British term.

Slides in Meter Schedules—The committee submits the tentative recommendation that the American Water Works Association adopt the three-step plan adopted a few years ago by the New England Water Works Association, but with the optional addition of a special rate for very large quantities. The service charge principle should also be endorsed. A broadening of the scope of the committee to include all phases of meter rates is also advised. The committee secured co-operative representation from the New England Association and in addition obtained the views of every member of the former New England Committee (of which Mr. Hazen was chairman). Under the slide plan now proposed, meter charge steps would be (1) the first 25,000, (2) the next 225,000, and (3) all in excess of 250,000 gal. a month; and where a special rate was charged it would be for very large consumption only, the suggested figure being for all in excess of 2,500,000 gal. per month. All these charges are *in addition* to a minimum charge based on the size of meter used.

The three steps or slides already given provide for what are termed domestic, intermediate and wholesale or manufacturing rates. Nothing in the report should be considered as adverse to a no-slide or uniform meter rate, combined with a meter or service charge, where conditions are favorable. A uniform rate would be logical where the cost of water mains are assessed against abutting property owners.

The committee finds that the New England three-step plan (or a similar two- or four-step plan), is already used by the Spring Valley Water Co., and the East Bay City Water Co., California; the Hackensack Water Co., and a number of other companies and cities.—Allen Hazen, chairman; Isaac A. Walker, secretary.

Abstracts—A corps of 19 abstractors has been formed, with Frank Hanna, chemist filtration plant, Toronto, Ont., as abstractor-in-chief. More abstractors are needed. About 75 publications have been selected for abstract. Co-operation with the American Chemical Society has been arranged for. In the January and March issues of the *Journal* there were published 78 abstracts, filling 19 pages.—Almon L. Fales, chairman.

Standard Methods of Water Analyses—Different elements of the existing standards of the American Public Health Association have been assigned to sub-committees for study. These include some matters previously in dispute and some

new points. The committee proposes to add to the procedure for each determination a brief discussion of its significance. Unfortunately it has not yet been possible to effect co-operation with the similar committee of the American Public Health Association.—J. J. Hinman, chairman.

Discussion: Allen Haze, chairman of the Chemical and Bacteriological Section (before which this report and the one on colloids was presented) said that when the revisions and additions to the existing A. P. H. A. standards have been completed he felt that co-operation could be secured since the original A. P. H. A. committee was composed largely of members of the waterworks association. A show of hands indicated that a majority of those in attendance (about 75 at the Chemical and Bacteriological Section were members of the American Public Health Association.

Colloidal Chemistry in Relation to Water Purification—The committee has collected and compiled data on hydrogen-ion determinations from many laboratories. The usefulness of this determination seems to be greater with soft than with hard waters. A definite appraisal of the method cannot yet be made. Laboratories are requested to send the committee all available hydrogen-ion determinations, no matter how meager.—Robert S. Weston, chairman.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

From an Engineer's Wife

Sir—I am not a writer, but I am a civil engineer's wife and take a great interest in the profession. My husband takes *Engineering News-Record* and we find it very helpful and instructive to him as well as interesting to us both. For myself I think engineering is a profession that should be classed among the greatest of professions, but from close observations am forced to the conclusion that in the eyes of the general public it is not appreciated as it should be.

The question is, why? Is this not a very good reason: Every Tom, Dick and Harry that can purchase a pair of khaki trousers, puttees, and carry a transit on his shoulder calls himself a civil engineer? Here are a few instances in my home town. In one of our local papers a few days ago appeared this personal: "Mr. So & So, civil engineer, left this morning for his vacation." Now to my personal knowledge this man carried a chain and drove stakes on an engineering party for six months or a year; previous to this he was a street car conductor. Another man whom I know personally is listed in the City Directory as a civil engineer and posing as such before the public, when he has no more idea of the principals of engineering than my three-year-old boy. True he can wear puttees, carry a transit and set it up and that is about all.

Is this fair to the profession? How much does the world owe to engineers? In the World War who were braver or did more to hasten victory? The formation of engineering societies is a great step in the right direction.

AN ENGINEER'S WIFE.

Map Scales in Practice

Sir—In regard to the scales of the U. S. Geological Survey topographical maps, although there appears no good reason for the adoption of that of 1:62,500, or multiples of that scale, it would seem evident that the scale now in use, so closely representing one mile (or its multiple) to the inch, answers well for the non-technical or layman user, and that others who use the maps are very largely those of the engineering profession who make use of these for [illegible] water supply, irrigation, highway, railroad and other purposes. All of the maps are necessarily [illegible] to take the place of careful surveys where extreme accuracy is required.

For the determination of watershed areas the maps are generally sufficiently accurate for all practical purposes, except that on small watersheds it is necessary to correct the maps for errors that would be immaterial on larger areas. Using the scale of one inch to one mile on the maps engraved to a scale of 1:62,500 requires, for greater accuracy, a deduction of about 1½ per cent for lineal measurements and about 3 per cent for areas. The results then will be as close as it is possible to work from a map approaching that small scale, and especially since these maps are subject to the variable error due to shrinkage. It is well known that old maps show a very marked error by shrinking, and hence it would appear that the present maps should read "Scale 1:62,500 approximately," then, with the accurately drawn graphical scales in miles and kilometers, anyone would be able to work most accurately from the maps regardless of their age.

Without doubt, engineers would prefer the inch-to-the-mile scale, and if the cost of the change would not exceed $100,000, as stated by F. E. Bonner in your issue of April 6 to be a fair estimate, the change would probably meet the approval of a very large majority of all kinds of users of the maps, although for reduction to lineal feet there would be no advantage in multiplying inches of map by 5280 over inches by 5208, as at present.

It is probable that the compilers of automobile route books use these maps to determine distances between different points and very likely assume the maps are on a scale of one inch to the mile, and, if so, with the maps on that scale, the distances in the route books would be more accurate.

It does not seem advisable to consider a change to the metric system. The great value of the maps is that they are contoured. The changing of their horizontal projection by photolithographic process to a metrical scale would leave the contours referred to sea level, so that there would be confusion in that respect. To change the contour lines to the metric system would be so expensive as to be impracticable.

Rochester, N. Y., May 18. CHARLES C. HOPKINS, Consulting Engineer.

Lost Time in Paving Work

Sir—The article by H. K. Davis in *Engineering News-Record*, May 4, p. 720, brings out particularly the following facts:

1. "In ninety-six working days work was done on only seventy-four days, and only fifty-five full days were worked."

2. "If there had been no delays the whole season's work could have been done in two and one-half months." (in other words, work was carried on intermittently and when work was going on it was not always with full capacity).

These facts do not apply to concrete pavement construction alone. The condition is the same with every kind of paving work. Perhaps in some types, like asphaltic pavements, other elements enter in which make the situation worse. I venture the statement (based on twenty years' experience) that there is not a single asphalt paving plant operating in any large city of the United States that could not finish the work done by it in any year in less than ninety days, if the plant was working continuously and working to full capacity.

Such statements make the reader who is interested in paving, either as contractor, taxpayer, or engineer, sit up and take notice. Delay and loss of time mean larger overhead charges and the profit to the contractor either is not as much as it could be or the taxpayer is paying more for the paving than he should pay.

The facts stated in the article suggest the question: What can be done? Is there no way of doing away entirely or at least, partly with these handicaps? The question needs serious consideration. It's answer requires the co-operation of contractors and engineers.

G. G. HIGHSTAS.

Brooklyn, N. Y., May 9.

NEWS OF THE WEEK

New York, May 25, 1922

J. Waldo Smith Resigns as Catskill Aqueduct Chief

Terminates 17 Years Service as Engineering Head of New York Board of Water Supply

After a continuous service of 17 years, during which New York City's 100-mile Catskill aqueduct was designed, constructed and placed in operation, J. Waldo Smith has resigned as chief engineer of the Board of Water Supply in order, as he expresses it in his letter of May 15 to the board, "to lay aside some of the responsibilities that have been carried for many years and to serve in another capacity." Mr. Smith will continue his connection with the Board of Water Supply as consulting engineer, and upon his recommendation Thaddeus Merriman, deputy chief, will succeed him June 1 as chief engineer. "I would not think of taking this step," said Mr. Smith in his letter of resignation, "if there were not others entirely familiar with the work, having a length of service nearly equal to my own who, by experience and ability, are capable of directing the work and unless I had a firm belief that I could be more helpful in an advisory position where I can have a better perspective of the future."

His Early Work

While the Catskill work has been the outstanding feature of Mr. Smith's professional career he has had a long and varied experience in water supply and hydraulic work in the New England States and particularly in New Jersey. He was born in Lincoln, Mass., in 1861 and was graduated from the Massachusetts Institute of Technology in 1887. After a period as assistant to Hiram F. Mills, in Boston, Hamilton Smith, Jr., and Clemens Herschel, in Holyoke he became in 1890 resident engineer for the East Jersey Water Co. on the construction of dams, reservoirs and experiments on gates and 48-in. Venturi meters. In 1897 he was appointed engineer and superintendent of the Passaic Water Co. of Paterson, N. J. and also of the Montclair Water Co. and under his direction the well-known filtration plant at Little Falls, N. J. was designed and built. At that time it was the largest in the United States.

Mr. Smith undertook larger responsibilities in 1903 when he was appointed chief engineer of the Croton Aqueduct Commission, New York City, and during his tenure of that office such well known structures as the Croton Dam, the Cross River Dam, and the Jerome Park reservoir were constructed.

When the Board of Water Supply of the City of New York was organized in 1905 by Mayor McClellan to administer the great Catskill water project, Mr. Smith was appointed chief engineer and he has served in that capacity continuously to date. A detailed account of his administration of the Catskill work was published in *Engineering News-Record* Oct. 11, 1917, on the occasion of the official opening of the aqueduct. Under his direction were built structures which have won international reputations, including the Askokan reservoir, the Kensico dam, the Hudson River pressure tunnel 1,100 ft. below the water surface, the 18-mile city aqueduct tunnel, the longest continuous tunnel in the world, and the 18-mile Shandaken tunnel now under construction for the development of the Schoharie watershed.



J. WALDO SMITH

J. Waldo Smith has received many professional honors. He was elected a director of the American Society of Civil Engineers in 1906, and vice-president in 1913. In 1921 he was a candidate for the presidency of the society but was defeated in a close vote by

(*Continued on p. 888*)



THADDEUS MERRIMAN

Thaddeus Merriman Is Water Board's New Chief Engineer

Thaddeus Merriman, deputy chief engineer, has been appointed chief engineer of the Board of Water Supply of the City of New York, to succeed J. Waldo Smith, whose resignation is noted elsewhere in this issue. Mr. Merriman has served on the engineering staff of the board since 1905, beginning as assistant engineer, with successive promotions to assistant to the chief engineer in 1907, department engineer, headquarters, in 1914, and deputy chief engineer in 1918. He enters upon his new duties with the unqualified endorsement of his former chief. In speaking of his long service and special fitness Mr. Smith said of Mr. Merriman: "In all the positions he has filled he has rendered a high order of service and has displayed unusual ability and good judgment."

Mr. Merriman was born in New Haven, Conn., April 6, 1876, and was graduated from Lehigh University with the degree of civil engineer in 1897. During the summers of his college course he served as rodman with the borough engineer of Bethlehem, Pa., in the drafting office of the Bethlehem Iron Co. as sanitary inspector of the Montclair, N. J. Board of Health, and as rodman and transitman on the Lehigh Valley R.R.

After leaving college he engaged on geological survey and reconnaissonce work in Pennsylvania and then went to New Britain, Conn., as assistant engineer on water supply development.

Served in Nicaragua

For two years, beginning in 1897, he served with the United States Nicaragua Canal Commission and in 1899 became assistant engineer and chief of party on canal surveys in Nicaragua with the U. S. Isthmian Canal Commission. Returning to the United States in 1900 he joined the staff of the New York Continental Jewell Filtration Co. and prepared the designs for the Little Falls, N. J. filtration plant. For a year ending in 1902 he was inspector, in the United States, of bridges, locomotives and railway materials for export to Ecuador for the Guayaquil & Quito Railway Co.

Mr. Merriman's continuous service in the water-works field began in 1902 with the Jersey City Water Supply Co. as assistant engineer on the Boonton, N. J. dam and later as division engineer on completion of work and on general hydraulics and construction for the East Jersey, Passaic and Aquackanonk Water companies, where he served under J. Waldo Smith. Shortly after Mr. Smith became chief engineer on the Catskill Aqueduct Mr. Merriman joined that organization in August, 1905, and served in the several capacities indicated in the earlier part of this article.

Mr. Merriman will assume his new duties as chief engineer on June 1, the date on which Mr. Smith's resignation becomes effective.

U. S. Chamber of Commerce Holds Annual Meeting

Influence of European Conditions On American Business Taken as Theme for Many Discussions

(Engineering News-Record Staff Report)

European conditions and their effect on American business was the keynote of the tenth annual meeting of the Chamber of Commerce of the United States, held at Washington, May 15-18. Special interest attached to this meeting, coming as it did during the final sessions of the Genoa conference. As a result it was the scene of several announcements by government officials concerning the attitude of the United States toward European problems.

On Thursday, President Harding addressed the convention. In describing the work of the Department of State, Secretary Hughes took occasion to lay down principles having a direct bearing on relations between this country and Mexico and Russia. Secretary Hoover outlined the effect of the European situation on American business. As essential steps in the restoration of stability abroad, he laid down the following:

PRINCIPLES FOR STABILIZATION

"First, such political relations between the states in Europe themselves as will produce an atmosphere of peace and destroy the atmosphere of war.

"Second, the reduction of armament not only to lessen government expenditure but to give confidence of peace.

"Third, the inter-governmental debts including German reparations to be fixed upon such a definite basis of payment of interest and principal as will create reasonable confidence that payments will be met.

"Fourth, the balancing of budgets more through the reduction of expenditure than the increase in taxation, and a cessation of the consequent inflation in currency and short-time bills.

"Fifth, the ultimate establishment of the gold standard with the assistance of either credits or gold loans, and where necessary, the acceptance of diminished gold content to many old units of currency.

"There are many less important steps but they become easy and certain when these major issues are accomplished. If these measures could be accomplished tomorrow the stream of commerce and industry would rush economic recovery at a pace which would amaze the world."

At the general sessions, held mornings and evenings, the broad questions of international economics, industry, and finance were considered.

Albert D. Lasker, chairman, U. S. Shipping Board, laid before the convention the president's program for a ship subsidy to aid in the establishment of the American merchant marine and urged its approval by the business men of the United States. The proposal was discussed from the viewpoint of the farmer by Harvey Sconce of Sidell, Ill., from the viewpoint of the ship builder by J. G. Ackerson, vice-president, Merchant Shipbuilding Co., and from the viewpoint of the ship operator by Frank C. Munson, president, Munson Steamship Lines. Mr. Ackerson and Mr. Munson emphasized the growing importance of the Diesel engine in the field of marine engineering.

At the afternoon sessions group conferences considered the details of the specific problems now in the forefront of American business life.

Transportation was considered under three heads: railroads, highway transport and merchant marine. Under the first was considered the experience of the American railroads under the Transportation Act of 1920. The opinion prevailed that the act had not yet had time to demonstrate its wisdom and that no change should be made in it at this time. The highway transport section as noted elsewhere in this issue, discussed the practical regulation of highway transport and the economic foundation for its future progress. At a general meeting on transportation Frederick Delano former president, Wabash R.R. and former member of the Federal Reserve Board, discussed comparative transportation conditions in Europe and America. Dr. R. F. MacElwee, dean, School of Foreign Commerce, Georgetown University, described the European water carriers and set forth their relative function in the transportation scheme, and Col. Clarence B. Smith, U. S. Army, unofficial representative of the United States on the Austrian Section of the Reparations Commission, told of the problem of southeastern Europe and the Portorose conference at which he was American observer.

During the sessions the cornerstone was laid for the new home of the Chamber of Commerce at the corner of Connecticut Ave. and H. St. Julius H. Barnes of Duluth, Minn., was elected president to succeed Joseph H. Defrees [illegible] Other officers elected were [illegible] for the Eastern States, A. C. Bedford of New York for the Southern States, Thomas E. Wilson of Chicago for the Southern States, Glenn Black of California for the Western States, Thomas P. Stearns of Boston, Henry [illegible] vice-presidents, William Butterworth of Moline, Ill., L. M. Clement of Minneapolis

Engineers on Exposition Committee

Twenty-one members of the Engineers Club of Philadelphia have been appointed to the Committee on Grounds and Buildings for the Sesquicentennial Exposition to be held in that city in 1926. In the committee membership of sixty-six the following is the engineer representation:

Alba B. Johnson, chairman; Samuel Rea, W. F. Ballinger, W. F. Barba, Samuel T. Bodine, Charles E. Brinley, Charles Day, Kern Dodge, W. C. L. Eglin, Benjamin Franklin, Philip H. Gadsden, John Price Jackson, L. H. Kinnard, C. N. Lauer, Joseph B. McCall, John Meigs, Ralph Modjeski, Charles Penrose, E. B. Temple, Samuel T. Wagner and George S. Webster.

State Sanitary Engineers Re-elect Old Officers

At the Conference of State Sanitary Engineers held at Washington, D. C., May 16 and 17, C. A. Emerson, Jr., Harrisburg, Pa., was re-elected chairman; W. H. Dittoe, Columbus, Ohio, vice-chairman; and Theodore Horton, Albany, N. Y., secretary-treasurer. Over twenty representatives of the engineering divisions of the various state departments of health were present.

Water-Works Convention Breaks Records

American Association Hears Fifty Papers and Reports and Holds to Its Schedule

(Engineering News-Record Staff Report)

Besides the large attendance and the extensive display of the Water-Works Manufacturers' Association in unusually attractive and comfortable quarters, features of the convention of the American Water Works Association held last week in the Bellevue-Stratford Hotel, Philadelphia, were eight valuable sub-committee reports resulting from the work of the Council on Standardization, a Manufacturers' evening for the presentation of papers, a successful Superintendents' Day, and crowded meetings of the Chemical and Bacteriological Section, one of which was held jointly with the other members. Fifty papers and committee reports were presented, not counting the topical discussions on Superintendents' Day. From the presidents' address and informal reception Monday evening to late Friday afternoon the only time not devoted to papers and discussions was Wednesday afternoon, when the members and guests enjoyed a boat ride on the Delaware provided by the Manufacturers' Association. The convention was also notable for close adherence to the program.

CLASSIFICATION OF MEMBERSHIP

In his presidential address, abstracted with other papers and committee reports elsewhere in this issue, Lt.-Col. Edward Bartow stated that the association has grown from 349 to 1,608 members in 20 years. Later, Robert Morse, chairman of the Publication Committee, reported that the membership [active only] was divided as follows: Engineers, 569 or 43 per cent; superintendents, 288 or 22 per cent; executives, 248 or 18 per cent; chemists and bacteriologists, 87 or 6 per cent; unclassified, 134 or 10 per cent. Mr. Morse also explained that the program had been made long to afford added information and the convention carried through the whole of Friday to give the chemists and bacteriologists more time than they have had at previous conventions. On the closing day a considerable majority of those voting on the subject declared themselves in favor of two sessions on Friday next year.

The Finance Committee, through George C. Andrews, chairman, reported a good working balance, besides $12,000 in the investment fund. A budget of $20,100 for 1922-3 was proposed and adopted. Of this sum $8,500 is for the *Journal*, $2,500 for committee expenses, and $1,200 for salary of the editor.

A canvass of the ballot for officers disclosed no opposition to the committee nominees. The following were elected: President, W. S. Cramer, Lexington, Ky.; vice-president, George W. Fuller, New York City; treasurer, W. W. Brush, New York City (re-elected); trustees, George W. Batchelder, Worcester, Mass. for District 1, and J. W. Ellms, Cleveland, Ohio, for District 4. Before adjournment the Executive Committee announced the reappointment of John M. Diven, New York City, as secretary; Abel Wolman, Baltimore, as editor, Robert Morse

(Continued on p. 887)

Lives Lost in Texas Bridge Wreck

Failure of the Brazos River bridge west of Marlin, Texas, May 16, caused the death of a number of persons who had been standing on the structure when it went down. The river was at flood stage. Repair work was in progress, and several dozen people were watching the work from the deck of the bridge. Details of the cause of the accident are not yet available.

Public Roads Bureau Gets $483,320 by New Act

Congress has finally passed and the President has approved the appropriation bill for the Department of Agriculture for the new fiscal year beginning July 1. For the Bureau of Public Roads the bill makes available $483,320, of which $367,120 is for various investigations and $116,200 for administration.

The appropriations include: $66,800 for investigations of road management and highway construction; $77,060 for investigation of best methods of road making; $175,000 for investigation of chemical and physical character of road materials; and $15,000 for maintenance and repair of experimental highways.

New York Section, Am. Soc. C. E., Elects New Officers

At its annual meeting May 17 the New York Section of the American Society of Civil Engineers elected J. Vipond Davies, consulting engineer, as president. F. C. Noble and Charles W. Leavitt were elected vice-presidents. H. M. Lewis and C. R. Hulsart become secretary and treasurer respectively. The two new directors are W. G. Grove and W. C. Briggs.

Regional planning for the New York district was discussed at the same meeting. The ground covered was similar to that traversed at the special meeting on regional planning of the previous week, reported on p. 842 of last week's issue. The subject was introduced by Charles D. Norton, chairman of the Committee on Plan for New York and Environs of the Russell Sage Foundation. Arthur S. Tuttle, chief engineer of the city's Board of Estimate and Apportionment, described the origin of the present city plan and incidentally defended the Manhattan street plan. H. M. Lewis presented a large collection of maps and diagrams bearing on the growth of the metropolitan district and its present equipment and requirements as to roads, parks, water-supply sources, and sewage disposal plants.

Jay Downer, chief engineer of the Bronx Parkway Commission, outlined the present Westchester outer park system and the enlarged system expected to develop from the connection of Bear Mountain Park and the new Mohansic Lake reservation with the nearly completed Bronx River Parkway under the new Bronx County Park Commission. Morris Sherrerd, of Newark, sketched the change in point of view in New Jersey as to the unit of planning, from city to county and now to something larger than the county. He urged the need of an excess condemnation law for efficient execution of development plans. B. H. Saunders, chairman of the Plan Commission of Paterson, spoke of the efforts now being made to develop that city.

Freight Rates Reduced by Commerce Commission Order

(Washington Correspondence)

Reductions equivalent to 10 per cent on all freight rates were ordered in an opinion handed down by the Interstate Commerce Commission May 24. After considering all the facts of record, including the necessity of expenditures for additions and betterments, the commission found in part:

(1) That on and after March 1, 1922, a fair return upon the aggregate value of the railway property and material defined in Section 15 A of the Interstate Commerce Act, determined as therein provided, will be 5.75 per cent of such aggregate property value as a uniform percentage for all rate groups of territories designated by this commission.

(2) That the existing freight rates and charges, including charges for switching and other accessorial services and all other charges applicable to freight service, which were increased by authority of "Increased Rates, 1920, supra," will be, on and after July 1, 1922, unjust and unreasonable to the extent that they may respectively include more than the following percentages of increase over the rates in effect immediately prior to Aug. 26, 1920, in and between the various rate groups as defined in certain orders:

In the Eastern group, also between points in the Illinois territory and between the Illinois territory and the Eastern group, 26 per cent instead of 40 per cent is authorized in the decision cited.

In the Western group and between the Western group and the Illinois territory, 21.5 per cent instead of 35 per cent so authorized.

In the Southern and Mountain-Pacific groups, 12.5 per cent instead of 25 per cent so authorized.

On inter-territorial traffic, except as provided otherwise, 20 per cent instead of 33⅓ per cent so authorized.

Statute of Limitations Pleaded in Knickerbocker Case

John H. Ford, of the Union Iron Works, Washington, who designed the steelwork of the Knickerbocker Theater roof and was recently indicted for the collapse of the roof on Jan. 28 when 97 persons were killed, has pleaded the statute of limitations against prosecution under the indictment. The theater was built in 1917 and Ford was indicted on April 3, 1922, and he claims that the offense charged did not occur within three years prior to the finding of the indictment. Other objections to the indictment are made in his answer, among them the claim that it fails to charge Ford with a definite individual duty for the neglect of which he is sought to be held responsible, and there are no facts alleged to show that any duty was imposed on him when undertaking his part of the construction work conjointly with the other defendants. It is claimed also that nothing in the indictment shows that there was any duty on Ford either by contract or operation of how to notify and warn any person of the alleged danger of the unsafe condition of the Knickerbocker Theater Building or any neglect of duty in permitting patrons to attend the theater and be in the building at the time of its collapse.

Second Election Required on New Charter for Atlanta

Owing to the lack of a majority for any one of the three charter plans voted on at Atlanta, Ga., May 16, there will be a second election on May 30, on the two plans that got the highest number of votes. The vote May 16 stood (1) 4,095 for amendments to the present charter; (2) 3,335 for a modified type of commission-manager plan; and (3) 2,283 for the federal plan—a clear-cut separation of legislative and administrative functions, except that the council would confirm and could remove by two-thirds vote any one of the five executive department heads appointed by the mayor, while the mayor himself would be subject to recall.

Of the two plans to be voted on again, (1) would amend the present charter by vesting in the council the functions now performed by water, health, park and police boards, but the executive heads, including the city engineer and superintendent of waterworks, would continue to be elected by popular vote. Under (2) a board of aldermen (including the mayor as a member) would appoint a chief administrator, who, according to the proponent of the plan, would have somewhat less power than does the city manager under most of the manager charters.

Contract for Sewage-Works Let at Decatur, Ill.

A coarse screen, a three-compartment grit chamber, six Imhoff primary settling tanks, two dosing tanks with 30-in. siphons for alternate operation, three acres of filter beds 6 ft. thick, a Dorr secondary settling tank, 40,000 sq.ft. of sludge drying beds, a 40-in. Venturi meter, a river outlet, and water-supply and drainage systems are included in the sewage-works for Decatur, Ill., contract for which had been awarded to L. N. Cope & Son, of Decatur, at $567,630. Four other bids ranged from $622,000 to $692,000. The engineer's estimate was $560,000.

The work is to be completed by Dec. 15, 1923. This plant is designed for a population of 60,000 in 1930, except that the filters are considered sufficient for a present population of 45,000 together with a considerable amount of corn-products waste. Space is provided for increasing the filter area to twelve acres. Pearse, Greeley & Hansen, Chicago, are the engineers.

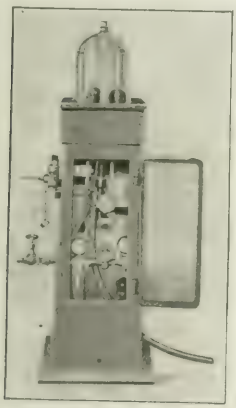
Once More the World's Largest Ship

On May 17 the White Star liner "Majestic," the world's largest ship, reached New York on her maiden voyage. She is 956 ft. long, 100 ft. wide and 102 ft. deep from bridge to keel. Her registered tonnage is 56,000 tons, her displacement 64,000 tons and her oil-burning turbines have 100,000 maximum horsepower, which permit of an average speed of above 25 knots. The loaded draft is given as 41.3 ft. The "Leviathan," formerly the "Vaterland," which has been the largest vessel since before the war, is 950 ft. long, 100.3 ft. wide and is registered at 54,200 tons. The "Majestic" was built in Germany; she was to have been the "Bismarck" but was taken over by the British and completed by the firm of Blohm and Voss to British order.

New Water-Works Equipment Shown at Convention

Among the newer pieces of apparatus in the unusually complete exhibition of water-works machinery and equipment at the Philadelphia convention of the American Water Works Association last week were the following:

A long-distance water-stage recorder manufactured by W. & L. E. Gurley, Troy, N. Y., consisting of a float-operated sender located over a stilled-water chamber, electrically connected to a graphic recorder or indicating device which may be housed at a distance. The sender is the novel part of the apparatus. It is equipped with two electrical contacts, one of which closes for a fraction of a second every time the water rises 0.05 ft., while the other closes when the float falls an equal amount. The contact is made by the tilting of a bent metal tube in each leg of which is a mercury column. When the angle in the bent tube is lower than the end of the long leg, contact is effected. The recorder is equipped with two sets of magnets to operate a horizontal



VACUUM-FEED CHLORINATOR

drum above which is a clock-operated pencil carriage. Energizing one of the magnets which takes place whenever the circuit of the sender is closed operates a ratchet turning the drum one way when the water falls and the other way when it falls.

The Corcoran wipe joint machine exhibited by the A. T. Taft Manufacturing Co., Cleveland, consists of a clamping vice to bring together and hold steady the ends to be wiped. A split metal mould is then clamped around the pipe ends. After molten lead is poured into the mould the mould is partially revolved in both directions to make a smooth joint. It is claimed that four joints can be made by unskilled labor in the time it ordinarily requires a skilled mechanic to make one joint.

Split sections of 6-in. cast-iron pipe made by the de Lavaud centrifugal process were shown. The mould is revolved rapidly while the molten metal is poured in from the end of a spiral pouring trough which is slowly withdrawn as it pours the length of the pipe. The exhibit was by the U. S. Cast Iron Pipe & Foundry Co.

A water-service pipe packer was developed recently for New Orleans by the Ford Meter Box Co., to remove service cocks at the curb and thus save digging up the street to shut off the corporation cock. It consists of an expander on the end of a long rod inserted through a stuffing-box head which screws into the service cock. When the expander has closed off the water the stuffing-box head is removed and then the old service cock is repaired or replaced, the head put back, the expander removed and the cock closed.

Wallace & Tiernan exhibited a new vacuum-feed chlorinator which consists of a chlorine pressure-reducing and constant rate-of-control mechanism housed under a water-sealed glass bell jar in a hard rubber tray at the top of a cast-iron pedestal. Located in the base of the tray is an injector for making a solution of chlorine and water, both of which are supplied through float-controlled pressure reducing valves. The vacuum produced by the flow of water through the injector produces a vacuum in the bell jar. This vacuum is transmitted to the bell jar through a glass orifice meter-tube assembly containing a silver tube adjustable as to height to control the water and chlorine differentials created by the vacuum.

Inside the bell jar, in addition to the ball-float reducing valve and meter tube, is a ball-float vacuum relief to admit air if the water supply is turned on without the chlorine. It prevents the water rising to the height of the gas-inlet connection.

The apparatus will function with chlorine pressures as low as 25 lb. and safety is insured, because the chlorine is automatically shut off with the water.

Water-Works Convention

(Concluded from p. 885)

Baltimore, chairman, Publication Committee; George C. Andrews, Buffalo, chairman Finance Committee, and Theodore Leisen, Detroit, chairman Membership Committee. The new nominating committee announced George W. Fuller's name as candidate for president for 1923-4.

The Water-Works Manufacturers' Association elected as president Edgar Buttenheim, of *The American City*, New York City, and re-elected the following: Vice-president, Charles R. Wood of R. D. Wood & Co., Philadelphia; treasurer, G. F. O'Brien, of the A. P. Smith Manufacturing Co., East Orange, N. J.; secretary, John A. Kienle, of the Mathieson Alkali Works, 25 West 43d St., New York City.

Delegates Gave Next Convention

For the next convention the executive committee announced duly accredited invitations from Detroit, Omaha, and [illegible] The latter city waived [illegible] The ballot gave Detroit the convention with 182 votes, against 12 for San [illegible] and 10 for Omaha.

[illegible] contributions to other associations the Executive Committee announced the decision against [illegible] the Association to [illegible] its treasury any part of the [illegible] collected by the [illegible] Committee on Elections. [illegible] was voted an appropriation for the [illegible] amount $1,800. The Executive Committee also reported favorably on [illegible] the American Committee on [illegible] of the National Fire Protection Association.

The Engineer in Public Life

THOMAS R. AGG

Service as a member of the Board of Education of the City of Ames, Iowa, is among the public activities of Thomas R. Agg, professor of highway engineering at Iowa State College and consulting road engineer to the Iowa Highway Commission. He is 44 years old, was graduated from Iowa State College in 1905, taught for three years at the University of Illinois and then served with the Illinois Highway Commission from 1908 to 1913 when he joined the faculty of Iowa State College. Prof. Agg has taken a prominent part in the activities of national local engineering societies, and in addition is a member of the Ames Chamber of Commerce. He is author of "Construction of Roads and Pavements" and "American Rural Highways." During the war he served in this country as captain, 109th Engineers, 34th Division, and later was promoted to rank of major and assigned to the 98th Engineers.



U. S. Chamber of Commerce Holds Highway Session

For the first time in its ten-year history the U. S. Chamber of Commerce devoted a session at its annual convention in Washington, D. C., last week, to highway transport. The meeting was held May 16 under the auspices of the transportation department of the chamber and was presided over by A. J. Brosseau, president of the International Motor Co., and director of the chamber, with J. R. Bibbins as secretary of the session. The speakers were Thomas H. MacDonald, chief of the U. S. Bureau of Public Roads, who spoke on "Economic Foundation for Future Progress," and E. J. Mehren, editor of *Engineering News-Record* on "Practical Highway Transport Regulation."

Mr. MacDonald's paper was a careful inquiry into the factors needing consideration in the framing of a sound financial policy. He contended that highways should be placed in the self-supporting class of public improvements. Among other things he suggested that there was no good reason why highway bonds should be amortized within the life of the road, since experience has shown that there are certain permanent elements in highway improvement. He maintained that sufficient revenue could be derived from the users of highways to pay all of the maintenance and a percentage of the construction charges. New construction would be paid by bond issues. An abstract of the paper will appear in an early issue.

Mr. Mehren's paper, printed elsewhere in this issue, pleaded for more regulation, designed to increase traffic and secure maximum economic benefits.

Propose Five-Year Courses for Engineers

Deans of Fourteen Universities and Colleges Agree to Advocate Plan for Their Schools

Five-year courses for engineering students were unanimously favored by a conference of the engineering deans, directors and representatives of fourteen colleges and universities held in Chicago May 19. Each of the deans is to present the recommendations approved at the conference to his engineering faculty and to his president and will urge their adoption. It is hoped that this concerted action will bring about the publication of new five-year courses of study in time to become effective not later than 1924.

The resolutions that embody the conclusions of the conference and the names of the participants follow:

The undersigned engineering deans, directors and representatives, in conference assembled, hereby

Resolve, That in order to meet the constantly enlarging responsibilities of the engineering profession we favor an advance in engineering education at this time that shall provide for five years of collegiate training for those engineering students whose aim is to be qualified to take positions among the creative leaders in the profession, and that such advance shall be made in accordance with the following plan:

1. Remodel the present four-year engineering curriculums by substituting a substantial proportion of humanistic and fundamental subjects in place of an equivalent amount of advanced technical work. It is desirable that so far as possible the curriculums in the different branches of engineering shall be sufficiently uniform to permit students to defer their final choice of a specialty at least to the end of the second year.

2. Add a fifth year of advanced work, mostly or wholly technical and specialized to such an extent as desired.

3. The first four years of work shall lead to a bachelor's degree, and the fifth year to an advanced degree in engineering.

Resolved: That each member of this conference will present the above recommendations to the authorities of his institution, and will report back at the second session of this conference, which is to meet at Urbana, Illinois, during the week of June 18, 1922:

Dean W. G. Raymond, State University of Iowa, chairman.
Dean O. M. Leland, University of Minnesota, secretary.
Dean E. A. Hitchcock, Ohio State University.
Dean A. A. Potter, Purdue University.
Dean M. E. Cooley, University of Michigan.
Dean G. W. Bissell, Michigan Agricultural College.
Dean C. R. Richards, University of Illinois.
Director J. F. Hayford, Northwestern University.
Prof. Edward Bennett, University of Wisconsin.
Dean E. J. Babcock, University of North Dakota.
Dean O. J. Ferguson, University of Nebraska.
Dean Anson Marston, Iowa State College.
Dean W. E. McCourt, Washington University.
Dean H. S. Evans, University of Colorado.

City Bonds at Low Interest Rates

Woonsocket, R. I., has just sold $575,000 of 4½-per cent bonds which are being offered by the purchasing bond house at par. Watertown, N. Y., has sold $375,000 of serial 4½ per cent due annually from 1925 to 1945, which are now for resale by the broker to yield 4.05 at all maturities.

Enjoins New York City Project for Narrows Tunnel

On the application of William J. Shiefflin, chairman of the Citizens Union, a temporary injunction has been granted restraining the City of New York from proceeding with the Narrows Tunnel project. (See *Engineering News-Record*, April 13, 1922, p. 626, and May 18, p. 846.) The action alleges that the project is beyond the authority of the Board of Estimate and Apportionment and that it will involve the waste of from $60,000,000 to $100,000,000 of public funds on an impracticable scheme.

Headings Holed Through on Shandaken Tunnel

Headings between shafts 5 and 6 of the 18-mile Shandaken tunnel, forming part of the Catskill water-supply system for New York City, were holed through May 20.. After the ceremony luncheon was served in the tunnel, which had been decorated for the occasion, to a party of about 150, headed by J. Waldo Smith, chief engineer of the Board of Water Supply and including other members of the board's engineering staff, guests and representatives of the contractor, the Shandaken Tunnel Corp., with which the Ulen Contracting Corp., (T. S. Shepperd, vice-president and general manager) is associated. The first pair of headings, between shafts 4 and 5, had been holed through in March.

Cement Trial Nears Close

The case against the cement manufacturers of the Eastern district, who are being tried for violation of the Sherman anti-trust law in the federal court for the Southern district of New York, was scheduled to go to the jury this morning. The government began its summing up argument on Monday and the prosecution closed its rebuttal on Wednesday. A verdict is expected some time today.

American Construction Council Gains Headway

Much activity is being displayed by the temporary operating committee which has arranged for the organizing meeting in Washington, D. C., June 19 of the American Construction Council. Representatives of the committee put the matter last week before the national executive board of the Associated General Contractors meeting in Washington; before the Philadelphia convention of the American Waterworks Association and the meeting of the U. S. Chamber of Commerce in Washington.

The board of the Associated General Contractors voted to support the council, while the members of the waterworks association adopted a resolution that it was the sense of the convention that the association should take membership in the council. The purposes of the proposed organization were presented before the U. S. Chamber of Commerce by Arthur S. Bent, president of the Associated General Contractors, who spoke immediately before President Harding addressed the chamber.

Harrington Nominated for Presidency of A.S.M.I.

John Lyle Harrington, of Kansas City, Mo., was chosen by the nominating committee of the American Society of Mechanical Engineers at the spring meeting held in Atlanta, Ga., May 8-11, as candidate for president of the society to succeed Dean Dexter S. Kimball, of Cornell University, whose term of office expires this year. Mr. Harrington is a member of the firm of Harrington, Howard & Ash, consulting engineers, of Kansas City. Most of his professional experience has been in bridge work.

J. Waldo Smith Resigns

(*Concluded from p. 884*)

George S. Webster. He was awarded the John Fritz medal in 1918 in recognition of high engineering achievement and during the same year received honorary degrees of doctor of engineering from Stevens Institute of Technology and Columbia University.

At its meeting of May 23 the Board of Water Supply accepted Mr. Smith's resignation and appointed Thaddeus Merriman as chief engineer to succeed him. To those who have been associated with him on the Catskill work Mr. Smith sends the following message:

FROM "THE CHIEF" TO HIS MEN

"In announcing my resignation as chief engineer it seems fitting to address a message to the past and present members of the engineering organization, to the contractors and to others who have wrought with us, expressing my deep and lasting appreciation of their helpfulness and support throughout, their spirit of cordial co-operation, their many kindnesses to me personally and their self-sacrifice and loyalty to the work. Our distinguished consulting engineers have very aptly and truly stated publicly that, for ability, efficiency, integrity, loyalty and devotion to duty, the organization has seldom been equalled and never excelled by any other within their knowledge. By reason of this I feel that degree of obligation for all that has been done for me and for the ever-present helpfulness extended that I could not take this step if I believed it would react against the interests of the organization or the work.

"These have been exacting years, but they have been supremely happy ones. The human side and the personal relations have been intensely interesting and have been a source of recreation and real joy. It is my wish that, as the years go by, all who have been connected with the work may look on their service with the Board of Water Supply as I know I shall—as a real event in their lives.

"As in the past, the principle of promotion within the organization has been followed, and no stranger will head the engineering staff. In the position of consulting engineer, while this work will still be my chief interest, I hope to have more leisure to consider the developments of the future. Be assured that my interest in the organization's personnel and the welfare of the work will continue unabated. I bespeak for my successor the loyal support which has been the distinguishing characteristic of this work."

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Annual Convention, Salt Lake City, Utah, June 5-7.

NATIONAL CONFERENCE ON CITY PLANNING, Boston, Mass.; Annual Meeting, Springfield, Mass., June 5-7.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Annual Convention, Portsmouth, N. H., June 21-22.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, University of Pittsburgh; Annual Convention, University of Illinois, June 20-23.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual Meeting, Atlantic City, N. J., June 26-30.

The Engineer's Society of Pennsylvania has elected the following officers for the year: President, T. E. Seelye; first vice-president, R. W. Moorehead; second vice-president, William Brown; secretary, Howard E. Moses; treasurer, Harry T. Neale.

The Engineering Institute of Canada will hold a professional meeting in Vancouver, B. C., June 16 and 17.

PERSONAL NOTES

PAUL STARRETT has resigned as president of the George A. Fuller Co., but will continue to serve as director. James Baird who has been in charge of the Washington office for twenty-two years, has been elected president and will make his headquarters in New York.

LORENZO C. DIEKS, who was in charge of the shipbuilding undertaken during the World War by the George A. Fuller Co. at Wilmington, N. C., has resigned his position with that company upon the completion of the work there.

F. M. REGISTER, formerly in the chemical department of the Barrett Co., Frankford, Pa., is now with the L. Martin Co., manufacturers of lamp black, as superintendent of their Tacony, Philadelphia, plant.

B. H. PIEPMEIER, road engineer of the Illinois State Division of Highways, has been appointed chief engineer of the Missouri State Highway Department, succeeding Alexander Graham, resigned. A biographical sketch of Mr. Piepmeier will appear in next week's issue.

BERT H. CALKINS has been appointed city manager of Albuquerque, New Mexico, and will assume his new duties on June 1. He succeeds James N. Gladding who resigned on April 1.

JOHN LAYLIN, formerly a division engineer in the Ohio State Highway Department, has been appointed superintendent of public works, Columbus, Ohio, succeeding E. S. Smith, resigned.

H. A. TERREAULT, has been appointed director of public works, Montreal, Canada, succeeding A. E. Doucet, resigned. He was formerly superintendent of the city water works.

DANIEL P. POWERS, construction engineer for the Stebbins Engineering Co., Watertown, N. Y., is returning from Rajamundry, India, where he has been in charge of the construction of paper and pulp mills for the Carnotic Paper Mills, Ltd.

CHARLES R. MCELLEN, formerly with the New York State Highway Department, has become associated with James P. Brownell, consulting engineer, Watertown, N. Y.

M. G. SNOW, formerly assistant engineer in the valuation department of the New York Central R.R. at Cleveland, Ohio, has become cost engineer with the Froehlich & Emery Engineering Co., Toledo, Ohio, who are appraising all the interurban railways of the state of Michigan for the public utilities commission.

ROLAND E. STOELTING has been appointed commissioner of public works at Milwaukee, Wis. He was formerly assistant city engineer and engineer of the Board of Public Land Commissioners.

W. F. STROUSE, chief engineer of the public service commission, Baltimore, Md., has been made valuation engineer. H. CARL WOLF, assistant engineer, will be made chief engineer.

JACOB LABISHINER, recently associated with the Great Western Gateway Project at Schenectady, N. Y., has been appointed city engineer of Amsterdam, N. Y.

BUSINESS NOTES

The ILLINOIS ZINC CO., manufacturers of zinc shingles, slab zinc, strip zinc in coils, electrolytic slab zinc, sulphuric acid and zinc dust, has opened a selling office for its products in Chicago.

ARTHUR MCMULLEN CO. announces the resignation of F. P. Parker and the election of Edward P. Palmer, as secretary of the company.

THE KEYSTONE CONCRETE BLOCK CO., Rochester, N. Y., has been appointed vicinity representative of the Consolidated Expanded Metal Co., Braddock, Pa., for the distribution of steelcrete "Rid-gid" metal lath.

THE ALLEN-[illegible] ENGINEERS, [illegible] engineers, contractors and managers of Milwaukee, Wis., has established a [illegible] office.

WILLIAM S. MOORE, formerly city engineer of South Bend, Ind., has resigned as vice-president and general manager of the Bethlehem Steel Pile Co., Bethlehem, Pa., and formed a [illegible] partnership with CHARLES W. COLBY, a member of the Indiana Bar, for the practice of engineering and surveying. The [illegible] has offices in South Bend.

EQUIPMENT AND MATERIALS

A Special Contractors' Truck

A contractors' truck, with a 10-ft. wheel base and a special dump body, has been put on the market by the Atterbury Motor Car Co., Buffalo, N. Y. Designed primarily for carrying batches of concrete materials, the 2-cu.yd. body is fitted for general haulage. A Heil hydraulic hoist giving a 43-deg. dumping angle gives precise control in dumping and the use of the chain spreading



device on the tail gate makes it possible to use the truck for stone spreading.

The body is fitted with steps on both sides so that men can spread and level the load. All corners are rounded to facilitate scavenging, and the rear end of the body is fitted with slanting plates to confine the load to the skip when dumping. This feature, in connection with the swinging lateral partition, allows both batches to be dumped into the skip without moving the truck.

New High-Power Excavator

To meet the demand for a larger size excavator designed to come within standard railway clearances without dismantling, a new machine is now being placed on the market by the Pawling & Harnischfeger Co., Milwaukee, Wis. This machine will handle a 1-cu.yd. dragline bucket on a 35-ft. boom, a ¾-cu.yd. bucket on a 40-ft. boom or a ½-cu.yd. bucket on a 50-ft. boom. It will also handle clamshell buckets of



from [illegible] to [illegible] yd. capacity depending upon the material handled. With [illegible] interchange the [illegible] can be easily [illegible] handling a 1-cu.yd. dipper. In addition to being used as an [illegible] dragline or clamshell and dragline [illegible] the machine can be used with [illegible] scraper, crane hook or electric magnet.

The [illegible] has four movements forward and in reverse on its crawler tractions. The power unit is a 75-hp. gas engine.

Business Side of Construction

Facts and Events that Affect Cost and Volume

What Materials and Labor Cost in Milwaukee

Higher Lumber Prices Forecasted During Summer—All But Iron-Workers Busy—Detailed Prices

Among the cities not covered in the Monthly Prices of Construction Materials or the Weekly Construction Market of *Engineering News-Record*, Milwaukee is the next to receive consideration in these pages. Materials prices and labor rates in Buffalo were published on Jan. 19, p. 132. Other buying centers not included in the regular price lists will be featured from time to time, from information obtained first hand by our regular correspondents.

Following quotations are to contractors, in car lots unless otherwise stated:

Sewer Pipe—Current prices per ft., in the following sizes:

3-in diameter	$0.18
5-in. diameter	.27
8-in diameter	.42
12-in diameter	.81
24-in diameter	2.48
36-in. diameter	5.13

Sand, Gravel and Crushed Stone—Gravel, 1½-in. screen, quoted at $2.10 per cu.yd. Sand prices range from $2.20 to $2.40 per cu.yd. Crushed stone, both 1½-in. and ¾-in., $2.25 per 2,500 lb.

Cement—Natural (Louisville) cement sells for 90c. per sack; portland cement at $2.16 per bbl., without bags, f.o.b. Milwaukee.

Lime—Hydrated common lime $10 per ton at warehouse, including cloth bags; common lump per bbl., 180 lb. net., $1.60.

Brick—Chicago common brick quoted at $13.50 per 1,000. Milwaukee brick costs $12.50; Hy-tex rustic at $37.50 and tapestry brick at $45.

Hollow Wall and Clay Drain Tile—Price per block for hollow wall tile, 4 x 12 x 12, 8c.; 8 x 12 x 12, 14½c. Clay drain tile quoted per lin. ft., in the following sizes:

3-in	$0.05
4-in	.06
6-in	.09
8-in	.14

Lumber—Leading wholesalers expect higher lumber prices in early part of summer. Prices wholesale, per M ft. b.m., in carload lots, to dealers, f.o.b.; for No. 1 grades:

Yellow pine, 1-in. rough, 10-in. and under, 16 ft. and under	$37
Fir, 1-in. rough, 10-in. and under, 16 ft. and under	37
Hemlock, 1-in. rough, 10-in. and under, 16 ft. and under	37
Yellow pine, 2-in. tongue and groove, dressed and matched, 10-in. and under, 16 ft. and under	38
Fir, 2-in. tongue and groove, dressed and matched, 10-in. and under, 16 ft. and under	38
Yellow pine, 8x8-in. and under, 20 ft. and under	42
Fir, 8x8-in. and under, 20 ft. and under	42
Hemlock, 8x8-in. and under, 20 ft. and under	42
Spruce, 8x8-in. and under, 20-ft. and under, including jack pine balsam	52
Yellow pine, 12x12-in., 20 ft. and under	51
Fir, 12x12-in., 20 ft. and under	51
Maple, factory grade, 1x2½-in. m. and d.	30
Maple, clear, 1x2½-in. m. and d.	100
Oak, 1x4-in. m. d and b.	175
Wood lath, No. 1 hemlock, per M	10
No. 1A, hemlock, per M	8.50
No. 1 pine, per M	12

Expanded Metal Lath—Prices per sq.yd., are as follows:

Gage	
27 dia. mesh	$0.21
27 herringbone	.22
26 dia. mesh	.23
24 herringbone	.28½
24 dia. mesh	.27½

Pyrobar—

	C.L.	L.C.L.
3-in. per sq.ft.	$0.10½	$0.11
4-in. per sq.ft.	.13	.13½
5-in. per sq.ft.	.20	.
6-in. per sq.ft.	.22	.
3-in. roof tile	.22	.24
3½-in. hollow roof tile	.22	.24
4-in. hollow roof tile	.23	.25
Book tile per piece	.15	.16

LABOR RATES PER HOUR AND CONDITIONS

Bricklayers	$1.00	Plenty of work
Lathers	1.00	
Carpenters	.85	Plenty of work, best receive 90c. per hr.
Painters	.80	
Hoisting engineers	.92½	No standard wage, paid on merits.
Plumbers	.90	Effective since May 15; formerly $1 per hr.
Hod carriers	.50	
Pile drivers	.50@.75	No standard wage; based on individual merits.
Plasterers	1.10	
Structural iron-workers	1.00	Not much demand.
Common labor, non-union	.40	Obtainable at 35c.

Steel and Iron in April and March

United States steel orders at the end of April were 5,096,917 tons as compared to 5,845,224 tons for the corresponding period in 1921. Daily pig iron production for April was 69,070, a great increase over the same period of last year when 39,768 tons daily were reported. April's total production of pig iron is estimated at 2,072,114 tons in comparison to 1,193,041 tons last year.

At the end of March, United States steel orders amounted to 4,494,148 tons compared to 6,284,765 tons for the corresponding period of 1921. Daily pig iron production for March, 1922, was 65,631 tons and 51,463 tons for 1921.

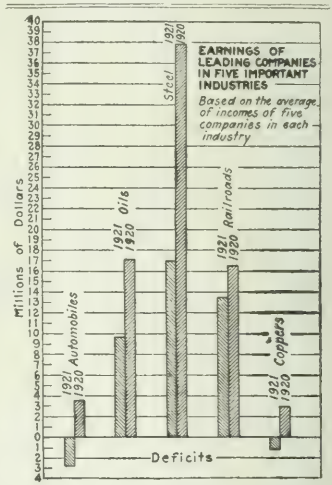
A decrease in the number of employed in eight industries and an increase in four others during the month of April, as compared with March, is reported to the Department of Labor by twelve representative manufactories.

Cost of money at New York last week was 3½@3 per cent.

Corporate Earnings Chart Shows 1921 Losses

Yearly financial statements of twenty-six well-known American business organizations, as reported to newspapers, show seven returned deficits in 1921 as compared with only one in 1920.

Largest gains in the accompanying table of earnings were made by Wells Fargo & Co., the Magma Copper Co., American Power & Light Co. and Pere Marquette Ry. Co. Returned deficit of the Braden Copper Co. was $5,013,720. (Sixty-six other financial statements from well-known companies were reported in the April 27 issue *Engineering News-Record.*)



Taking the average of five leading companies' earnings for 1921 and 1920, the comparison in the following chart shows that in each group 1920 profits were appreciably larger than those for the year 1921.

Company	Net Earnings or Losses (Deficits shown in *italics*) —Total— 1921	1920
American Power & Light Co.	$1,003,178	$967,240
Anaconda Copper Mining Co.	*16,999,555*	.....
Braden Copper Co.	*5,013,720*	*2,179,938*
Chicago & Northwestern Ry. Co.	*1,245,432*	12,459,253
Chicago, St. Paul, Minneapolis & Omaha Ry.	*285,677*	2,587,669
Colorado Power Co.	383,589	.....
Crescent Pipe Line	168,666	146,102
Havana Electric Ry.	4,620,064	4,108,510
Hurley Machine Co.	429,309	706,663
International Cement Co.	1,529,900	.....
Kennecott Copper Co.	3,799,392	6,477,021
Lanston Monotype Machine Co.	477,877	.....
Magma Copper Co.	*389,830*	102,545
Merritt Oil Corp.	999,456	.....
Mutual Oil Co.	1,257,689	.....
Ohio Fuel Supply Co.	2,293,524	.....
Pere Marquette Ry. Co.	3,765,879	1,393,972
Steel & Tube Co. of America	*2,371,358*	6,315,209
Sterling Products	2,057,703	.....
Standard Oil Co. of New York	9,698,971	39,405,631
Union Pacific R. R.	31,301,074	32,674,231
Utah Copper Co.	*2,038,109*	4,924,498
Vacuum Oil Co.	6,158,566	8,386,783
Wells, Fargo & Co.	1,279,707	453,041
Western Pacific R. R. Co.	2,808,533	.....
White Eagle Oil & Refining Co.	790,808	.....

Business Briefs

Gold money in the world in estimates submitted in connection with the Genoa conference will have reached £2,277,000,000 in 1930. This would compare with £1,916,000,000 in 1918, and £733,000,000 in 1891.

Gold imports last month amounted to $12,243,555, as compared with $33,488,256 in March and $80,662,202 in April, 1921, according to the Department of Commerce.

Building trades wages have been reduced on the average of 16 per cent since Jan. 1, the National Industrial Conference Board reports. Twenty-eight decreases were noted, eighteen occurring in the last two months and confined largely to the East and Middle West.

Wholesale prices of most commodities in April varied little from those of the preceding month, according to the Bureau of Labor Statistics, the all commodities index remaining the same as March.

New railroad equipment, consisting of 20 locomotives, 5,390 steel freight cars, 500 steel automobile cars, 100 steel passenger cars and 250 caboose cars, has just been ordered by the Southern Railway System as evidence of its faith in the early return of business prosperity in the South.

Gross domestic crude oil stocks held in pipe line and tank farm storage in the United States increased 9,583,000 bbl. in April, reports the American Petroleum Institute. The increase east of the Rockies was 7,763,000 bbl. and in California, 1,820,000 bbl.

Gross railroad earnings for the second week in May amounted to $7,416,004 in comparison to $7,157,170 for the corresponding period in 1921, showing a gain of $258,834 or 3.61 per cent.

Freight Car Surplus Decreases Five Per Cent in Week

In the fifth complete week of the bituminous coal miners' strike, that ending Saturday, May 6, 1922, revenue freight loading substantially maintained the figure of the previous week, the decrease being only 2,537 cars. Coal and coke in the aggregate were practically stationary. Grain and grain products, live stock and merchandise l.c.l., showed slight increases, while there was a decline in the loading of forest products, ore and miscellaneous freight. Compared with the corresponding week of the previous year the week's total of 755,749 was an increase of 34,027 cars despite the natural decline in coal loading due to the strike. The only other commodity which fell off compared with 1921 was ore. Compared with the same period two years ago the decrease in the total loading of 1922 was 87,435 cars. In the week ending May 8, 1922, there was a decrease of 18,299 freight cars or approximately 5 per cent, in the surplus, the total being 353,239 cars against 371,538 for the period ended April 30th. Surplus coal cars totaled 226,276, surplus box cars 86,604. The balance were miscellaneous.

1921 New York Road Contract Prices Fell Heavily

Data Based on 3,175 Miles for Seven Years Gives an Index Number of 214 for 1920 Compared to 208 Last Year

By W. G. Crandall
Assistant Engineer of the New York State Highway Commission

Contractors' prices index number on items entering into contracts awarded by the New York State Commission of Highways for the years 1915 to 1921 inclusive, shows 208 for the year 1921 in comparison to 214 for 1920, the peak year. Data was compiled from bids received on approximately 3,175 miles, extending over a period of seven years. It is interesting to note that the highest average bid price for 1921 is lower than the 1920 general average on earth excavation, foundation course and cement concrete pavement. Following are the values, the average bid price for 1915 is given an index value of 100.

Item	1915	1916	1917	1918	1919	1920	1921
Clearing and grubbing	100	197	200	114	136	106	208
Earth excavation	100	116	140	238	253	349	267
Rock excavation	100	113	120	170	195	233	221
Overhaul	100	80	100	133	153	171	127
6-in. vitrified pipe	100	105	275	.	185	300	195
8-in. vitrified pipe	100	109	143	. .	191	215	211
10-in. vitrified pipe	100	103	133	. .	188	230	263
12-in. vitrified pipe	100	108	142	140	210	244	262
15-in. vitrified pipe	100	122	140	. .	205	265	267
16-in. vitrified pipe	100	78	169	. .	165	.	.
18-in. vitrified pipe	100	104	126	. .	184	239	234
20-in. vitrified pipe	100	90	175	. . .	220	.	224
24-in. vitrified pipe	100	104	124	. . .	183	165	193
6-in. vitrified pipe underdrain	100	105	135	175	200	230	210
6-in. porous tile underdrain	100	85	120	115	155	180	150
Concrete leaching basins, type A	100	130	135	. .	187	191	180
Vitrified leaching basins	100	84	. .	. .	170	.	174
Catch basins	100	108	148	83	184	157	191
Changing elev. of catch basins	100	127	117	234	231	173	229
Cast iron pipe	100	118	149	158	233	245	248
Relaying old pipe	100	108	91	88	129	135	171
Stone filling	100	131	148	190	256	318	240
Piles, wood	100	63	70	. .	. .	.	204
Timber and lumber	100	136	154	157	199	271	261
Riprap	100	115	131	150	200	229	222
First class concrete	100	62	. .	. .	107	159	129
Second class concrete	100	105	118	135	168	242	213
Third class concrete	100	110	126	153	188	282	233
Stone masonry	100	105	122	135	207	261	182
Stone curbing	100	120	133	.	167	211	235
Resetting old curb	100	103	. .	. .	163	140	230
Concrete curb, type A	100	115	144	163	202	235	210
Concrete curb, type B	100	112	136	. .	229	.	191
Concrete edging	100	133	167	. .	367	.	. . .
Cobble gutter, cement joint	100	109	115	174	184	200	150
Cobble gutter, sand joint	100	112	123	172	190	252	190
Concrete gutter	100	148	152	.	252	271	275
Brick gutter	100	100	. .	. .	165	.	. . .
Metal reinforcement	100	103	123	179	151	170	144
Misc. iron and steel	100	103	123	149	150	164	139
Wood guide railing	100	112	140	146	200	267	262
Pipe railing	100	109	147	. .	165	192	229
Guide signs	100	111	129	150	156	180	200
Highway number signs	100	118	80	93	99	112	97
Danger signs	100	111	142	147	229	210	238
Concrete sign posts	100	125	129	154	155	165	175
Screened gravel	100	91	111	172	155	153	178
Broken stone, loose measure, trap rock	100	118	122	94	189	.	185
Broken stone, loose measure, trap rock	100	112	113	147	198	235	212
Foundation course, screened gravel	100	130	161	. .	235	230	366
Foundation course, field or quarry stone	100	108	134	147	217	262	216
Bottom course, screened gravel	100	113	154	. .	245	154	. . .
Bottom course, broken stone	100	111	125	169	190	221	193
Concrete foundations for pavement	100	109	134	104	200	300	241
Top course, waterbound macadam	100	110	124	163	213	241	193
Scarifying and reshaping old macadam	100	92	. .	. .	105	212	. . .
Surface treatment with bituminous material	100	101	128	109	145	138	. . .
Top course, bituminous macadam, penetration	100	110	117	187	197	220	208
Bituminous pavement	100	. .	113	. .	137	.	. . .
Concrete pavement	100	109	144	237	203	274	239
Sodding, laid flat	100	100	120	. .	135	171	. . .
Asphalt block	100	135	116	. .	. .	.	174
Brick pavement, type I	100	111	126	157	199	.	210
Stone block	100	106	134	. .	233	283	. . .
Bituminous material A, penetration	100	102	119	191	120	223	136
Bituminous material B, Tarvia	100	93	105	183	141	125	. . .
Cement rubble	100	112	111	103	150	171	. . .
Cement rubble, non-pulverizing	100	127	131	100	170	200	. . .
Average	100	110	133	151	186	214	208

SURPLUS AND SHORTAGE STATEMENT—MAY TO 8, 1922

	Flat Cars		All Box Cars		All Coal Cars		Total All Cars	
	Surplus	Shortage	Surplus	Shortage	Surplus	Shortage	Surplus	Shortage
	887		13,780	100	83,048		102,403	100
	492		12,437		104,740		121,097	
	162		791		1,954		3,926	
	2,199	7	7,569	124	4,770	737	18,779	875
	796		21,451	50	2,611		30,841	50
	1,040		22,368	5	26,116	50	61,873	111
	350		8,208	151	3,037		14,520	151
	6,016	7	86,604	483	226,276	787	353,239	1,287
	1,745		26,975		1,340		36,765	
Grand total	7,761	7	113,579	483	227,616	787	390,004	1,287
Apr. 30, 1922	9,162	84	122,688	369	236,789	374	410,203	842

Failures Gain in Week

Following last week's substantial reduction, business failures in the United States this week shows an increase, numbering 459. The total compares with 408 last week, and is considerably in excess of the 315 defaults reported to R. G. Dun & Co. a year ago. Of this week's insolvencies, 262 had liabilities of $5,000 or more in each instance, which represents 57.1 per cent of aggregate number. Last week, there were 233 failures for $5,000 or more.

April Residential Contracts Amount to $132,477,800

Residental contracts let for April amounted to $132,477,800, making a total of $405,451,500 for the first four months of 1922, according to F. W. Dodge construction figures. Total contracts for the first quarter amount to $273,000,000 as follows: $75,728,300 for January; $75,727,500 for February, and $121,550,900 for March.

Through an error *Engineering News-Record* in the May 11 issue published the Dodge residential construction figures as for the whole first quarter of 1922 instead of for the month of March only. Dodge's figures for March were $121,550,900. Residential contracts for the first four months of this year are as follows:

District	Value
Boston	$36,628,600
New York	176,835,200
Philadelphia	64,295,300
Pittsburgh	45,746,500
Chicago	74,264,900
Minneapolis	7,580,400
Total	$405,451,500

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of May 4; the next, on June 1.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$2.58	$3.50	$4.00	$2.48	$2.76	$3.50	$3.10	$3.60	$3.75
Structural rivets, 100 lb	3.50	4.25	5.50	3.10	3.90	4.45	4.50	3.75	6.50
Reinforcing bars, ½ in. up, 100 lb	2 48	3.50	3.50	2.38	2.66	3.52½	2.55	3.60	2.75
Steel pipe, black, 2½ to 6 in. lap, discount	61%	61.15%	45%	59½%	61.9-5%	44%	56.1%	53%	30.00
Cast-iron pipe, 6 in. and over, ton	46.80@47.80	48.00	48.30	44.10	48.50	55.00	51.00	52.00	50.00
Concreting Material:									
Cement without bags, bbl	2.50@2.60	2.39	2.25	1.97	2.24	2.90	2.83	2.94	2.48
Gravel, ¾ in., cu.yd	1.75	1.85	2.25	1.80	1.50	2.50	2.25	1.50	1.50
Sand, cu.yd	1.00	1.15	2.25	1.80	1.00	1.10	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd	1.75	1.90	2.73	1.60	2.25	3.50	2.25	3.00	—1.60
Miscellaneous.									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	48.00	+38.00	34.50	40.00	39.00	+47.00	26.00	+21.50	47.00
Lime, finishing, hydrated, ton	15.80@16.80	18.00	25.00	18.00	29.00	24.00	22.00	24.00	21.00
Lime common, lump, per bbl	2.75@3.18	1.25	2.50	1.40	1.40	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	23.40	9.00	11.15	11.00	+16@17	12.00	15.00	14.00	16.00
Hollow building tile, 4x12x12, per block	Not used	.0795	.115	.0821	+.082	.08	....	.12	.09
Hollow partition tile 4x12x12, per block	.1112	.072	.115	.0657	....	.08	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal	.95	—1.00	1.09	1.04	1.06	1.18	1.04	.86	.97
Common Labor:									
Common labor, union, hour	.75	.35	.....	.80	.....	.50@.55	.56¼	.50@.60	.....
Common labor, non-union, hour	.44@.60	.20	.25	.72½	—.35@.50	.35@.50	.47½@.50	.....	.20@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks.

Montreal quotes on fir instead of pine. Sand, stone, gravel and lump lime per ton. Lime and tile are delivered; cement, sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.13 cents). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $30; 6-in., $110.

Changes Since Last Week

Steel shapes, plates and bars firm at $1.60 per 100 lb., Pittsburgh; mill shipments, New York, $1.98. Rise expected in warehouse prices as quotations in effect at present are based upon $1.50, Pittsburgh. Iron and steel scrap prices up; coke also slightly advanced. Falling off in demand for fabricated steel but mills increasing production on semi-finished products.

Stiff advances in lumber. Denver quotes Douglas fir at $47 as against $36.75. Seattle $21.50 advanced from $20 and Atlanta quotes pine at $33 as compared with $36 per M ft., one week ago. Common brick in Minneapolis is now $16@$17 as against $15. Face brick is also up there, by $2, and hollow building tile has risen slightly. Crushed stone quoted at $1.60 as against $2 per ton in Montreal. Raw linseed oil $1 in Atlanta as compared with $1.05 per gal., 5 bbl. lots, one week ago.

Common labor quoted at 35c.@50c. in Minneapolis as against the former rate of 40c.@50c. per hr. Hod-carriers, recently on strike in New York, have returned to work; agreements on the wage rate of $7 per day or 87½c. per hr. having been effected. This schedule was maintained throughout 1921 and is to continue in force during 1922.

A total of 377 mills reporting to the National Lumber Manufacturers' Association for the week ending May 13, show 207,799,592 ft. cut, or a reduction of 2 per cent from the week ending May 6; shipments amounting to 226,826,577 ft., or a reduction of 1 per cent from the previous week and orders for 261,354,729 ft. as against 261,666,175 ft. b.m. for the week preceding. Orders reached 17 per cent and shipments 2 per per cent above normal, while production stood at 7½ per cent below.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren *Editor*

Volume 88 — NEW YORK, JUNE 1, 1922 — Number 22

Standardization in the Lumber Industry

IN bringing together the producers, distributors, and users of lumber to establish standards and provide for guarantees as to sizes and grades, Secretary Hoover has added to the list of his practical services to American business. *Egineering News-Record* looks upon this proposal as another step in line with a policy it has consistently endorsed. It is to be hoped that from these conferences may issue a plan that will carry the practice of grade marking far beyond the few large mills that now employ it.

Poor Professional Tactics

PARTICIPATION in public affairs is such a new thing for engineers that a degree of ineptness must be expected before proficiency is attained. An example of how not to do it might readily be made out of the utterances of a certain local chapter of an engineering society which has felt called upon to muckrake the conduct of a municipal power project. The charges, which are being freely circulated in the local press, attack the chief engineer of the project, a prominent engineer called in from another city, because he has appointed other than local engineers as subordinates, and in so doing has not only violated the civil service law but has also grossly overpaid the men—a $5,000 construction engineer being cited as an example. Whatever the rights of the case, this is poor tactics for those whose avowed intention is to build up engineering prestige. The average citizen reading the report will see in it only the professional jealousy which, whether the animus of the report or not, sticks out of every paragraph and will have only disrespect for the quite natural office holder's attitude toward the outsider who gets an inside job. Engineers may not be any better than any other class of men in these respects, but surely the engineering profession can be but poorly served by publishing their limitations and by intimating that a $5,000 construction engineer is a superfluity on a three or four million dollar project.

Uniform Highway Markers

HIGHWAY engineers, during recent years, have been so intent upon large programs of construction that many of them have lost sight of the importance of making routes of maximum service to the traveling public. Such service does not end with the construction of a durable type pavement. It must include directions which facilitate the use of the highway by those who pay for it. For example, a plan of uniform numerical markings for roads throughout the New England States has been agreed to by the state highway authorities in that region. Markings are in the form of squares, painted in yellow and black on telegraph poles, carrying odd numbers for east-and-west routes and even numbers for north-and-south routes. Under the agreement reached a road extending through several states carries the *same* number. The plan for uniformity, started by the American Automobile Association, should be extended throughout the country. At present there is a great vogue among state highway departments to use colored markers or painted bands for the designation of trunk-line routes. These have been applied, for the most part, within individual states; they are meaningless except to residents and are of little aid to interstate traffic. Numerical markings are logical and have stood the test of time, particularly in France where they have reduced to a negligible quantity the inconvenience caused to highway traffic by unfamiliarity with the country. The highway traffic association, at its annual meeting, endorsed the numerical system of marking. Highway engineers can reinforce this action by getting back of the movement and extending the scheme westward from New England to the Pacific Coast.

More Study of the St. Lawrence

PROCEDURE in the matter of the St. Lawrence waterway is difficult. There are few rules and no precedents for the joint development of an international waterway. The advances toward a treaty with Canada just made by Secretary Hughes, therefore, do not mean much more than that the administration is favorably inclined toward the project and is willing to discuss with Canada the preliminaries leading up to the opening of the river to ocean going ships. If such a treaty is agreed upon by the executives there remains the legislative authorization of funds. It is imperative, however, before the last two hurdles are crossed that an extended and expert economic investigation of the project be made. Up to now all we have are heated and partisan statements from overwrought commercial and political bodies filtered through the wide mesh of the joint commission's report and an itemized estimate of cost of a given project by a board of engineers. The best thing Congress could do during the diplomatic discussions of a treaty would be to authorize an unprejudiced group of economists, shipping men and engineers to report on the possibilities and practibilities of the waterway.

A Promising Step

SIGNIFICANT possibilities are contained in the move of Cleveland contractors to clean up building conditions in that city. The same problems exist elsewhere, and an energetic precedent can be a powerful influence for good. Only last week we referred to the difficulties of the problem of getting sound building construction, chiefly with reference to the engineer's part in work where questions of strength and stability are primary. But in every city, and in Cleveland fully as much as anywhere, bad building—sometimes ignorant but more often wilfully bad—is an infinitely worse matter than design deficiencies. If unchecked, bad building infects every branch of the building art and

produces a fatally diseased condition, as is well known to building officials and others who see the process go on elsewhere. A supplementary inspection bureau, such as has been suggested in Cleveland, is an untried remedy, but one which contains great promise. It will not only supplement and make really effective the inevitably inadequate municipal inspection, but it will enroll in the fight the people most directly interested in good building. The fight surely concerns every reputable contractor, if he wants to remain reputable. But it concerns the engineer fully as much, and should engage the most active interest of Cleveland's professional men. The progress of the movement will be watched throughout the country with close interest, we feel sure.

Remolding Engineering Education

WHAT is likely in the future to be looked upon as one of the important steps in American engineering education was that initiated at Chicago week before last, when the deans of engineering schools of fourteen of the great Middle Western universities agreed to recommend to their authorities new courses with a greater content of "humanistic and fundamental subjects." The faculties have yet to approve the recommendation but the group endorsement carries a pressure that should secure favorable action. The plan is not merely the matured conclusion of a single dean and his associates, but of the leaders of engineering education throughout the virile Mississippi Valley.

The plan calls for the discontinuance of the present courses and the substitution therefor of new four-year courses in which advanced technical work will be replaced by an equivalent amount of cultural and fundamental subjects. The new courses would lead to a bachelor's degree. A fifth year of advanced work, "mostly or wholly technical and specialized to such an extent as desired" would be added and would earn an advanced degree.

Many details are still to be determined. The proportionate time alloted to the humanistic studies, the fundamental subjects which are to be expanded, and similar problems are presumably to be left to the determination of each college. How far, therefore, the new courses will be an improvement on the present ones will depend much on the judgment of the different faculties.

It will be seen that the proposal answers two demands that have become more articulate each year for at least a decade: first, that there be a larger cultural content in the courses, and, second, that there be less specialization and more attention to engineering fundamentals. These demands we have believed to be sound and we commend accordingly the new proposal.

What effect Prof. Burr's paper before the Society for the Promotion of Engineering Education had in bringing the issue to a head there is no means of knowing, but we believe it safe to surmise that it was no small factor. The plan recommended, however, differs from the Burr plan of a six-year course, half of cultural and half of engineering studies. The Western deans hold fast to four years as the desirable length of course—a wise conclusion, at least as a transition step. The alternative would have been to arrange parallel courses on the Burr plan, letting the students choose which they would. Evidently the deans believed that in expanding the humanistic and fundamental studies and restricting the advanced work they were making a course so far superior to the present ones as to warrant the elimination of the latter entirely.

The purpose of the Western action is, of course, to prepare men better fitted to carry the larger responsibilities in engineering—a sound purpose indeed, and one that should particularly concern our universities, for to them we are entitled to look for our leaders and our men of culture. It should not be forgotten, however, that the execution of engineering work requires many men who stand below the leaders in intellectual equipment and whose chief asset should be a strict discipline in those branches of engineering science required in the details of design. Heretofore many of these men have come from university schools; others from the technical institutes such as Williston, Pratt, Cooper Union and Ohio Mechanics Institute. If the university schools more and more place emphasis on training for leadership, the thinking of teachers and engineers will have to broaden in sympathy toward these other institutions on which will fall the burden of preparing for the profession a very necessary part of its complement. Running parallel with such awakening of sympathy must come an appreciation among high-school directors of the function of the technical institutes referred to so that they may be disposed to direct to such schools those of their young men whose intellectual equipment and personalities suit them better for that type of training. Thus will the requirement be fulfilled for the detailed as well as for the advanced positions in the profession.

An Undecided Case

IT is most disappointing that the jury in the long drawn out trial of the Eastern cement men for violation of the Sherman Act were unable to reach a decision. Business in general, and particularly the construction business, needs a judicial ruling on the several issues involved in that trial. The legality of trade associations, operating under the Eddy plan, is still ambiguous, in spite of the Supreme Court's hardwood decision, but this issue was thrown out of the cement case because of a technicality which establishes a precedent only insofar as it relates to the statute of limitations and its effect on a contract. The larger question as to whether the cement companies fix prices the jury could not agree upon. Eight weeks hard labor of many men and hundreds of thousands of dollars have gone for naught.

To one who sat through the case or read the record it is not surprising that the jury was confused. Here is no ordinary question of fact, no weighing of evidence to decide whether an obvious and understandable crime had been committed. The judge's charge made it clear that the crime punishable by the Sherman Act is the "unreasonable" restraint of trade. Restraint of trade, he assumed, was inherent in the practices which the cement companies freely admitted. Whether or not it was unreasonable he left to the jury, and he could give them little assistance in the definition of that word. To get twelve men to agree on a definition is well nigh impossible.

The prosecution based its case on the assumption that any deviation from the old theory of cut-throat competition in business is a violation of the law. According to that theory each competitor is at war with every other one and secrets must be as zealously guarded and as secretly sought as they are in war. And every busi-

ness act is a secret. The trade association, honestly conducted, is a revolt against the uneconomic idea of business war, which may for a time result in lower prices to the consumer but which, like all war, taxes the community out of proportion to its individual apparent benefits. The danger of the trade association lies in the ease with which community of interest can be shifted into conspiracy against the consumer in the way of monopoly control of a needed article. Between the extremes of secrecy and combination lies a proper, economic and probably legal zone. In this transition period of economic thinking, however, that zone is difficult to delimit and the recent trial leaves still doubtful whether the cement companies are operating in or out of it.

Brushing aside all generalities, what the cement consumer wants to know is whether he is paying more for cement than he ought to. That, we think, the prosecution did not prove nor the defense disprove. It was not, apparently, a legal essential of the case. The government proved that there was the closest sort of interchange of vital unformation and that there was a remarkable uniformity of price, but that that uniformity was the result of anything but the natural level-seeking of a uniform product there was no convincing evidence. Circumstantial implications of illegality were, however, great enough to warrant the trial and in the minds of some of the jury enough to keep them from rendering a verdict of not guilty. The case against the cement manufacturers is, therefore, still *sub-judice* and will not be cleared up until a retrial of the present case or the trial of the similar case against the Mid-West group.

In justice to the Portland Cement Association, it should be said that it was given a clean bill of the health. Even the prosecutor admitted in his summing up that there were no practices of that association not perfectly justified in law and in morals. It is clearly an educational institution.

Government Promotion of Foreign Trade

AMERICANS interested in foreign trade have often expressed great admiration for the assistance accorded British exporters by their government, and have been apologetic regarding our own foreign trade promotion service. But a change is in progress; and if Congress will continue to back the Department of Commerce, we shall rapidly cut down the lead which our British brethren have had through their government-supported promotion efforts.

The strides that have been made under Mr. Hoover's direction are remarkable. More specialists of high grade have been brought into the service, emphasis has been laid upon the value of immediate information, the trade representatives in Europe have had a convention to discuss their common problems and increase their grasp and effectiveness by an interchange of ideas, a closer system of direction for representatives has been established, questions that have been critical for various industries have been run down, to the great economic benefit of those industries and of the country.

At home the department has sought and has received the most satisfactory assistance from our industries. No less than seventy trade committees, representing 150 firms, are now working with the commodity divisions of the department. Thus it is possible to quickly formulate the sort of information that the industries need, and to get it while the situations are vital into the hands of the department's 1,000 agents abroad. These committees in turn see to it that when the information is collected the industry takes the matter in hand so that there will be action and definite economic results for the government's expenditure of time and money.

After a number of years in which to mature this work we may arrive at what has long been needed—the formulation by the government of a definite foreign trade policy. This would involve, of course, more than a foreign trade promotion program. It would necessarily include, for example, certain conclusions regarding the broad lines of our tariff policy. It may seem chimerical to hope for anything definite where tariff is involved, but it must not be forgotten that Congress in the end is responsible to the voice of the people and that Mr. Hoover's development of work of the Bureau of Foreign and Domestic Commerce will have the result of awakening our business men to a broad appreciation of the factors in foreign-trade building. From them a broad view of the subject will get back to Congress.

Betting on Prosperity

IN announcing a ten per cent reduction in freight rates, the Interstate Commerce Commission is not so much contributing to a revival of business as it is betting that one is close at hand. It has turned down a rational policy of substantial reductions on the raw materials of productive industry and has elected instead to slash more or less blindly into railroad revenues, hoping to achieve somehow a vague "psychological" effect that may help business along its road to recovery. If it be indeed necessary to tap the meagre earnings of the railroads for investment in American business at large, courage and prudence might suggest that the investment be made where it would do the most good, and not dissipated indiscriminately over luxuries and necessities alike. The commission has passed up a chance to perform a constructive service for American industry and business and has chosen to follow the easier way.

In view of net earnings of but 4.36 per cent for the first three months of the year, no one affects to believe that if the business revival should not materialize the roads can earn, with present volume and 10 per cent lower rates, anything like the 5.75 per cent set up by the commission as a reasonable return. Disappointment as to the revival will be disastrous to the railroads, many of which have already cut operating and maintenance costs so far as to impair their physical properties and to threaten the morale of their responsible operating and maintenance staffs.

One chance remains to reduce the hazard. The Railroad Labor Board has just handed down its answer, insofar as maintenance-of-way employees are concerned, to the application of the railroads for relief from high wages and burdensome restrictions. If this action, together with its impending decision as to other classes of labor will effect a saving commensurate with the impending loss of revenue the railroads still have a chance. There are those who reason that wages should not be dependent on revenues. A sound principle for sound conditions, but without significance in the artificial atmosphere of government regulation. Government made wages and government made rates have climbed hand in hand to their present eminence; hand in hand they must descend. The issue is in the hands of the Labor Board.

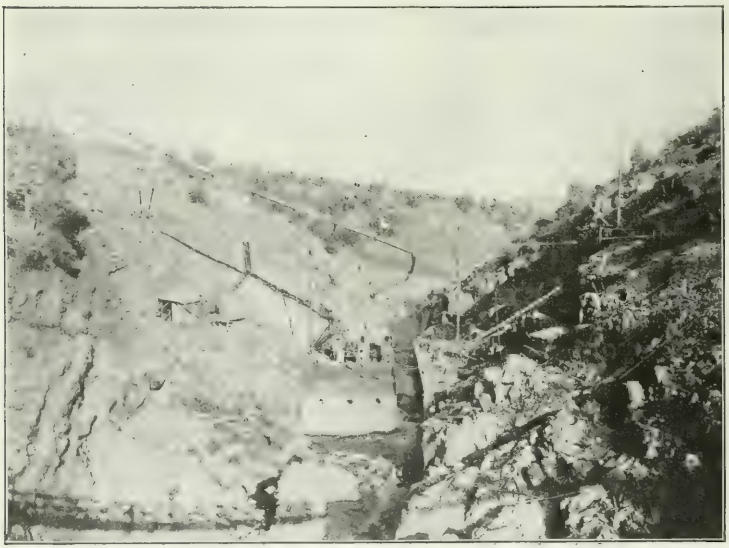
Novel Construction Features on 279-Ft. Don Pedro Dam

Large Storage Facilities—Steel Pouring Trestle Combined With Improved Chute System—Mixing Plant Delivers 1,200 Cu.Yd. of 1:11½ Concrete in 8 Hours

By R. McC. Beanfield
San Francisco, Cal.

OUTSTANDING features in the construction of the Don Pedro dam in California are unusually large material storage facilities combined with simple economical methods of material handling, a plant for mixing 1,200 cu.yd. of 1:11½ concrete in 8 hours, and the development of a new system for placing concrete in large concrete dams, involving a steel trestle partly incorporated within the dam and combined with a novel system for spouting concrete containing large sized cobbles. The layout of the construction plant is such that the path of materials entering the dam is direct, hoisting is eliminated and gravity is used to the utmost. The centralization of practically all the operations and plant units is particularly noteworthy.

Location—The Don Pedro dam site is on the Tuolumne River at the lower end of the Don Pedro bar, four miles above the La Grange diversion dam and about 60 miles below the Hetch Hetchy dam now being built by the city of San Francisco. The Don Pedro reservoir is intended to regulate the river for the joint use of the Turlock and Modesto irrigation districts. The reservoir when full will cover an area of 3,086 acres and will have a capacity of about 270,000 acre-ft.



VIEW LOOKING UPSTREAM SHOWING 20-FT. FLOOD CHANNEL THROUGH VALLEY AT SITE OF DON PEDRO DAM

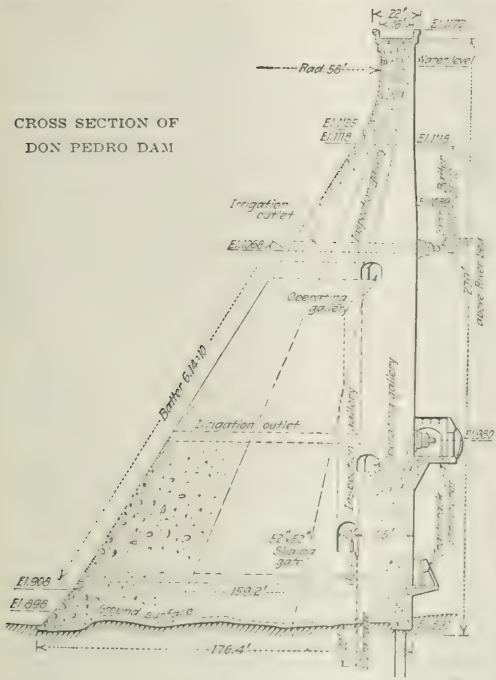
Special Features on this Dam Construction

- Large Aggregate Storage
- Steel Trestle Inside Dam
- Chute For Cobble Concrete
- Specially Built 2-yd. Mixers
- Novel Mixer Water Feed
- Rapid Concreting 1,200 cu.yd. per day Plant

Before actual construction on this job was started an unusual amount of study was put on cost analysis as well as on construction methods, design of the construction plant and camp layout. The result was the completion of detailed plans with bills of material before they were needed on the work. This policy prevented the rush that so often occurs in the preliminary phases of a large construction project with attending general inefficiencies. In fact the policy in programming the entire Don Pedro work was based on the belief that the most important problem in modern large scale construction work is the transportation problem—the efficient movement of materials from one location to another.

The dam is of the arched-gravity, non-overflow type, will contain 270,000 cu.yd. of concrete and will have a maximum height of 279 ft. above the natural river bed, which is also the extreme height of the dam since the river at this point flows upon the bare rock. The height above the natural river bed is the real measure of the comparative height of dams for utility though not for cost. In terms of height above the river bed the Don Pedro dam will be highest in the world, surpassing the Roosevelt dam by 40 ft., Elephant Butte dam by 69 ft., Shoshone dam by 36 ft., Pathfinder dam by 61 ft., Lake Spaulding dam by 54 ft. and the Arrowrock dam by 28 ft.

Sand, gravel and cobbles are obtained from gravel bars along the bed of the Stanislaus River, 42 miles from the dam site. A segregating and washing plant designed for a capacity of 1,200 cu.yd. per day was built near the center of these beds. The segregated materials are hauled to the dam in steel hopper bottom



CROSS SECTION OF DON PEDRO DAM

dump cars (ore type), of 50-ton capacity. The last 7.5 miles of the haul is via the spur of the Sierra R.R. built to serve the dam.

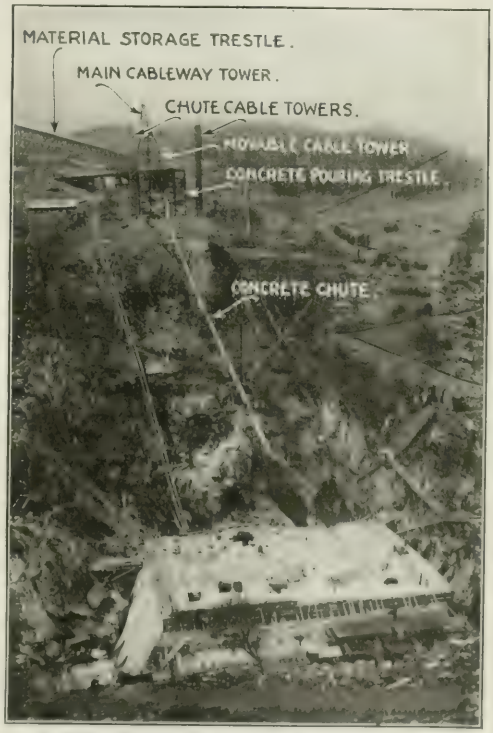
Construction Plant—In order to complete the construction of the dam within a prescribed period and because of the possibilities of delays in deliveries of materials, unusually large storage facilities at the damsite were necessary.

Sand, gravel and cobbles delivered in train loads are dumped directly from a timber storage trestle more than 500 ft. long, and beneath which are two timber tunnels, extending the full length of the trestle. Materials dumped from the trestle are separated by transverse timber bulkheads. The storage capacity beneath the trestle is approximately 25,000 cu.yd. To expedite the unloading of the hopper cars, especially those carrying sand, portable pneumatic hammers are applied to the steel sides of the cars. These produced sufficient vibration to cause the material to discharge rapidly.

Materials from these storage piles are trapped by two gate-tenders per tunnel, through radial, over-cut gates of special design, and are measured by volume into trains of four hopper cars each. The hopper cars used for this purpose were designed to hold sufficient aggregate (82 cu.ft.) for a batch in one mixer, yielding 2½ cu.yd. of mixed concrete. Trains of four cars each are hauled by 3-ton gasoline locomotives. The tunnel gates are installed on 9-ft. centers corresponding to centers between hopper cars; so that all the cars in a train may be loaded simultaneously.

The success of these operations was seen to depend to a large extent on what may be termed small details. Some of these were the design of the tunnel gates for rapid and easy operation without jamming, large capacity equipment and elimination of heavy pressures from movable parts; a design of the steel hopper cars that would make them self-cleaning (steep slopes and rounded corners), running gears with heat-treated axles, roller bearings, spring pedestals and couplings tending to minimize maintenance and derailments. The tunnels are well ventilated to free them of dust. Air jets are used to break sand arches over the tunnel gates.

The trains of four cars from the tunnels deliver the measured batches of concrete aggregate to a set of four batch-hoppers whose centers correspond to those of the



CONSTRUCTION PLANT ON NORTH BANK

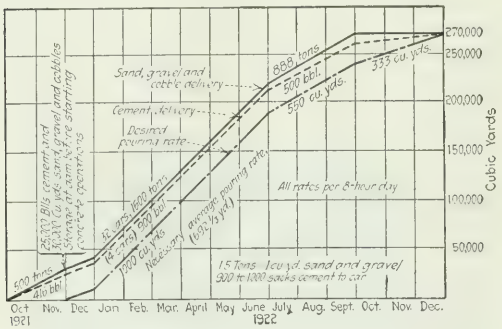
cars, thus a train of four cars can be simultaneously unloaded into the batch-hoppers and the train promptly released. Each mixer is served from either of two hoppers, thus no time is lost waiting for the makeup of the batches. Trains containing four batches can make, on the average, a round trip every four minutes.

The mixer plant contains two 2-cu.yd. concrete mixers with cast-steel drums which rotate at the rate of 14 r.p.m. These mixers were especially constructed for this project by the Norris K. Davis Co. of San Francisco, they are belt-driven from 50-hp. motors and turn on roller bearings. All the gates on the batch-hoppers and the discharge spouts on the mixers are operated by hydraulic rams controlled by 4-way valves.

The water for the concrete batches comes from automatic measuring tanks and is jetted through ¾-in. pipes into the batch-hoppers. This large volume of jetted water tends to slush out the materials in the hoppers, keeps them clean and cuts down the time of empty-

ing. An auxiliary 2-in. water line is piped direct into the mixers making it possible to temper the concrete mix properly.

Difficulties in the delivery of materials due to road and railroad conditions which caused the shutdown of the plant during the period of heaviest rainfall were removed about March 1 and the plant has since then been operating eight hours daily, this being the present limit for the rate at which materials can be delivered. Since getting into full operation this spring the mixing



MATERIAL DELIVERY AND CONCRETING SCHEDULE

plant has been consistently delivering 1,200 cu.yd. per eight hours of the 1:11½ or 1:12 mix.

Concrete used in the major part of the dam consists of approximately the following proportions: 1 part cement, 2½ parts sand, 6 parts gravel (¼ to 2½ in.) and 3 parts cobbles, which measure from 2½ to 14 in. in maximum dimensions. The specifications originally called for cobbles graded from 2½ in. to 6 in.; however, due to scarcity and conditions at the gravel pit it was found uneconomical to maintain a maximum limit of 6 in., therefore larger cobbles were used.

For a thickness of 3 ft. over the entire upstream face and for a thickness of 5 ft. over the downstream face below El. 1,000, a richer concrete in the proportions of 1 part cement, 2 parts sand, 4 parts gravel (¼ to 2½ in.) and 2 parts cobbles (2½ to 14 in.) is poured. No forms are used to separate the richer mix from the leaner or standard concrete; the richer concrete is placed to about its proper distance back from the face of the dam and allowed to take its natural slope, the leaner concrete is poured against it and blends into it. Where the richer mix is used the desired number of full bags of cement is added to the standard or leaner mix, no change being made in the proportions of the other materials. Aggregate proportions are changed slightly from time to time when tests of the materials show sufficient variations in density and permeability.

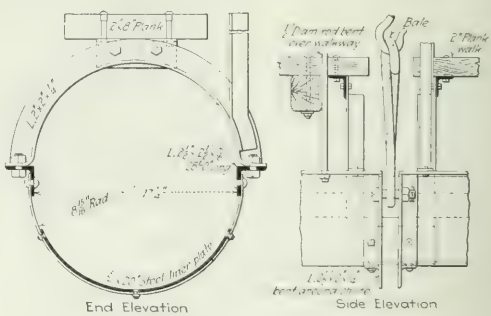
Cement Handling—Cement is delivered in bags direct from the box cars which are spotted on a trestle above and alongside the mixer house. The bags go by gravity rollers and friction chutes to a movable table alongside the batch-hoppers where the sacks are emptied by three men to each mixer. A wire screen over part of the batch-hoppers prevents empty sacks from occasionally falling into them.

Reserve storage for 25,000 bbl. of cement is provided in a storehouse located on sloping ground alongside a standard-gage track. With this arrangement all cement can be stored by gravity roller conveyors and due to a continuous sliding door system along the track side, cement cars can be spotted at any point, which permits of unloading more cars than would be possible if doors were spaced on the usual 40-ft. centers.

The roller-gravity conveyors are cleaned of cement dust once daily with air jets and lubricated with a light oil. After three months of service no wear was noticeable in the ball bearings of these conveyors. They have proved very effective for handling cement in bags and could be operated on grades 2½ in. to 1 ft., the bags rolling directly on the rollers. Cement is taken from the lower side of the storehouse on flat cars, four cars to the train, drawn by a 3-ton gasoline locomotive, and is delivered direct to the batch-hoppers.

A batch of materials entering the concrete mixers is proportioned so as to permit the use of a definite number of whole sacks of cement, usually seven sacks for the standard mix, which yields approximately 2¾ cu.yd. of mixed concrete. Empty cement sacks are cleaned in a sack shaker, constructed on the job, consisting of a revolving screen, with a capacity of 150 sacks, rotating at 20 r.p.m. and belt-driven by a 2-hp. motor. The empty sacks are bundled by a baling machine with a semi-automatic counter attachment.

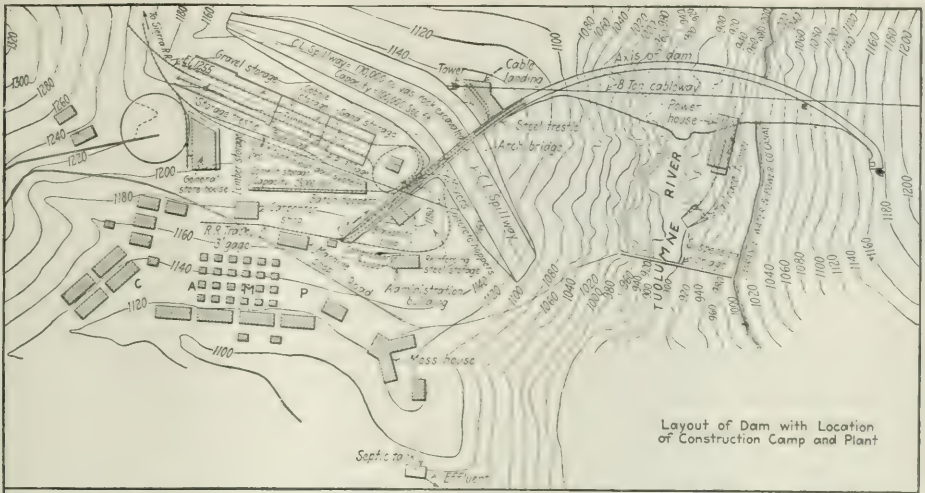
After turning each batch for 60 seconds, the mixers discharge into four hoppers whose radial gates have centers with the same spacing as cars in the concrete train; thus four cars in a train can be loaded simultaneously. These concrete cars, which are practically the same as the hopper cars used in conveying materials from the storage tunnels, deliver by dumping into steel hoppers of 10-cu.yd. capacity, located on a steel trestle

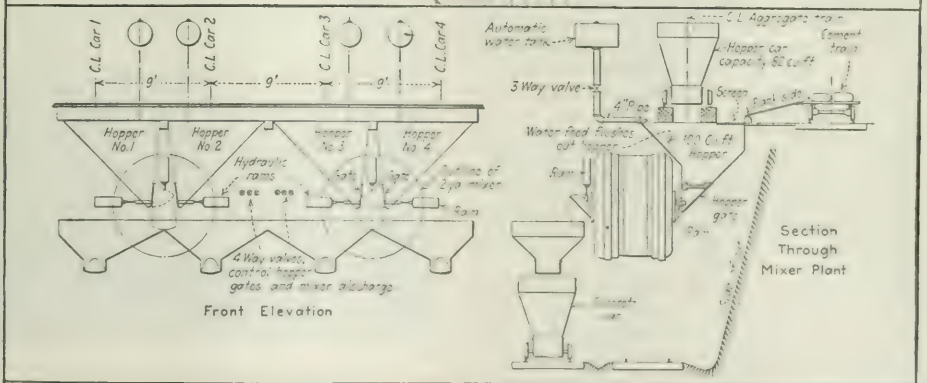


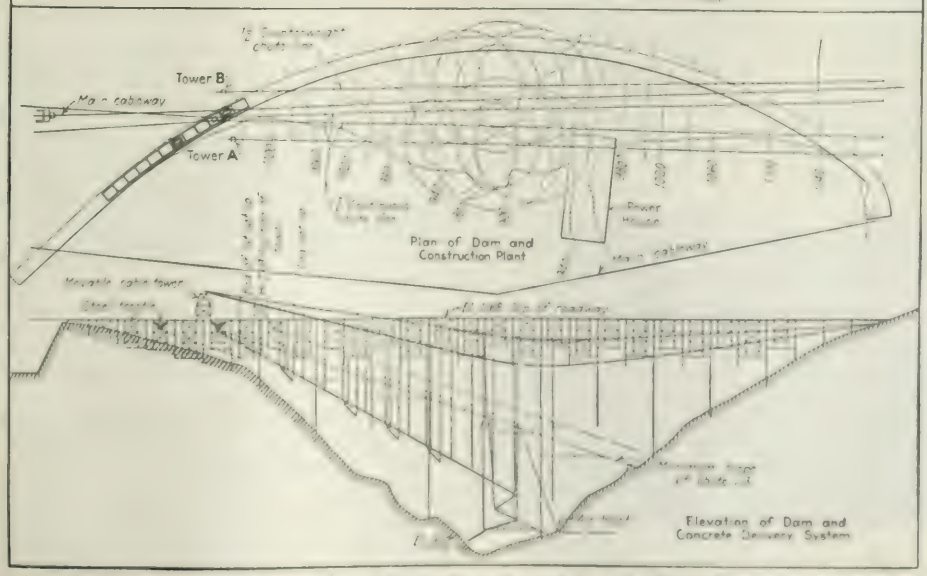
DETAILS OF CONCRETE CHUTE

which is installed in units along the axis of the dam as the work progresses.

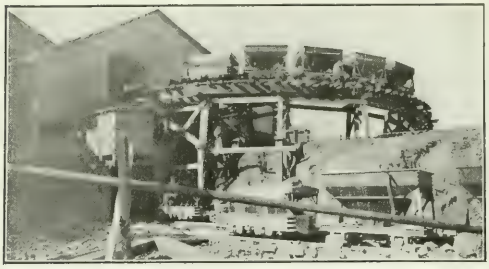
Steel Trestle System—The steel trestle is a bolted structure and in addition to carrying the concrete cars, has, at its outer end, a steel tower for supporting the main chute cables. As the sections of the dam nearest the outer end of the trestle are raised to a predetermined height, additional units consisting of completely braced bents, are added, thus lengthening the trestle. Eventually it will extend the full length of the dam. All bracing and beams are re-used, only the posts being incorporated within the dam. The braced bents are located so that they will always center between and clear the expansion joints of the dam. Erection of the steel







CAMP, PLANT AND CONCRETE MIXER LOCATION ON THE DON PEDRO DAM—1,500 CU. YD. OF CONCRETE PER DAY



MIXER PLANT—MATERIALS ENTERING (ABOVE) AND CONCRETE LEAVING (BELOW)

trestle is greatly facilitated by having its members standardized and therefore interchangeable.

The unit-construction, steel-trestle method for pouring concrete in large dams was devised by the writer to eliminate high towers, hoisting and rehoisting of concrete, and excessive length of chutes with the attendant difficulties when handling lean mixtures containing large aggregate The steel-trestle system is simple, avoids the use of hoists in any part of the system and permits of pouring a large percentage of the total volume of the dam with the installation of the first few bents of the trestle.

Spouting System—Concrete from the trestle hoppers is fed by a radial gate into a continuous line of steel chutes. The spouting system for distributing concrete was especially designed by the writer for this project and contains many novel features. To chute distances as great as 350 ft., using lean concrete mixtures containing large cobbles, it was necessary to employ a chute cross-section whose mean hydraulic radius would give maximum velocities for a given slope. In the calculations the chute was considered 75 per cent full. For all practical purposes the result was taken as a semi-circle.

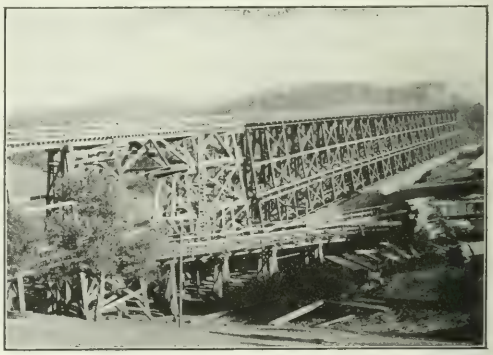
The chutes were designed for a delivery of 2 cu.yd. of concrete of normal consistency per minute on a 1 to 2¾ slope, with a cross-sectional area sufficient to pass cobbles up to 18 in. in maximum dimension. The swivel joints, universal in movement, are constructed with gimbals with no interior members or hanger rods which would retard the flow of the concrete and tend to clog the chute.



LOWER END OF CONCRETE CHUTING SYSTEM
Note strongly braced counterweighted truss, walk and life lines.

The counterweight trussed chutes were designed to withstand severe torsional stresses from tag-line pulls as well as the usual end concentrations. All chutes are lined with ⅜-in. plates of class A steel (American Steel Manufacturers' Specifications) and are secured to the chutes by key plow-bolts instead of rivets, thereby facilitating their renewals. As the bottom of the chute receives the most wear, the liner plates are cut lengthwise into two halves which, when worn on the lower parts, can be reversed, thus increasing their life. With this arrangement new plates are required, as a rule for every 30,000 cu.yd. of 1:11½ concrete.

Considerable attention was given to the details of rigging the chutes. It will be noted that all the chutes are suspended from wire-rope pendants hanging from trolleys on the main cables. The desired slope is obtained by means of tackles with two 8-in. double blocks and ⅞-in. manila rope. The wire-rope pendants saved considerable manila rope by shortening the tackles. The standing parts or fall lines of the tackles are made fast to wooden cleats on the chutes instead of



TRESTLE AT AGGREGATE STORAGE YARD

being secured to anchors on the ground or otherwise independent of the chutes, thus reducing the pull or load on the main chute cables. Screwed shackles were used in preference to hooks throughout the rigging.

Another feature of the spouting equipment is the plank walk and life lines attached to the arched braces along the chutes. The walk and life lines greatly facilitate work aloft on the chutes as well as being a safety-first feature. All the units of the spouting equipment are standardized and interchangeable. The entire spouting system is covered by letters-patent issued to the writer.

Auxiliary cables suspended parallel to the main chute-cables across the canon support the counterweighted trussed chute which is the pouring end of the last chute. These cables are also used to advantage to erect and strip forms on the dam.

The latest cost on concrete in place in the Don Pedro dam is a total of $6.50 per cu.yd., including a charge of $1.20 for overhead and plant.

The construction plant was designed by the writer, who was formerly assistant general superintendent of the project. R. V. Meikle is chief engineer, P. Jones, associate engineer, and R. C. Duncanson, general superintendent. A. J. Wiley is consulting engineer.

The Outlook for Road Building

-An Interview with H. Eltinge Breed, Consulting Highway Engineer, New York City

DATING from the recognition of the principle of federal aid, as embodied in the act of Congress of 1916, the nation's road-building activities received so tremendous an impetus that today funds are going into highway improvement, outside of city limits, at the rate of $2,000,000 a day. Year by year expenditures for road construction and maintenance have shown a steady increase. The government's supervisory agency in the federal-aid program—the U. S. Bureau of Public Roads—has enlarged its personnel of technical and administrative specialists and broadened the scope of its functions. The states, spurred on by the promise of federal participation in the cost of local work, have built up highway departments, headed by engineers, and throughout the country the trend has been toward the centralization of technical and financial control in these bodies, thus largely eliminating waste, incompetence, and even graver abuses incident to divided control by counties and lesser political subdivisions.

In step with these developments has occurred the expansion of industries engaged in the manufacture of equipment and materials for road construction, so that from the days, not so long ago, when highway work was largely a pick-and-shovel job the advance on the commercial side has swept into a period of specialized machinery, improved materials, and methods which have produced startling economies in time and labor.

Thomas H. MacDonald, chief of the U. S. Bureau of Public Roads, has estimated that $720,000,000 will be expended this year for highway construction and maintenance outside of cities, as compared with $600,000,000 in 1921, $500,000,000 in 1920, $389,000,000 in 1919 $286,000,000 in 1918, and $280,000,000 in 1917. These figures are significant especially when compared with the $60,000,000 total in 1904.

Peak Not Yet Reached—With all available evidence pointing to the fact that the road-building program is now running in high gear, the question arises as to whether the present pace can be maintained or increased and, if so, for how long? In other words, is the road-building curve near its peak and is a slump in activity within a few years probable, or, once the summit has been reached, will operations continue on a scale which will maintain the plotted line horizontal, denoting stability in the annual volume of work? It was on points such as these that H. Eltinge Breed, consulting highway engineer of New York City, and formerly first deputy commissioner of the New York State Highway Department, gave his views to *Engineering News-Record's* representative during a recent interview. In substance, he believes that for the next half dozen years there will be a progressive increase in the annual expenditures for highway improvement and that after that time and for many years to come there will be no falling off in amount of work done or money spent, but that activity will hold up at about the level reached when the curve ceases its present ascent and flattens out.

The Road Bond Market—To get at the reasons for this estimate of the situation, it is necessary to go back a year or two and consider the conditions which then surrounded the marketing of securities for highway improvement. With industrial stocks soaring to new high levels during the early part of the year 1920, with money rates abnormally high and business inflation in the final stages of its post-war rampage, highway bonds, even those carrying an interest rate of 5 per cent, were practically unmarketable at par. This condition had the effect of deferring highway improvements. Another factor which applied particularly to counties was the previous use of credit up to the legal debt limit, thus making unlawful the issuance of additional securities. Many counties, boroughs, and townships received in 1918 or later authorization for financing road-building programs with a certain definite sum available for covering a certain mileage of work. Due to various legal technicalities and the slow-moving routine of official channels many of the counties were not in a position actually to advertise contracts for the work contemplated until many months had elapsed and prices for labor and materials had risen to a point which made the cost of the proposed construction with the amount of money available prohibitive and the work, therefore, was postponed.

The foregoing combination of circumstances operated to delay work which should have been done and for which there was a popular demand as evidenced by the favorable results of bond issue elections. There had accumulated, therefore, a considerable volume of "frozen" highway improvement work which the present drop in prices of material and labor and the greatly improved market for bonds are thawing out. It is Mr. Breed's observation that 5-per cent highway bonds now find a ready market at par or better, and in several cases in the New England States it has not been necessary to look to outside sources for the disposal of the securities because local banks took the entire issues.

Many Influences Active—The first big influence favoring an expansion of road-building activity now is the strong position which states, counties and townships now find themselves in with respect to the sale of bonds, and the advisability of placing work under contract at present construction costs. Some deeper reason than the present status of highway financing, however, is needed to justify the prediction that road-building activity will continue on a large scale for many years. As Mr. Breed sees it, there have been at work a number of *cumulative* influences which are just now beginning to make their full force felt. At the head of these influences Mr. Breed places the federal-aid highway legislation which Congress has enacted and has now under consideration. The act of 1916, it will be recalled, appropriated a total sum of $75,000,000 for a five-year program of state highway construction and $10,000,000 for forest roads. There followed the 1919 amendment to the foregoing act appropriating $200,000,000 for a three-year program of state roads and $9,000,000 for forest roads. The most recent amendment, that of 1921, authorized $75,000,000 for a one-year program and $15,000,000 for forest roads Since 1916, therefore, the several federal appropriations for road-building purposes, exclusive of forest routes, have totaled $350,000,000 and as the availability of these sums was predicated upon the obligation of the states to raise equal amounts, a grand total of federal and state money of $700,000,000 for highway improvement is traceable directly to federal-aid legislation.

The federal-aid laws, however, have had an influence which reaches far beyond the raising of these specific

sums for road construction. They have been responsible for the development of state highway departments and the provision of adequate technical supervision over the work for which the money was spent. More than any other single factor, they were responsible for stimulating the public's interest in road construction particularly in view of the fact that the requirement of matching federal money with state funds made the issue one of direct local interest.

In 1915, prior to the Federal Aid Act, 70 per cent of the road work was done by agencies other than state highway departments, most of it by county officials. Such a system was bound to be wasteful. Overhead costs were high, engineers were not always employed, systems to serve the best interests of the state as a hole were not developed, and the opportunities for corruption were greater.

With the passage of the Federal Aid Act of 1916 and the insistence of the government upon the construction of federal-aid roads under the supervision of state departments, existing state highway departments were enlarged and strengthened, and in 17 states highway departments were created where previously there had been none or the existing one was not properly equipped to perform necessary functions. With efficient departments the work has been shifted to their hands until at the present time they supervise more than 60 per cent of the road work. This assures to the taxpayers the services of engineers trained in road work, a centralized authority responsible for the expenditure of funds and a far-sighted plan of development and financing.

It was natural that the activity in state highway improvement created by federal aid should be reflected in county, borough, and township work. With the federal government and the states setting them an example, the lower political sub-divisions, actuated in many cases by local pride, put into highway improvement money which, under other circumstances, it would have been difficult, if not impossible, to raise. Both directly and *indirectly*, therefore, the establishment of federal aid has built up in every state of the country an overwhelming sentiment in favor of good roads.

Other influences have also been at work. Automobile associations, both national and local, have been consistent good-roads supporters, while even more intensive educational work has been done by the organizations of automobile and motor-truck manufacturers. Added to these efforts has been the work of such trade associations as the Portland Cement Association, the Asphalt Association, and the National Paving Brick Manufacturers Association. Individual manufacturers of road-building machinery also have taken a prominent part in promotional work, while the technical associations have impressed upon the engineer the big place which highways occupy in the general engineering field. The good-roads doctrine also has been carried into the colleges and schools, and a great amount of educational work has been done by the Committee on Highway and Highway Transport Education.

With all these influences active, the public has been made to see so clearly the value of highway improvement and the present need for it that there has developed a nation-wide demand for the work to go forward on a large scale.

More Motor Vehicles—With 10,500,000 motor vehicles registered in the United States in 1921, equivalent to one motor vehicle for every ten people, Mr. Breed believes that with the present mileage and condition of highways in certain sections of the country the saturation point has about been reached. On the other hand, it is believed that the United States has not yet reached the peak of its motor-vehicle consumption powers, and with more automobiles and trucks in prospect the demand for more and better highways will be insistent. From this angle alone it would seem that there can be no letdown in the road program for a long time, and even after a decade or so, when our state highway systems have been developed, vast sums will have to be spent on reconstruction as well as maintenance. Once educated to the advantages of a hard-surface route, the public is sure to call for replacement, when necessary, of equally high, if not higher, types of construction.

In return for each dollar expended on them, good roads add a generous contribution to the national wealth, expressed not only in the cash accretion of realty values and marketing facilities, but also in the more intangible and vastly more potent increase in human happiness. This is the ultimate reason, surpassing all others, Mr. Breed believes, which makes people willing to contribute enormous sums for highway improvement. Good roads are a constructive achievement whose immediate benefits the most stupid can discern, while their social and economic values transcend the keenest imagination.

The future holds great possibilities for the further development of the motor truck as an agency of transport and to provide for this service roads of durable types will be in increasing demand. Mr. Breed makes the significant statement that today 80 per cent of our highways are inadequate for modern motor traffic. Among state highway officials with whom he has come in contact he finds a sentiment favoring a federal-aid program carrying appropriations of $100,000,000 a year for five years. With the states' share added, this would make available $1,000,000,000, exclusive of local funds which, in the active road-building states, far exceed the total involved in the federal-aid program.

No Slump Probable—On the assumption that such a program of federal aid should become effective, it is Mr. Breed's belief that the peak of road-building activities in the United States, measured by annual expenditures on construction and maintenance, will be reached in about six years. It does not follow that from this point on there will be any appreciable diminution in volume of work or funds expended, for by that time much reconstruction will be necessary and, with the increased traffic, many roads which even now are scarcely adequate will have to be widened, resurfaced and otherwise improved. It is pointed out that today the foundations under many roads with durable types of surfacing are only 5 or 6 in. thick, insufficient for heavy truck traffic. The future will call for a strengthening of such routes. Then, too, the public now refuses to accept the highway as a *seasonal* means of transport. It demands all-year-round traffic and this will mean, of course, the substitution of hard surfaced roads on adequate foundations where now the types are earth or gravel.

With this extensive program in prospect, Mr. Breed believes an increase in the personnel of our state highway departments must be made and high-grade experienced men secured *and held* in these organizations to insure the wise expenditure of the enormous amount

of money that will go into road work for a number of years. It is in the public interest to readjust salary schedules in almost all state highway organizations to make the work attractive to the right kind of men. Today the turnover is large because as good men are developed in the state organizations they are frequently offered more remunerative employment by commercial organizations in the highway field.

Taken as a whole, the evidence points clearly to the conclusion that highway improvement is now and for many years will continue to be one of the nation's great industries.

Cantilever Arms on Aqueduct Trestle Allow Unobstructed Stream Flow

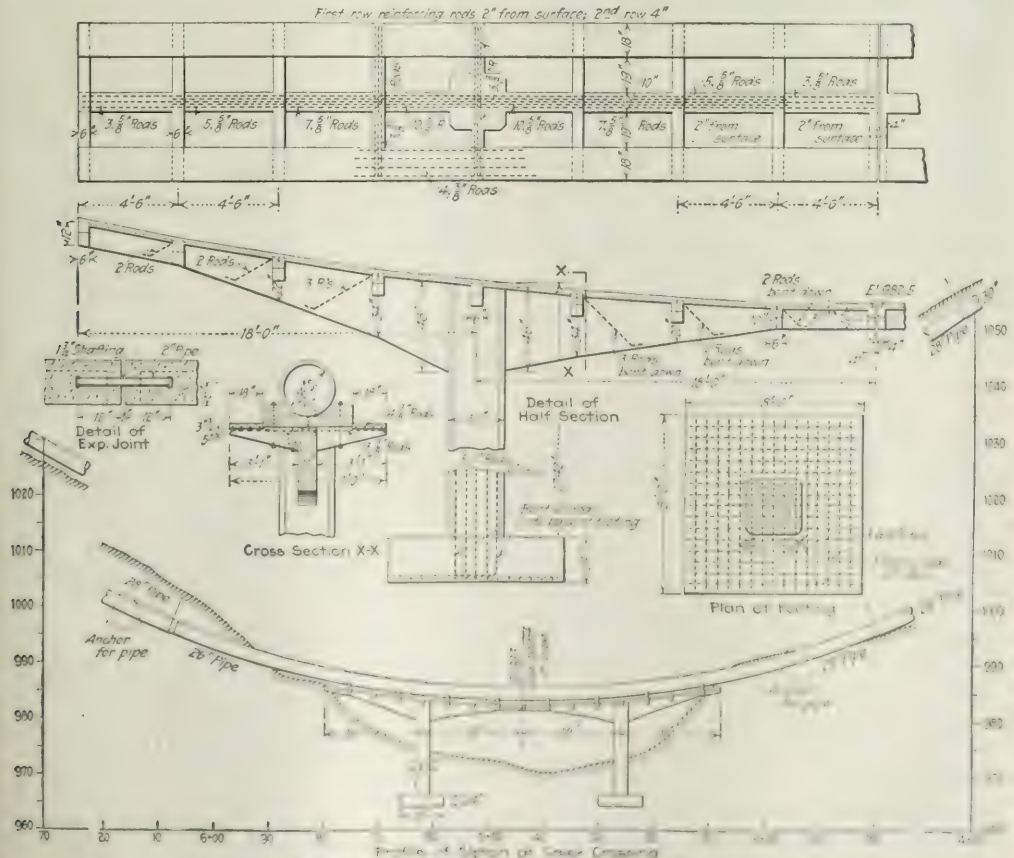
By R. A. Hill
Of Quinton, Code & Hill, Consulting Engineers, Los Angeles, Cal.

THE aqueduct which brings to Santa Barbara, Cal., water stored by the Gibraltar Dam on the Santa Ynez River, crosses as an inverted siphon the deep and narrow gorge of Mission Creek. At the stream crossing there was constructed a rather unique concrete trestle made up of balanced cantilevers, which supported the single wood-stave pipe line forming the siphon.

The steep sides of the canyon made it impracticable to carry the pipe beneath the bed of the stream on account of the sharp bend which would have resulted. At the time of construction the prices of structural steel were extremely high and the fire hazard made wood construction undesirable. Accordingly, it was largely a matter of determining the most economical type of concrete structure which would fit the existing conditions.

Mission Creek is a small stream which is normally dry during the summer months. Large flows often occur in the winter and pass down the canyon with extreme velocity attended by much scour and disturbance of the stream bed. Hence large openings with few obstructions had to be left for the passage of storm waters. It was also necessary that the volume of concrete be reduced to a minimum because all materials had to be packed down the side of the mountain on burros and mixed there by hand. The trestle which was built actually contained less than 30 cu.yd. of concrete for a span of 72 ft. of which the center 36 ft. presents no obstruction to the flow of Mission Creek.

Design of Cantilever Arms—The design was somewhat unique in that is consisted of four balanced cantilever arms 18 ft. in length, each pair being supported on a single column 30 in. square. As the minimum radius of 26 in. diameter wood-stave pipe does not greatly



LAYOUT AND DETAILS OF CANTILEVER ARMS OF CREEK CROSSING

exceed 150 ft. it was necessary to construct the trestle with the top of the cantilever following the curve of this radius with the lowest point of the curve at the joint in the center, midway between the two supports.

The wood-stave pipe was placed directly above the axis of the cantilever. The pipe was supported at 9-ft. intervals on timber cradles. These rested on brackets which extended out 3 ft. each side of the cantilevers themselves. The brackets, 4 ft. 6 in. apart, also served to carry a concrete walk along each side of the pipe. Each cantilever was 10 in. in thickness and varied in depth from 12 in. to 46 in. and was designed to have sufficient strength to carry the pipe should any other of the cantilever arms fail to assume its load.

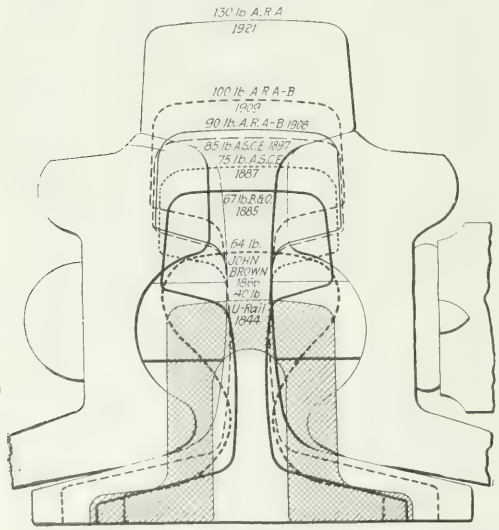
As stated above, each pair of cantilevers was supported by a single column 30 in. square designed to withstand the maximum bending moment which might come on it in any direction. These columns each rested on a simple slab footing 8 ft. square and 2 ft. thick placed at least 6 ft. below the bed of the stream.

An expansion joint 1 in. wide was inserted between the ends of the center cantilevers. The load from one cantilever to the other was carried across this expansion joint by means of a piece of 1¾-in. shafting 24 in. long, loosely fitted into 2-in. pipes set in each cantilever.

The trestle was designed and constructed under the supervision of Quinton, Code & Hill, consulting engineers, Los Angeles, who had charge of the development work on the City of Santa Barbara water supply.

Railroad History Written in Rail Sections

In describing the laying of the new 130-lb. rails on the Baltimore & Ohio R.R. the *Baltimore & Ohio Magazine* presents this interesting sketch which shows to a common scale the cross-sections of the several rails that have been used on that road since 1844. This sketch illustrates in a striking manner the efforts of railroad builders to keep pace with the increasing weight of motive power and rolling stock.



COMPARATIVE RAIL SECTIONS USED IN B. & O. R.R. The 40-lb. U-rail rolled by the B. & O. R.R. Co., and is said to have been the first rail rolled in the United States.

Limit of Roof Connections to Separate Sewage Systems

By John P. Wentworth

Assistant Engineer, Metcalf & Eddy, Consulting Engineers, Boston, Mass.

Success of a separate sewer system depends largely upon strict and careful administration. An important question for an engineer, in choosing between the separate and combined systems, is whether it is practicable to obtain such administration. The engineer should bear in mind that the separate system cannot be properly operated unless the city makes sufficient appropriations annually to employ competent engineering and plumbing inspectors. The community may provide an effective administration of the sewerage and drainage system for many years and yet during a lapse of a few years, connections may be wrongly made to such an extent as to render the system inadequate. After such connections have once been made it is with extreme difficulty that they can be traced and changed, particularly if a considerable time elapses between the making of the wrong connections and the effort to rectify the mistakes.

DATA FOR ESTIMATING MAXIMUM RATE OF FLOW IN SEPARATE SEWERS

Area of District, Acres	Max. Sewage Flow, Gal. per Acre per Day	Max. Allowance If Population Should Equal Flat Rate of 25 Persons Per Acre, Gal. per Cap. Daily	Number of Persons per Acre for which Provision Would Be Made on Basis of 300 Gal. per Cap. per Day	Number of Roofs which could be Connected with Sewers without Causing Surcharge Assuming a Uniform Pop. Density of 25 Persons Per Acre
10	21,900	875	73	one in 40
25	18,500	740	62	42
50	16,500	660	55	45
100	14,600	585	49	45
250	12,500	500	42	47
500	11,100	445	37	54
750	10,400	415	35	63
1,000	9,960	400	33	69
2,000	9,960	400	33	59
5,000	9,960	400	33	48

In a recent report to the Commissioners of Sewerage of Louisville, Ky., J. B. F. Breed, city engineer, and Metcalf & Eddy, consulting engineers, made certain allowances for storm water as a safeguard against the ultimate serious overcharge of separate sewers with roof water, which might be discharged into them through connections accidentally made with such sewers. The data relating to the method of estimating maximum rates of sewage flowing in separate sewers are shown in the accompanying table.

It will be seen that the allowance for rate of maximum flow decreases with the increase in area to 1,000 acres, beyond which the allowance is for a uniform rate per acre. In this way provision is made for unusual development of small areas, limited industrial or mercantile development, or admission through error of a small quantity of roof water. If there is no unusual development and if the population ultimately becomes 25 persons per acre the average density which it is believed may be reached within the next 40 years) the surplus will be available for carrying such storm water as may accidentally be admitted to the sewers and the number of roofs which could be connected is shown in the table. In the case of a 10-acre plot, the roof water from about 2½ per cent of the houses can be admitted without surcharge of the sewers. At 7½ houses per acre this is equivalent to the roof water

from about two houses. In the case of 1,000 acres, about 1½ per cent of the houses can be accommodated, which is equivalent to about 100 houses. The run-off from the roofs is estimated, by the rational method, using a 15-year frequency precipitation curve, a run-off coefficient of 0.8 and an average velocity of flow in the sewers, of 3 ft. per second.

It is very important to note that the allowance for storm water is only for connections accidentally made and the authors state this very clearly in the following paragraph:

> Wherever separate sewers are provided, it is absolutely necessary that roof and street water be rigidly excluded. If this policy is not strictly adhered to and such waters are discharged into the sewers, the system will certainly become overcharged and not only fail to function properly but will actually become a source of annoyance and damage, for which the city may be held liable. The allowance herein advised for roof water is provided solely for connections accidently made. Where any such connection comes to the knowledge of the city, it should forthwith be disconnected.

Hetch Hetchy Project Near Power Utilization Stage

RAPID PROGRESS has been made during the past year on the Hetch Hetchy project which is to store waters of the Tuolumne River in the Sierra Nevada mountains, about 150 miles east of San Francisco, and bring to that city a supply of 400 m.g.d. An increase in the yield rate on the bonds so that they could be sold more readily, the settlement of labor troubles by putting tunnel work on the open shop basis, and the effective organization of the work have all contributed to better progress. It is expected that water can be delivered by the end of 1923 through the 18.3-mile mountain-division tunnel. By that time the Moccasin Creek power plant, located at the lower end of the mountain division, and designed for a capacity of 70,000 hp. is to be ready for operation so that the water can immediately be utilized for power development.

The mountain division consists of a single conduit of full ultimate capacity. The portion of the aqueduct between Moccasin Creek and San Francisco, however, will be built in smaller units, probably three lines of steel pipe 7 ft. in diameter, each with a capacity of 133 m.g.d. These will not be constructed until it becomes necessary to supplement the Spring Valley sources and this work should be deferred as long as prudence will permit, City Engineer O'Shaughnessy says, in order to minimize the financial burden. Meantime, the demand for power has made it worth while to rush that part of the work on which the first unit of power development depends so that revenue from the sale of power may aid in meeting interest on the investment already made.

Concrete is now being poured in the Hetch Hetchy Dam at the rate of about 1,000 cu.yd. per day, and about one-third of the total 360,000 cu.yd. has been placed. The contract with the Utah Construction Co. calls for completion by Dec. 31, 1923. Although the ultimate height of the dam will be 430 ft., the present contract calls for building it to a height of 345 ft. only, which will develop a storage capacity of 206,000 acre-ft., or 60 per cent of the ultimate capacity.

The 18.3-mile tunnel which will convey the water to the Moccasin Creek power development is located in solid rock for its entire length. The tunnel is now being driven from ten headings by the Construction Company of North America under a cost-plus-fee contract. The best progress records were made at Priest Porta last August when the heading was advanced 776 ft. in 30 days. Of late the total progress at all ten headings for 30-day periods has been about 4,000 ft. The tunnel is designed to carry 619 sec.-ft. and where concrete lining is used has a horseshoe section 10½ ft. in diameter in the clear. A 6-in. concrete lining is to be placed in about half the length of the tunnel. At the lower end of the mountain division, and as a forebay for the Moccasin Creek plant, an earth and rock-fill dam, 145 ft. high, is being built to develop a storage capacity of 2,500 acre-ft.

Looking ahead to the time when Hetch Hetchy water can be delivered to San Francisco, the city has recently appropriated funds for the immediate construction of 23 miles of conduit on the San Francisco end of the aqueduct. This conduit is to carry 24 m.g.d. and until it is needed for Hetch Hetchy water is to be used by the Spring Valley Water Co., to bring a supply from Calaveras reservoir to supplement the present flow of 40 m.g.d. which is the maximum that can normally be delivered to the city through existing lines. The private company is expected to pay the city for the use of this new conduit an amount not to exceed $250,000 per year, which is to represent the interest on the investment. The Hetch Hetchy project is being carried out under the direction of M. M. O'Shaughnessy, city engineer, with N. A. Eckart as principal assistant.

According to the San Francisco *Municipal Record*, "all the more difficult portions of the work in the inaccessible mountains have been well started, and money may be spent now at the rate of $6,000,000 per year to complete the project. If this were done, water could be delivered to San Francisco inside of six years."

Among articles that have appeared in *Engineering News-Record* descriptive of the Hetch Hetchy project, some of recent date are as follows: Excavating Foundations of the Hetch Hetchy Dam, Aug. 11, 1921, p. 222; Tunnel Driving Progress, Nov. 17, 1921, p. 833; Cement Handling in Bulk on the Hetch Hetchy Dam, March 2, p. 352.

Portland Cement in the Orient

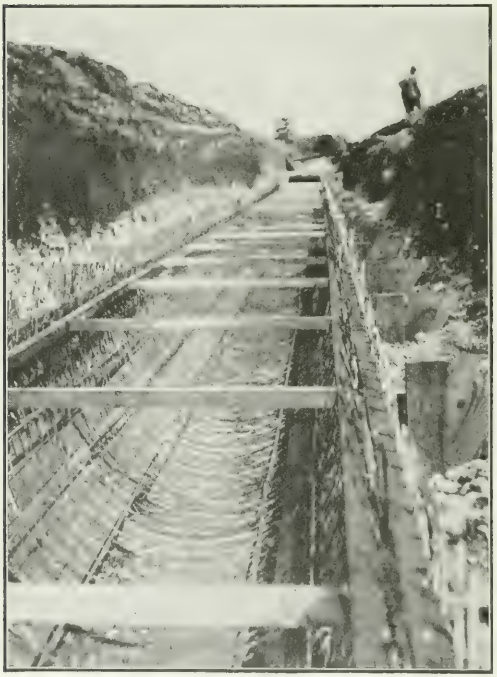
According to a recent bulletin issued by the Department of Commerce compiled from statistics and information contributed by the American trade commissioner in China, there are six portland cement plants operating in China at the present time. These are located at Tong Shan, Province of Chihli; Tayeh, Province of Huteh; Tsan Kan near Tsingtao, Province of Shantung; Canton, Province of Quwangtung; Kowloon, Hongkong Leased Territory; and Green Island at Macao. The daily capacities of these plants are as follows: Tong Shan, 3,000 bbl.; Tayeh, 400 bbl.; Tsan Kan, 570 bbl.; Green Island, 350 bbl.; and Kowloon 2,000 bbl. The average local price is between $6.50 and $7.50, Mexican, per barrel of 375 lb. During 1919 the production of portland cement in Japan had reached 6,500,000 bbl. per year, produced by twenty companies capitalized at about $22,000,000 and employing about 7,000 laborers. Cement in 1920 ranged around 17 yen ($8½) per barrel, but the price has now receded. The cost of production at the mill in 1920 was about 8 yen per barrel when cement was selling at 12 yen per barrel.

Tacoma Builds Semi-Circular Conduit of Gunite

Addition to Water-Supply Line for City in Washington Has Inverted Arch of Concrete Placed With Cement Gun With Precast Slab Top and Gunite Cover

LAST summer the city of Tacoma, Wash., through its water department, completed a built-in-place water pipe of novel section and detail which was especially novel in that concrete was placed by the cement gun. The line collects the discharge of wells, is 4,632 ft. long and under pressure of not more than 10 lb. per square inch. The gunite type was selected as the most economical after comparative estimates for steel and precast concrete.

A horseshoe cross-section was decided upon to facilitate the application of gunite, as it permits the nozzle-



PART OF 36-IN. PIPE READY FOR GUNITE

man to do all shooting from alongside of the ditch with the advantage of eliminating the inside forms. Two sections were designed, the smaller section measuring 24 in. and the larger section measuring 36 in. across underneath the top slab. The semi-circular part of the large section is made of gunite 3 in. thick designed as part of a cylinder and enlarged to 5 in. in thickness at the construction joints below the precast slab cover. Details are shown in the drawing. The precast cover was made of 1:3 cement mortar 1½ in. thick and reinforced as shown. These slabs were intended to carry only the weight of gunite during construction or the weight of a man temporarily while the top steel was being assembled and the top cover of gunite was being shot in place. Above the cover is a top slab of gunite 3 in. thick designed independent of the precast slab. A maximum backfill of 5 ft. was assumed and various heads up to 23 ft. were provided for in the reinforcement, water and backfill stresses being considered to act independently.

No expansion joints are provided for and temperature stresses are taken care of by eleven ⅝-in. rounds, spaced equidistant around the periphery and lapped 15 in. at splices. All gunite used both in the small as well as in the large section was of 1:3 mix cement and sand, measured in loose volume. The maximum unit stress for gunite in the top slab of the two sections was limited to 900 lb. per square inch. The maximum unit stress for the wire mesh was fixed at 16,000 lb. per square inch. On account of the extra reinforcement around the corners the top and bottom sections were considered to act monolithically.

Weir boxes, lamp holes and manholes were also built of concrete placed with the cement gun.

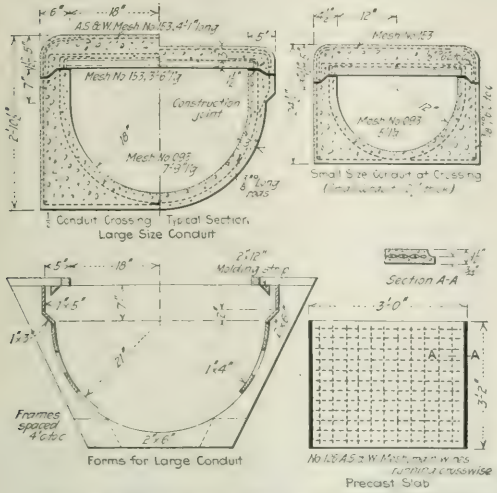
Details of the construction and tables of cost are given as follows by W. A. Kunigk, Superintendent of Water-Works of Tacoma.

Operating Outfit — The cement gun outfit for this work consisted of one N-1 and one N-2 cement gun. The mixing plant consisted of one sand-drier, one 4-cu.ft. gasoline concrete mixer and one rotating screen, all housed under a canvas roof. The cement guns were moved along as the pipe work was progressing. Usually about 400 ft. of pipe was built from one set-up of cement gun, limiting the length of the material hose to 200 ft. When construction work began the mixing plant was set up near the pump station and after about half of the pipe line had been built it was moved to a convenient place along the line about a thousand feet from the south end. In this manner all gunite material for the entire line was distributed from only two mixing stations.

A one-ton Ford truck took care of the hauling of this material to the cement guns, handling about one cubic yard per trip. The cutting and bending of the wire mesh was all done near the pump station using for the bending or straightening out a homemade roll consisting of three 6-in. diameter wooden rolls covered with old belting and supported on a wooden frame in the shape of an equilateral triangle. The upper roll was provided with a crank on one end and could be raised or lowered in a slot so that by passing the mesh between these three rolls it could be given the desired curvature required for the lower section of the gunite flumes or it could be straightened out as was necessary for the slab reinforcement of the upper sections. This device was found to be very simple and effective in taking care of the bending of all the wire mesh used.

All precast slabs were made in a temporary shed alongside of the pumping plant on flat forms which were piled on top of each other leaving about one inch of space between forms. This permitted the sprinkling of the slabs while they were curing and also provided for air circulation. The work was laid out and carried on with the idea of keeping as much of the old collecting system intact as was possible without seriously interfering with the progress of the new work. The maximum progress was limited to the output capacity of the two cement guns which the water department had available for this work. After the work had been gotten fully underway the various operations were carried on as follows:

Procedure of Operations — An excavation crew of 20 to 40 men made the excavation, trimming the ditch to the



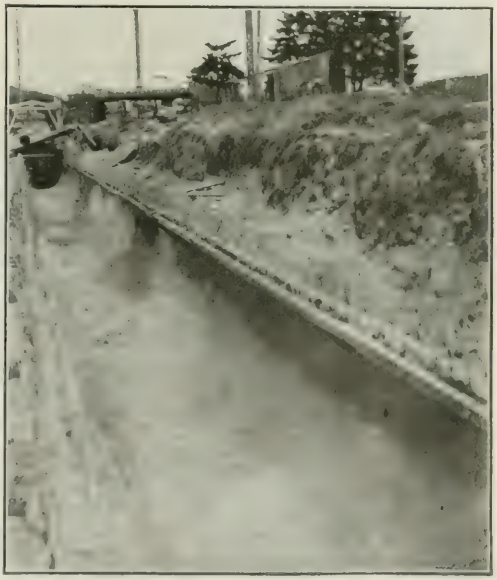
DETAILS OF THE TWO SIZES OF GUNITE CONDUIT

required grade and line and put in temporary street crossings at all street intersections. Then would follow a gang of from two to five men with a carpenter setting the forms in the ditch to grade. The forms consisted of girts spaced 4 ft. c. to c. sawed out of 2 x 6-in. lumber lined with 1 in. rough boards of a cheap grade conforming to the outside form of the lower section of the conduit. The girts were all cut at the sawmill according to templates furnished and the forms were assembled alongside the ditch in 12 or 16-ft. lengths. In setting the forms to grade and line in the ditch the lower quadrant of the circular section was left open, the backfill tamped to the required curvature and the sides then backfilled to the top of the forms. A crew of two or three men would then follow to place and wire the reinforcement for the circular section of the conduit. After the steel was assembled the wire mesh was raised the proper distance above the bottom of the forms and fastened with nails to the molding strips which formed the construction joints. Following came the cement gun crew consisting of one nozzleman, one helper assisting in moving of the material hose, one man with air hose, one cement gun operator, and one helper feeding the gun. For the shooting of the lower section the N-2 gun was used.

When starting on this work considerable difficulty developed in disposing of the rebounding sand which would accumulate in the bottom of the forms ahead of the gunite work and it was found difficult to remove from between the wire mesh reinforcement. The nozzleman would stand alongside of the ditch and shoot the side opposite him and when changing his position to the other side of the ditch to complete the half-circle he would find so much rebound accumulated that it was practically impossible to prevent sand pockets in the gunite. After some experimenting the following method was evolved. A ¾-in. air hose was connected to the main air pipe and fitted up at the end with a 4 ft. length of ¾-in. pipe hammered out at the discharge end to a flat nozzled tip. This air nozzle was operated by a laborer immediately ahead of the cement gun nozzle, always keeping the reinforcement clean and ready for the application of the gunite. (See view herewith). The sand accumulating was disposed of by blowing it into the space below the open part of the form where top would be purposely been kept somewhat below grade. About every 10 to 15 ft. of conduit the cement gun nozzleman would operate his nozzle with air and water only, thoroughly cleaning and wetting the forms ahead and also leveling off the sand below the reinforcement. In order to shoot the inside as nearly as possible true to line the nozzleman's helper would carry a light wooden template conforming to the inside outline of the conduit. With this he would keep a close check on the work as it was progressing, always pointing out to the nozzleman any slight variations in the gunite from the true line.

Finishing and Curing—Following the cement gun crew would be a cement finisher and his helper. In order that the finisher could work close to the nozzleman a canvas shield on a light wooden frame was always kept between the nozzle crew and the finishing crew. In this way the finisher was not bothered with flying sand which otherwise would have been troublesome on windy days. The finishing was done with a steel trowel after all surplus material had been removed with a straight edge by the helper. A very smooth surface was obtained in this way, equal in every respect to that of a precast pipe.

This surface was kept wet from four to six days and



COMPLETED INVERT OF 36-IN. SECTION

protected against the rays of the sun on bright days by portable canvas awnings mounted on 4 ft. x 12-ft. wooden frames. However, during the construction work considerable rainy weather was encountered which was conducive to producing a well-cured gunite. The cement gun crew and finishing crew would on such days work under canvas covers stretched over light portable wooden frames and practically no time was lost on this account except on a few days when the rain was accompanied by high winds. Next would come a small crew from two to four men removing the molding strips which formed the construction joints and the same crew would then proceed to lay the precast slabs. These slabs were laid with the troweled side downward in a 1:3 cement mortar and were also joined endwise with a mortar joint, striking off all joints on the inside of the conduit.

Following the crew placing the slabs came another small crew placing the reinforcement for the top slab. Then came the gunite crew shooting the top slab in place operating an N-1 gun, which has about 25 per cent less capacity than the N-2 gun which was used in shooting the bottom. In shooting the top, great care was exercised in thoroughly wetting the precast slabs and in making a perfect junction with the old gunite at the corners.

Finally came the finisher and his helper troweling off the top and taking proper care in protecting the green

gunite. The distribution of all the material for the cement gun, the forms, the reinforcing steel, the precast slabs, etc., was handled by a one-ton truck. On days when it did not rain the green gunite was kept wet by sprinkling and after three or four days was covered with about 3 in. of the excavated material which was then kept wet for another four or five days.

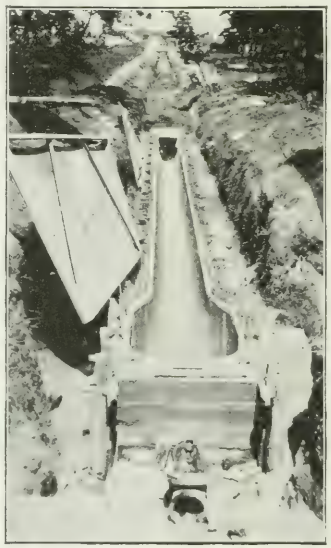
In joining the gunite work of consecutive days no other precaution was taken except that of running the end of a day's gunite work out to a feather edge over a distance of about 12 in. The next morning the new work was joined after a thorough cleaning and wetting of the end of the preceding day's work and not the slightest leakage has appeared at any of these joints. A working test was made 28 days after the last gunite was shot and only a few small damp places could be detected at the construction joints immediately below the flat slabs. The water was left standing in the gunite pipe for a number of days but no appreciable lowering of water level could be detected in the standpipes and the conduit was then put in service. The conduit has now been in operation through one summer and one winter season and has withstood all ranges of temperature changes from 90 deg. to 10 deg. above zero without the slightest sign of distress on account of its continuity.

TABLE SHOWING ITEMIZED COST OF CONDUIT

Forms	36-in.	24-in.
Labor and material	$0.43	$0.43
Cement	1.12	.67
Sand	.50	.30
Reinforcement (material only)	.95	.58
Reinforcement (labor of cutting, bending and placing)	.34	.34
Gunite (labor of placing)	1.15	.66
Precast slabs (labor and material)	.79	.58
Depreciation of plant and cost of air, etc.	.09	.05
Cost per lin.ft. in place	5.37	3.61
Cost of excavation, reclaiming of old pipe, and backfilling	1.70	1.65
Total cost per lin.ft.	$7.07	$5.26



SLAB IN PLACE READY FOR GUNITE COVER



PART OF 24-IN. SECTION WITH MANHOLE BASE



MAN WITH AIR NOZZLE AHEAD OF CEMENT GUN

Cost Figures—The total cost of this construction work, $40,053.31, distributed over the different items, is shown in the following statements:

2,900 ft. of 36 in. conduit @ $5.37 per ft.	$15,573.00
1,732 ft. of 24 in. conduit @ $3.61 per ft.	6,252.52
Excavation, backfilling, reclaiming and dismantling of old wooden pipe and connections	7,892.80
13 weir boxes, 2 concrete weir box stands, 3 standpipes, 5 lamp holes, weir box connections, changes in reservoir connections, new air line connections for wells, blow-offs, railings, etc.	8,884.99
Engineering, testing and office expense	1,450.00
	$40,053.31

In analyzing the cost of the gunite work the cross-sectional area of the gunite in each conduit as built was approximately 10 per cent greater than the neat dimensions shown on the plan. The principal reason for this is the open section of the forms at the bottom and also a slight increase in the thickness of the top slab. In considering depreciation a plant investment of $4,400 was charged against this work for a period of three months on the basis of 3 per cent per month. This gives a total depreciation of $396. In this equipment were included the two cement guns with all the necessary material, air and water hose, one 4-cut.ft. gasoline mixer, one air-dryer, one sand-dryer, one rotating screen with gas engine, canvas and awnings, fittings and necessary piping. The cost of furnishing air for the cement gun on this work was very small on account of operating one of the electrically-driven compressors at the pump station. The station attendant operating the compressor was not charged to this work, and power was furnished by the municipal light and power plant at ½c. per kw.h.

Lessons of Construction—From close observation during the progress of the work, Mr. Kunigk draws the following conclusions:

The section of the conduit as built was very well adapted for doing effective gunite work, the nozzleman always working to good advantage regardless what part of the conduit he was working on. It is important in planning gunite work that the nozzleman can shoot at the surfaces as near as possible with the material nozzle in a position not less than 3 ft. away from the forms, pointing the nozzle at right angles to the surface. When, on account of obstructions the nozzleman is compelled to shoot at a surface at an angle considerably less than 90 deg. the result will be that the gunite will build up in riffles like a sandy

river bottom and will not be dense and uniform. An excessive amount of rebound will also result from this cause. It is also desirable to have, if possible, only one layer of reinforcement in a gunite section. This will tend to keep the rebound down to a minimum. For reinforcement wire mesh is preferable to bars. If bars must be used then the bars should be round. Square bars have a tendency to produce a small triangular area of rebound material back of the bars which contains practically no cement at all.

A larger section of conduit could be built at considerably less cost per cubic yard of gunite in place because there would be less loss in time in moving equipment along the ditch and a smaller proportion of loss of material, and also less expense in finishing. The principal advantage in constructing the conduit section as designed was that all crews could work simultaneously without interfering with each other, and that there was no delay on account of removing inside forms which is one of the troublesome features attending the building of a continuous concrete pipe or small cross-sectional area. For obvious reasons this type of conduit would not be economical for heavy pressures, for which condition a circular section should be adopted.

The best results in guniting were always obtained when the material hose was 100 ft. or less in length; 250 ft. was the maximum length of hose used on the job. Air pressure should preferably be not less than 35 lb. per square inch at the gun and water pressure should be greater than the air pressure by at least 10 lb. per square inch. The mistake is often made in gunite work in using sand that is absolutely dry. The writer finds that the best results can be obtained when sand retains from 5 to 7 per cent moisture. The tendency to dust at the nozzle will then be eliminated and the material will not separate even in a long line of hose. The air, however, must be delivered dry to the gun. It would be an expensive experiment to try and operate a cement gun on a damp or rainy day without an air dryer. The result would be numerous shutdowns on account of clogging of the gun or hose, or both. [Sand and air dryers used on the work will be described in a later Job and Office section of this journal.]

The method of constructing gunite pipe as developed on this work is not patented, and it is stated that there is no intention of taking out a patent thereon. The work was designed and constructed by force account under the personal supervision of W. A. Kunigk, Superintendent of Water Works, with O. A. Abelson as designing engineer and J. A. Kuehl and R. Bergerson as constructing engineers.

How Rochester Engineers Have Solved Problems of Making Luncheon Meetings Interesting

Current Events Capitalized in Preparing Program—Local Speakers Developed—Joint Sessions with Other Bodies—Many Novelties Introduced

By Waldo G. Wildes

Chairman, Luncheon Committee, Rochester (N. Y.) Engineering Society

THE weekly luncheons which, for a decade, have been held by the Rochester (N. Y.) Engineering Society have become an important feature of its work and rank with those of the leading lunch clubs of the city. Gradually developing from a small informal gathering without any speakers, they have gained impetus until, in the last year, an excellent choice and a timeliness of subjects and men, as well as several novel expedients, have given them their present standing. In topics of public interest having an engineering phase they excel, but they are never technical and they are often broad in their appeal, with the double object of stimulating enlarged sympathies and activities among the members and of attracting the progressive men of the community whose interests interlock with engineering. They are designed to balance the more technical monthly evening meetings and the still more highly specialized group meetings also conducted by this organization.

Speakers and Subjects—As funds for securing speakers at the luncheons have never been made available, it has been necessary to depend almost entirely on the courtesy of local speakers. Last year, however, inquiries were sent out to several engineers asking if they were likely to be in the vicinity of Rochester in the course of the season, with the result that a number of prominent out-of-town engineers were secured as speakers at the luncheons, virtually without expense to the society. However, it was necessary to depend mainly on home talent and the surprise was general that there should be so many unfathomed resources in the community.

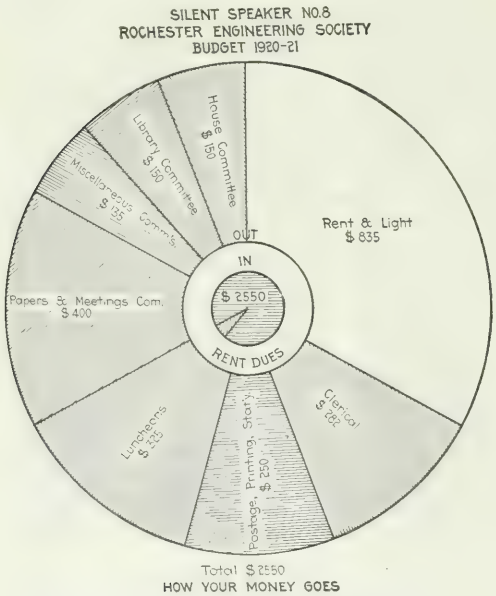
Making Home Talent Appeal—Ways were found to link these speakers into continuity programs. The "Rochester Live-Wire Series" was a caption adopted with this end in view. City planning was "Live Wire No. 1"; the Community Chest, "Live Wire No. 2; the University of Rochester, "5 Live Wires in 1"; the Chamber of Commerce, "The Last and Livest of the Live Wires." Speakers were invited to give their talks and topics special application to our group. Hence the subject of the Community Chest became "Social Engineering in Rochester." To give attractive force two appropriate topics were grouped in the "junior series" and combined with 5-min. talks on the junior engineers, organized by our vice-president, and the Boy Scouts and the Y. M. C. A.

Similarly, in order to make the luncheon meetings a clearing house for public matters relating to engineering an attempt was made to secure exhibits of important plans in progress—a local architect's conception of a central library building, for example, in conjunction with an address on our public library, or the unpublished studies for a proposed bridge over the Genesee River gorge, on another occasion. Sometimes, with similar intent, a brief, timely report was introduced—for example, from a local member of the American Engineering Council on the first meeting of that body. Considerable study was given to the presentation of the all-absorbing industrial problem, and where controversial discussions had arisen an effort was made to present the other side of the case later. To give further point and punch, the occasion of a speaker from the Chamber of Commerce, for instance, was advertised as Chamber of Commerce Day, drawings for the extension of the chamber building were exhibited and representatives of the chamber invited to attend.

Indeed, it was a rare occasion when some citizens known to be particularly interested in a topic were not extended an invitation to be present.

Joint Meetings—Carrying this principle further, invitations were extended to several local engineering organizations to meet with us on occasions of an appropriate address; the American Legion Engineer Post participated on Feb. 14, 1921, in a talk on "Americanization"; the local section of the A.I.E.E., was asked to put on a program of its own and furnished for the occasion an actual demonstration in wireless telephony. These meetings promoted attendance and co-operative spirit among the various professional groups.

Going still further afield, two joint meetings to consider arguments for and against the proposed St. Lawrence waterway were arranged with the Chamber of Commerce and drew an audience of more than 600 apiece. For another joint luncheon with the Rotary Club the speaker was furnished by the engineering society; and at still another time, the invitation to the secretary of the N. Y. State Builders' Association, then



ONE OF THE "SILENT SPEAKERS," SHOWING BUDGET

in convention in the city, to address the meeting, combined courtesy and expediency. Similarly, advantage was taken of speakers from particular colleges to invite the alumni on "University of Rochester Day" and "M. I. T. Day" and on all such occasions some little distinctive touch was added by decorating with the colors and, perhaps, marking the places at the table by small flags, as when the students training locally under the Federal Board for Vocational Instruction of Disabled Soldiers were luncheon guests by virtue of a special collection taken at a previous meeting. On occasion, also, appropriate songs gave character and contributed to the sociability.

Sociability—Aside from these expedients and the personal efforts of the leaders, there was instituted, to complete the breakdown of clannishness, a "Socialist" propaganda—a group of men being assigned red badges with the "Socialist" pledge (of sociability) upon it, and commissioned, each of them, to preside over one table and propagate the doctrines of the "Order of the Red Tag", passing the badge and responsibilities to another group after two weeks, and so on. This furnished mystery and amusement, with some telling effects on sociability, but fell to pieces prematurely through the enforced absence of the committee member in charge as "Chief Socialist."

"Silent Speakers"—At each of the first nine meetings a chart, especially prepared, was hung upon a frame on the wall behind the speakers table. Its object was not only to provide a novelty, but also to emphasize the topic or drive home some principle or information with economy of time and intensity of effect. These charts were called "Silent Speakers" and numbered 1, 2, 3, etc. They were executed, in general, gratuitously by various members from rough outlines furnished them. The first of these gave the membership statistics of the engineering organizations of the city. Another, in connection with the topic of the "Public Library," represented, in pyramidal form, the subdivisions of the society library. When co-operative industrial education was under consideration, the corresponding chart depicted Industry (embodied in a drawing of the Eastman Kodak buildings) linked to the University (a local university building) by the Rochester Engineering Society, which occupied the intermediate link, with the query underneath, "Why Not?" The distribution of the finances of the society was graphically portrayed in another and a cartoon on an unfortunate but amusing episode of an excursion of the society furnished material for the concluding chart—the artist being awarded a first prize on Ladies' Day and all the charts assembled for wall decoration. At the concluding luncheon of the season, also, a cartoon of the "Never Silent Speaker" was introduced by the president of the society as a surprise compliment to the committee.

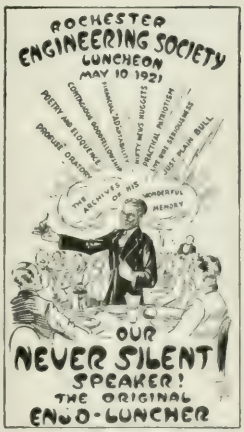
Instead of reading the formal report of the chairman at the annual meeting of the society, lantern slides of the best "Silent Speakers" and of a few statistics were shown. Indeed, lantern slides prepared by members of our group were several times used to assist a busy and impromptu speaker in presenting his subject in a forceful manner. In one instance the "Silent Speaker" was introduced on the screen by word and sketch as the presiding officer and in turn introduced the real speaker of the day.

The "News Nugget"—It has been the custom to mail to each of the members postcard notices of the meetings. The colored 4 x 6-in. cardboard (varying in color from week to week) was last year given a form more flexible and piquant than the curt statement of speaker and subject. Out of it was gradually evolved the form of a miniature newspaper of three columns, ultimately 4½ x 6 in. in size and entitled *"Enjo-Luncher's Weekly"* and, beneath, in smaller type "News Nugget." The left-hand column contained, under the headlines, graduated when possible to simulate or mimic the dailies, an announcement of speaker and topic, with a compact statement of the appealing features of both. The last column ordinarily carried an appeal from a different angle and in lighter vein, an improvised verse or maxim, some timely excerpt from the sage remarks of Mr. Loyal Enjo-Luncher or an "Extra" in bold headlines. "Per-

sonals," with pleasant drollery intermingled, have appeared and often notices of other departments of the society, but whatever and wherever these might be, the law of the quill was decency, pungency and force.

The insertion of a mock advertisement and the impulse due to an overstrained exchequer led to setting apart the entire middle column and the foot of the other two to about eight ½-in. advertisements—the "Business Directory," it was called—obtained, first, altogether from members, but, later in part from outsiders. Subsequently, the card was enlarged to carry three more advertisements or other matter if desired, and sometimes a much longer card was used for additional notices or for carrying detachable reply card. The standard 11-ad. card cost $14.50 to print and mail and brought in about $22.00 in advertising, so that the luncheons were a welcome source of revenue.

From the printer's supply of cuts, one or more was always selected and often the text was adapted to fit the cut rather than *vice versa*. A play on words was sometimes employed to catch the eye. Using cuts for underscored words, the following are examples: *Bear* in mind; A *Pile* of Thanks; *Can you* come? The cuts added, thus, little to the cost, but much to the attractiveness as used in this and other ways. Opposite the marginal rectangle containing the name of the society was a duplicate which served to blazon a motto or inscribe the words, "Patriotic Number," "Travel Number" or to make an appeal, "Safety 1'st, Reply at 1 ce," or to recite the latest figures for the circulation or announce the peak of the attendance for the season.



CARTOON TRIBUTE TO LUNCHEON COMMITTEE

Another lunch club has already done the society the honor of imitating the form of card, both as to advertisements and as to detailed typography; and *Engineering News-Record* (March 31, 1921, p. 571) has also reproduced one of the issues in its columns.

Newspaper Publicity—Besides the publicity from the weekly cards and the notices in the monthly *Bulletin* of the society, it has been the practice this year to invite as guests reporters from the two morning newspapers of the city and a large amount of space has been thereby allotted. Several of the plans of proposed public works and one of the cartoons exhibited have been reproduced in the news columns and, besides the advance notices, full-page reports of the luncheon addresses have frequently appeared, all duly credited to the society. Even the editors have stooped to recognize the society several times in their editorials, which it had the honor of inspiring.

Essential Details—In regard to certain practical details it may be submitted that promptness of service, permitting the chairman to call the meeting to order about 12:45, after an announced luncheon hour of 12:15, is important. The chairman of the meeting, who is the chairman of the committee, except as he affords the audience the variety of other leadership from time to time, may well consume 10 minutes in announcements and in carefully planned remarks designed to give a certain continuity and purpose as well as sociability and esprit. Any "extra" feature will consume 5 min., leaving the principal speaker on the program a half hour to 1:30, to be followed by questions closing at 1:45 or preferably earlier. To delay beyond that hour would grievously threaten the attendance by consuming more time than many of the men are properly able to spare.

A suitable meeting room, detached from outside confusion, centrally located in a hotel or club of first quality is also found to be a pre-requisite and it is deemed expedient to hold the meetings through from warm weather to warm weather, so long as the superior quality of the program can be maintained.

Results—Throughout this program, the aim has been to capitalize the moments of relaxation for growth and service—to dissipate the conventional narrowness and professional non-solidarity of engineers. The attendance, which in the aggregate averages over 100, doubled last year. The discussions, the enthusiasm and a universal spirit of co-operation seem to indicate that, even if there have not been many tangible accomplishments, the effort is appreciated and is having the desired effect.

Net Section of Riveted Tension Members

A new discussion of the methods of calculation applicable to tension members with staggered rivet holes is given in Bulletin No. 2 of the University of Toronto by Prof. C. R. Young. He derives the exact formula for the deduction of area to be made from a diagonal section through two rivet holes, when the compound stress existing on the diagonal section (direct tension combined with shear) is taken into account in terms of the maximum resultant stress. The formula resulting gives the deduction as a fraction x of one rivet hole as follows, where g is the gage (transverse spacing), s is the stagger or pitch (longitudinal spacing) and h is the rivet-hole diameter:

$$x = \frac{g}{h} - \frac{2\,(g^2 + s^2 - h\sqrt{g^2 + s^2})}{h\,(g + \sqrt{g^2 + 4\,s^2})}$$

Comparing the results obtained from this formula with various rules for rivet-hole deductions that have been advanced in the past (see in particular V. H. Cochrane, *Engineering News*, April 23, 1908; T. A. Smith, May 6, 1915; and D. B. Steinman, *Engineering News-Record*, June 14, 1917), Professor Young finds the rules to depart pretty widely from the actual results for various cases. The proper deduction increases with increasing size of rivets and with decreasing gage. Of the simple rules, Professor Young finds best the second of two rules proposed by Steinman (see third reference above), which provides that a second hole is to be deducted if the stagger does not exceed one-half the gage, but is not to be deducted if the stagger equals or exceeds the gage, while for intermediate values the fraction of the hole to be deducted is intermediate, being $2\,(g - s)\,g$. A closer adjustment to the usual conditions is obtained through a new rule proposed by Professor Young, which makes the deduction $x = 1.50 - 1.5\frac{s}{g}$. For important cases and complicated arrangement of holes, the exact formula should be used; diagrams given in the original paper, for several rivet sizes, facilitate its application.

Water-Works Field Surveyed from Many Viewpoints

Abstracts of Four Papers Read Before the Annual Convention of the American Water Works Association, Held in Philadelphia May 15-19

Experiences with Light Cast-Iron Pipe

By C. E. Inman
Commissioner and Superintendent of Waterworks, Warren, Ohio

THIRTY-EIGHT years' experience under water-works contractors who employed able engineers and further experience as superintendent of water-works in a number of widely separated cities, during which I have seen laid much cast-iron pipe lighter than is demanded by the standard specifications in use for some years past, combined with the satisfactory experiences given by that pipe and by much other light pipe of which I have learned by correspondence or otherwise, leads me to advocate the more general use of the lighter weights than are now current. In each town and city observed, the pipe was tested under 150 lb. pressure after it was laid. In one city, the pressure is run up daily, at noon, to 120-lb. pressure. In this and a number of other cities there has occurred, so far as my information goes, only one failure of the light weight pipe.

As far back as 1887, the late George A. Ellis published a statement in which he gave the general verdict of engineers, after long discussion and experiment, against using 40-lb.-per ft. 6-in. pipe when 28-lb. pipe will serve the purpose with equal safety.

If Classes A, B, C and D pipe, of less than 20-in. diameter, all poured from the same mix and melt, are foundry tested under 300-lb. pressure, why advise A for 43 lb., B for 86 lb., C for 130 lb. and D for 173 lb. per square inch?

Discussion: J. N. Chester, Pittsburgh, Pa., said that when, years ago, he became connected with the American Water Works & Guarantee Co., it was laying 100 miles of pipe yearly, of which 80 per cent was 6-in. weighing only 30 lb. per foot. He became a convert to that practice. Those who fixed the standard higher, although well intentioned, have loaded the country with many tons of unnecessary pipe weight. William F. Wilcox, Ensley, Ala., said that for many years past 30-lb. weights have been used for 6-in. pipe in the south. Leonard Metcalf, Boston, Mass., remarked that much light-weight pipe has been used in New England.

* * *

Some Observations on Wood Pipe

By J. W. Ledoux
Consulting Engineer, Philadelphia, Pa.

FOR all ordinary sizes of pipe it is generally recognized that the present standard is cast-iron pipe. For water purposes there is more cast-iron pipe used than all other pipes combined, the reason being that cast-iron pipe can be made absolutely tight under all circumstances and will remain so under all variations of pressure. For very large sizes, however, it is too costly as compared with wood or steel, and under many situations the reduction in capacity due to tuberculation is so serious that engineers will prefer a reinforced-concrete pipe or wood pipe.

Undoubtedly in regard to extensive use, wood pipe comes next to cast iron. It may be conservatively stated that cast-iron pipe will last one hundred years. Although there are many modern wood pipes that have been giving good service longer than 25 years, when we compare wood with cast iron it is best to assume a short life for the wood pipe.

Comparative Cost of Wood and Cast-Iron Pipe — As an example, let us take 24-in. continuous redwood pipe and assume a life of 25 years. Say the wood pipe will have to be renewed four times in 100 years and cast-iron pipe will last indefinitely. Let us take the average discharging capacity for the wood pipe as 20 per cent greater than that of cast iron. Table I shows the details and result of a cost comparison, computed on the basis of present worth. [Table II, showing various comparative data on the cost of wood and cast-iron pipe is also reprinted here. The original paper contains many data on wood pipe design, both as to banding and hydraulic calculations.—Editor.]

For machine-banded eastern pine (also 24 in.) the initial cost would be $28,900 as against $41,900, but after making the same calculations as are shown in Table I the present worth figures obtained for wood pipe would be $50,125 and for cast-iron pipe $86,650, a saving of $36,525.

TABLE I—SAVING BY USING WOOD RATHER THAN CAST-IRON PIPE

	Wood	Cast Iron
Initial cost of 24-in. pipe	$41,900	$67,600
Increase in cost of cast-iron pipe to obtain 20% increased capacity	.....	6,450
Initial cost for equal average capacity	$41,900	$74,050
Annual Charges:		
Wood pipe—repairs 1%, taxes 0.6%	$670	...
Cast-Iron pipe, repairs 0.25%, taxes .6%	.....	630
Present worth of $41,900 at 5% for renewal in 25 years	$12,373	.....
Present worth of $41,900 at 5% for renewal again in 50 years	3,654	.....
Present worth of $41,900 at 5% for renewal again in 75 years	1,079	.....
Present worth of $41,900 at 5% for renewal again in 100 years	319	.....
Present worth of $670 per year for 100 years at 5%	13,400	.....
Present worth of $630 per year for 100 years at 5%	.....	12,600
Initial cost for equal average capacity	41,900	74,050
Total present worths	$72,725	$86,650
Saving (about 20%)	14,488	..

TABLE II—COMPARATIVE COST PER FOOT INSTALLED OF WOOD AND CAST-IRON PIPE FOR 65-LB. PRESSURE

Nominal Diameter In.	Machine-Banded Wood Pipe Pine	Redwood	Fir	Continuous Wood Pipe Redwood	Fir	Cast-Iron Pipe at $44 Per Ton
6	$0.96	....	....	....	....	$1.26
12	1.49	....	....	....	....	2.69
20	2.29	3.70	3.27	3.43	2.92	5.21
24	2.89	4.84	4.31	4.19	3.58	6.71
30	4.13	....	....	5.27	....	9.13
36	....	....	....	6.35	....	12.02
48	....	....	....	9.50	....	18.90

Trenching is for all kinds of pipe taken as follows:

6-In.	12-In.	20-In.	24-In.	30-In.	36-In.	48-In.
$0.37	0.52	0.76	1.00	1.15	1.40	2.00

The following weights of pipe are taken in pounds per lineal feet:

	6-In.	12-In.	20-In.	24-In.	30-In.	36-In.	48-In.
Machine banded pine	15	22	38	49	85	...	.
Machine banded fir	..	..	37	40	...	...	...
Continuous redwood	.	..	35	44	60	76	115
Continuous fir	...	...	38	48	66	83	125
Cast iron	31	76	160	210	300	407	660

Hauling taken at $2 per Ton.

For 12-in. machine-banded eastern pine pipe the initial cost would be $14,900 for the wood pipe and $26,900 for the cast-iron pipe, making the same calculations as before, the present worth of the total cost of the wood pipe would be $25,847, and of the cast-iron pipe $34,027, or a saving of $8,180, 28 per cent of the initial cost of the cast-iron pipe.

Why Is Cast-Iron Pipe Generally Preferred?—When a financial comparison on a rational basis shows such a material advantage of wood over cast-iron pipe, the question naturally arises, why is cast iron so universally preferred by most of the leading engineers? It is, no doubt, because there have been so many unfortunate experiences with wood pipe.

From our knowledge of water pipe, it may be said that the best pipe that could be obtained for any purpose would be cast iron with some sort of non-corrosive and indestructible inner lining, but in ten years from now, this statement may be obsolete, and the writer is of the opinion that we are on the eve of great and fundamental improvements in water pipe manufacture. However, it is believed that it is believed that it will be many a decade before the use of wood pipe will be unwarranted. At present it is in use

by at least 500 municipalities and water companies scattered throughout the United States.

Discussion: J. E. Gibson, Charleston, S. C., said he did not think Mr. Ledoux had taken into account the cost of digging up improved pavements for the replacement of wood pipe, which would eat up the savings effected by the use of wood. Charleston has a large mileage of continuous wood stave pipe and some machine banded wood. It is going to lay five miles of 6 to 16-in. cement-lined cast-iron pipe. The reduction in diameter caused by the lining will be nothing like that due to tuberculation which soon comes back after cast-iron pipe is cleaned. John Cheater, Pittsburgh, Pa., said it is now impossible to get white pine suitable for wood pipe and that he would not want to use spruce. He was against using wood pipe in distribution system. He did not like to see wood put under pavement.

* * *

Present-Day Tars for Pipe Coatings

By W. R. Conard
Inspecting Engineer, Burlington, N. J.

WHEN Doctor Angus Smith got out his process for coating cast-iron pipe, coal tar was a residue of the manufacture of gas from coal, just as it is today, only in those days the many by-products to be obtained from this residue were apparently little known, and the tar was what is termed "virgin tar". Could the good Doctor have forseen some things, such as by-products, tar from oil and water gas sets, etc., it is probable that he would have given much more detailed specifications, and placed many safeguards around the coating.

The present standard specifications follow somewhat the Smith specifications, but although they call for coal tar pitch varnish the material actually used is not pitch nor is it varnish as those terms are generally understood. Moreover, the kind or kinds of oil to be used "to keep the mixture at the proper consistency" and the proportions are not definitely stated, nor is needed provision made for variations in season and weather.

Composition of Tar—Average coal tar is made up of carbons, oils, acids and gases. The acids and gases are in the forms of hydrogen, oxygen, nitrogen and sulphur. Its main body is carbon and it is the carbon held together by the oils which protects the metal from corrosion, and it is the acids that tend to attack and corrode. Therefore, it is desirable to get for pipe coatings a tar as free from acids as may be, and as high in carbon and oils, especially the heavier oils, and to use the coating at temperatures that will not evaporate the oils.

Coal tar and its by-products are put to a wide variety of uses. The heavier material usually called tar (no matter how much it has been distilled or refined) is used for paving, road work, the various forms of roofing materials, etc., while the lighter part is used in many lines of industry, particularly the chemical, so that the value of coal tar is greater for refining purposes than in its crude state, which condition is the best for pipe coating purposes. The result is that unless the pipe maker controls some source of production, he has to compete with the refiner, with the consequence that there are times when he gets left, and the pipe purchaser is the innocent sufferer.

While the pipe maker specifies and tries to get virgin tar, I believe that the tar he does get does not contain as large a proportion of the heavy mineral oils as the tars of Angus Smith's time contained, so there are cases where the coating is not as durable as it once was. It seems possible that even using coal tars that have had their by-products extracted together with some other material or materials, whether oils or some other form of binder, that a better and more durable coating than at present can be found. I would not say to disregard tar entirely for as I view it there has not yet been found anything that could [illegible] limits take its place, but I do not think that the virgin tar of today is the last word in pipe coatings, and I do not think thorough research would develop some other material to put with tar that would form a much better protection to iron and steel pipe surfaces than we are now using.

Coating Not Impervious—From what I have observed of pipe which have been in service, it is my conclusion that the coating on the pipe is not impervious to moisture, having small pores which usually extend through the coating. This allows the moisture to get to the metal, whereupon ferrous oxide forms, comes out through these pores and spreads over the interior of the pipe. There is need to see whether there is something to use with the tar that will seal the pores. Also, I believe that investigation should be made of whether pipe of different sizes and classes should be dipped in the tar bath at different temperatures, for the volume of the metal in the pipe controls the number of heat units to be thrown off before the coating sets, and as long as the heat prevents the setting of the coating, the heat will also continue to evaporate the oils in the tar and tend to leave nothing but dead pitch.

As to what materials might be used in conjunction with tar to prevent the forming of iron oxide, these things have occurred to me. One is the coating, especially of the interior of the pipe, with some parrafin substance before applying the tar; this was suggested casually by S. B. Brown of Warren Foundry. The other is the use of some substance that has no oil- or gas-forming constituent, but is very dense and, when set, impervious to moisture, which will become fluid at approximately the same temperature as tar, and will mix with tar readily, and can therefore be put in the tar tank, and applied in conjunction with the tar. And still another might be to find some means of getting a much thicker coating on the pipe, which would stay put, and not tend to scale in cold weather, and soften and run in hot weather.

* * *

Fire Prevention and Fire Protection in Relation to Water Supply

By Frank C. Jordan
Secretary, Indianapolis Water Co., Indianapolis, Ind.

REGARDLESS of insurance, when a fire occurs everybody loses. American fire losses are about $5 per capita, European countries show losses of only $0.11 to $0.60. Over 80 per cent of fire losses in America are preventable. The causes of these great losses in this country should be studied and a preventive campaign should be marked out, the latter to include legislation entailing personal liability for preventable losses. In many countries, the man in whose building a fire occurs must prove he was not responsible for the fire or forfeit his insurance.

A high fire loss in a city raises a question as to the integrity of the water-works just the same as a high typhoid fever rate raises a question as to the quality of the water supply, and therefore the water authorities should aim to cut down fire losses. In Indianapolis we have a fire prevention committee of 3,500 members, with representatives from every part of the city. The city is backing the work. The schools are used in the campaign.

The fire loss curve in Indianapolis had been going up steadily for years, as is true in other cities. In the year 1921 the Indianapolis firel oss decreased 36 per cent compared with 1920.

The committee has secured an agreement from roofers to charge reasonable prices for putting on fire-resisting roof coverings and to adopt a one-dollar-down deferred payment plan.

Discussion: Allen Hazen said that the city of Havana, Cuba, is almost free from fires. The water distribution is not laid out for fire protection. There is only one fire house in the city and that was built during the period of American occupation. Mr. Hazen thought that after shingle roofs, wooden floors would be the next thing to go in the interest of fire protection. Leonard Metcalf spoke appreciatively of Mr. Jordan's work in Indianapolis and added that it could well be duplicated by many members in their own cities. Dow R. Gwinn, Terre Haute, Ind., said that the people of Indianapolis and of Indiana are proud of Mr. Jordan's work which has been extended to other Indiana cities than Indianapolis.

Caisson Cofferdam Foundation With Special Bracing

Deep Cellar Substructure in Filled Ground, First National Bank of Jersey City—Caissons Braced by Built-up Struts During Excavation—Toe Wall Holds Caissons Against Sliding—Waterproofing

By T. Kennard Thomson
Consulting Engineer, New York City

CERTAIN special requirements arising from the ground conditions and from the construction procedure adopted led to the development of new arrangements of bracing in the caisson-cofferdam substructure of the First National Bank of Jersey City, recently completed. The temporary timber bracing by which the cofferdam wall was held during the work of excavating the interior of the cellar was concentrated in a small number of compact struts, leaving large open spaces between, through which the excavation could proceed. This arrangement was used in place of the ordinary system of closely spaced vertical bracing frames because the contractor wanted to carry on the excavation work more systematically and expeditiously than is possible when the lot is filled with a large amount of bracing. After the steelwork of the building had been erected and wedged into bearing against the caissons, to serve as their permanent bracing, the timber bracing was of course removed. A second new feature of the substructure is a toe wall of vertical I-beams concreted into the rock floor below the caissons and projecting up to hold the toe of the caissons from any possible inward movement. This device was used along the side of the cellar where the plane of cleavage in the gneiss rock on which the caissons rest slopes downward toward the building.

These two features are more fully brought out in the following account, which covers also some other interesting phases of the design and construction work.

Site in Filled Ground—The building site, just south of the old Jersey City station of the Pennsylvania R.R. and west of the Colgate soap works with its big clock, was originally in the Hudson River. Formerly the river bank was on the west side of Hudson St., which borders the site on the west. Borings showed that the ground on which the building was to be erected contained a tangle of old timber cribs, piles, grillages, and the like. High tide still occasionally reaches street level at this point, although the groundwater level is ordinarily about 4 ft. below the surface.

As indicated by the original borings, the subsoil consisted of some 10 ft. of backfill, sand, clay, brick masonry, timber, and the like, below this 6 ft. of clay and sand, then 12 to 20 ft. of river mud, and a small amount of mica sand on top of 3 or 4 ft. of rotten rock. Bed rock was 25 to 35 ft. below street level.



FIG. 1. CAISSONS BUILT FULL HEIGHT BEFORE SINKING

We have found the same kind of rotten gneiss rock, though not always in such large quantities, in lower New York, as at the Mutual Life Bldg., and in fact, under most of the downtown skyscrapers. Recent borings indicate the same condition will be found under the New Cotton Exchange on William St., Beaver St. and Hanover Place, which is very close to Pearl St., the old water's edge of the East River. Conditions under the First National Bank are more like what is found along West St. in Manhattan, such as at the Barrett Bldg., (West, Rector and Washington Sts.), where a mass of timber grillages, piles and a large amount of rip-rap were also found. On the Manhattan side, however, we generally find the Hudson River silt rather than river mud as in New Jersey.

In Newark Bay we also find a great deal of Hudson River silt, and an especially treacherous quicksand overlying the rock; these conditions, however, vary considerably in different locations. At Perth Amboy we have driven 90-ft. piles in this silt without reaching bottom, and after ten days have loaded a platform supported on four of such piles to 160 tons without any settlement, although the piles had been driven in about 6 min. each with the steam hammer of the driver following the pile under water to the river bed, and with no increased resistance or sign of more compact material when the driving stopped.

The bank site occupies the block on the east side of

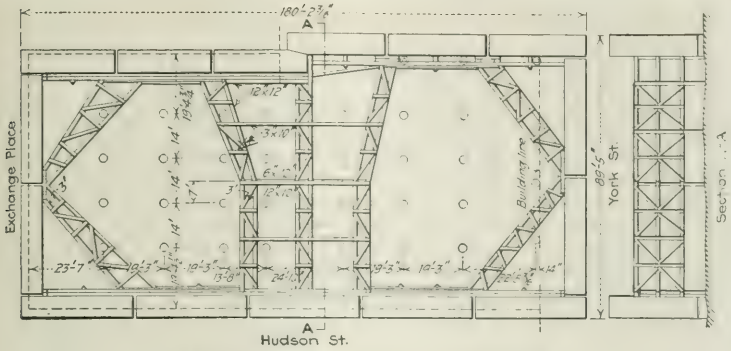


FIG. 4. BRACING OF CAISSON COFFERDAM
Concentrating the bracing gave large open working spaces.

Hudson St., with a frontage of 180 ft., and a width of 84 ft. on Exchange Place and 89 ft. on York St. The old bank building was located at the north or Exchange Place end. It was first planned to build on the south end of the lot before disturbing the bank occupancy, then transfer the bank, take down the old building and complete the new structure. There were several disadvantages in this plan: increased cost and longer time required for construction, and the necessity of underpinning the south wall of the old building. Fortunately, the bank succeeded in finding temporary quarters elsewhere and it was possible to build in a single operation.

Alternate Foundation Plans —The original design for the new building placed the basement floor at street level and provided foundations comprising a circular caisson for each column. This construction would have cost more and taken a longer time to carry out than the plan adopted. It was next contemplated to put in a deep cellar at the south end of the lot, to receive the boilers, and provide individual caissons under the other columns, thirty-seven in all. But it was realized that by putting in a deep cellar over the entire site the total cost would be reduced and at the same time some 25,000 sq.ft. of floor surface would be added, the value of this additional floor space alone exceeded the entire cost of the foundations. For this reason, the deep cellar plan with caisson inclosure and with interior columns founded directly on the rock floor of the excavation was finally adopted.

In the enclosure cofferdam as designed, with caissons 7 ft. wide with lengths varying from 29 ft. 11½ in. to 36 ft. 8 in., fifteen caissons were required. They were carried down to good rock, about 30 ft. below street level. This rock, New York gneiss, is usually overlaid by several feet of badly decomposed rock, often soft enough to be taken out with a shovel, and sometimes extending down into deep crevices where it may be hard to detect and remove. The depth of basement as planned was sufficient to carry the entire construction well below the level of the decomposed rock and in fact extend several feet into the sound rock.

At the north end of the lot, the party wall of the property adjoining to the east is carried directly on the caissons. To make the work here practicable, the party wall was taken down and subsequently re-erected on the caisson foundation; the owners were paid *pro rata* for the time the building was disturbed. South of this, it was possible to arrange with the adjoining owners to place the caissons in large part on the adjoining lot, as indicated by the offset shown on the plan. By making the cellar 6 ft. wider here it was possible to provide for getting the elevators down to the basement without cutting the caissons, as had to be done at one point near the northeast corner.



FIG. 2. ARRANGEMENT OF CAISSON COFFERDAM
Reinforced-concrete cap continuous around lot

Caissons Design — As already mentioned, the cofferdam caissons were made 7 ft. wide. The writer has often been criticised for using so great a width, in place of 5 or 6 ft., but in every case the greater width made a better and quicker as well as a cheaper job.

The 5-ft. width is too narrow for quick work in excavating and sinking the caissons. In one specific case it took one-third longer to sink 5 x 19 ft. caissons than to sink 8 x 26 ft. caissons on the same site, with the same number of men per caisson. It is also easier to keep the wider caissons in line vertically and horizontally. Further, their extra weight and strength simplify and cheapen the bracing

Continuous concreting of each caisson from cutting edge to bottom of concrete caps was stipulated in the contract. This requirement was carried out except in three caissons, where the contractor was permitted to build up in two sections in order to avoid cutting the floor joists of the adjoining building. Continuous concreting avoids horizontal joints, which always give trouble sooner or later, producing nasty looking seepage lines. I had used it in three important buildings previously, with caisson heights 20 to 30 ft. above cutting edge, and succeeded in doing away entirely with the ugly horizontal construction joints, which always contain more or less silt and milk of lime or laitance. It seems almost impossible to scrape or otherwise remove this substance in construction, and yet sooner or later it is either washed out or penetrated by the water pressure, producing percolation or leakage. Evidence on this point can be found in retaining walls along several railroads near New York, where unusual pains and expense had been taken to clean the top of a day's work before adding more concrete, but the formation of seams such as referred to was not prevented.

When all the concrete is placed before sinking is started, a caisson goes down easier and quicker and keeps its position better both vertically and horizontally. The practice is therefore economical. Less loading of caissons by pig iron or the like is required, moreover, because sinking can be continued without the interruption caused by concreting; any such interruption permits the soil to bind around the caisson to such an extent that additional weight and time are required to break the bond, and in some cases even jetting, with the danger of throwing the caisson more or less out of plumb or possibly warping it.

Where it is possible, then, by far the most economical way to sink caissons is to concrete all of the caissons before putting compressed air on any of them. Where this cannot be done, it pays to have as many as possible built before starting the pneumatic work.

Joints Between Caissons—A space of 8½ in. was left between caissons, with a view to using a clay joint placed by "stock ramming." The construction of this joint is practically the same as that used by the writer on the Assay Building, New York City, two years ago. The oak timbers or separators shown in the plan of the joint, Fig. 5, were bolted to the ends of the caissons before sinking. They serve the purpose not only of keeping the caissons from getting too close together, but also of preventing the clay rammed into the joint from spreading all over the lot. When I used stock ramming on the Commercial Cable Building in 1896, without such timbers, the clay was subsequently found to be 20 or 30 ft. away from the joint in places. (Stock ramming on the Mutual Life Bldg. was described in *Engineering News* of March 28, 1901, p. 221, and that on the Assay building in *Engineering News-Record*, Jan. 22, 1920, p. 165.)

Joints as made by the stock-ramming process actually cost about $300 each on this job (First National Bank). Those made by the pneumatic method would have cost at least $2,000 each. Thus a saving of at least $25,000 and considerable time was attained, and in addition we could feel satisfied that less material would be drawn from the adjoining property while making the joint; in other words, the clay joints can be made more safely than the pneumatic or the half-moon joints.

Drainage and Waterproofing—After the deep-cellar design of building had been decided upon it was arranged to put the bank vaults in the basement, and the boilers were placed at a still lower level. This meant excavating to El.-25.5, or 38.5 ft. below street level. Some 3,000 cu.yd. of good rock had to be excavated to reach this level.

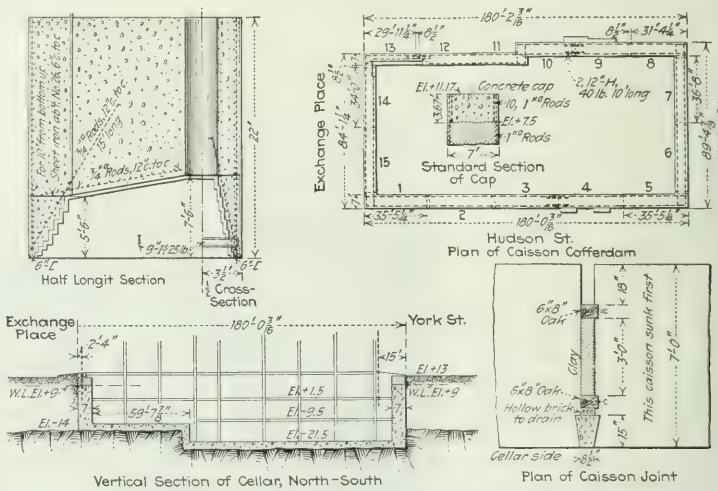


FIG. 5. BRACING AT NORTH END OF COFFERDAM

Caissons stopped on sound rock. Excavation inside carried down 12 ft. lower. Along west side a steel toe-wall was built to hold the caissons against possible sliding of rock on inclined seams.

Drainage necessarily received very careful consideration. If there is any cellar in lower New York 20 or 30 ft. under water without some seepage through fissures in the rock, I have not seen it. Further, concrete caissons under such a head are practically never wholly watertight. Theoretically they can be made so, but practically most of them will show occasional wet spots. This fact and also the fact that any masonry wall even of less than 1-ft. thickness, let alone 7 or 8, will collect an enormous amount of condensation when subjected to changing temperatures, made it advisable to provide drainage along the caisson walls also. Therefore, in addition to making the caisson concrete of the best possible quality, the inner face was later lined with hollow tile, waterproofed with tar and felt, and an enameled brick wall laid up inside of this to hold the waterproofing in place. If any water should ever seep through the walls or joints, it will simply pass through the hollow tile to the sump.

In the bottom of the excavation a 10 x 10 x 10-ft. sump was blasted out of the rock to receive all wall and floor drainage. Over the entire botton of the excavation a 6-in. layer of broken stone was placed, with lines of

tile duct draining to the sump. A 4-in. layer of concrete was placed on top of the broken stone, then tar and felt waterproofing and then a main floor slab of 24 in. of concrete.

While these elaborate drainage provisions might indicate that there was considerable water inflow, it should be said that this particular cellar is remarkably dry; very few cellars of this size and depth below water will require so little pumping.

Preparing the Ground—Under the particular circumstances existing at this site it would have been an expensive and slow matter if caisson sinking had been started from the surface of the ground. The mass of piles, grillage and cribwork, riprap, etc., below ground would have introduced very troublesome delays in sinking. For this reason open sheetpile cofferdams were driven, and the ground between them excavated deep enough to permit removing all this obstructing material in the open. Some of the timbers removed were oak sticks 14 x 20 in. and 20 ft. or more long, some of them in excellent state of preservation. After the obstructions had been removed, the trenches were backfilled with cinders to ground level, a depth of 10 to 15 ft., and the sheetpiling then pulled, to permit constructing the caissons at ground level.

The weight of the caissons due to their being made 7 ft. wide, and the removal of obstructions as just described, made it possible to sink the caissons with almost no extra weight in the way of loading by cast-iron blocks or pig iron. In some caisson work, such loading is necessary to the extent of 200 or 300 tons per caisson.

Rapid Build-up—The first two or three caissons took a day and the best part of the night to complete the concreting from the cutting edge up to the top, a height of about 26 ft. The other caissons, however, were all completed between 7 a.m. and 6 or at the latest 9 p.m.

Rapid Sinking—In sinking, care was taken to arrange the work so that adjoining caissons would never be in progress of sinking at the same time. The entire sinking was done between Sept. 10 and Oct. 11, 1920, working two sets or six gangs of men (three 8-hr. shifts). The depth at which the cutting edges were stopped ranged from 25 to 29½ ft. below street, but the cutting-edge excavation and concreting usually went down deeper, on account of the excavation required through decomposed rock.

Special Cofferdam Bracing—The temporary bracing required to hold the walls against the earth pressure from the outside while the interior of the site was being excavated and before the permanent steelwork was in place was concentrated in three heavy, built-up struts in the center of the lot and one heavy diagonal strut at each of the four corners. They bore against three heavy lines of waling timbers placed against the caissons. This bracing, designed for about 12 tons per lineal foot pressure against the cofferdam wall, was so arranged as to present the least possible obstruction to the excavation work and to the steel erection. T. B. Bryson, vice-president of the Holbrook, Cabot & Rollins Corp., made the general design for this bracing, which was then worked out for him by Carlton Greene, consulting engineer.

Caisson Toe Wall—Carrying the caissons down to basement floor level would have required sinking them through 12 ft. vertical of good rock on the average. This work, under compressed air, would have much more than doubled the cost of the caisson sinking and with the same men and equipment would have taken at least a year longer. It was decided, therefore, to excavate in the working chamber to good rock only, and to make sure that the rock was such that there would be no liability of the caisson ever slipping into the cellar. After excavating the cellar, however, it was found that on a portion of the west side of the lot there were some bad fissures in the rock, with planes of cleavage sloping toward the cellar. It was feared that at some time in the future the softer material in these fissures might gradually wash out, allowing a bad slide. To prevent any such danger a steel and concrete toe wall was built in front of the caissons, securely anchored into the rock of the cellar floor.

This wall was constructed of twenty-two H-beams, 24 in. by 80 lb., reinforced with 10 x ⅜-in. cover plates, concreted into holes in the rock 4½ ft. below the finished

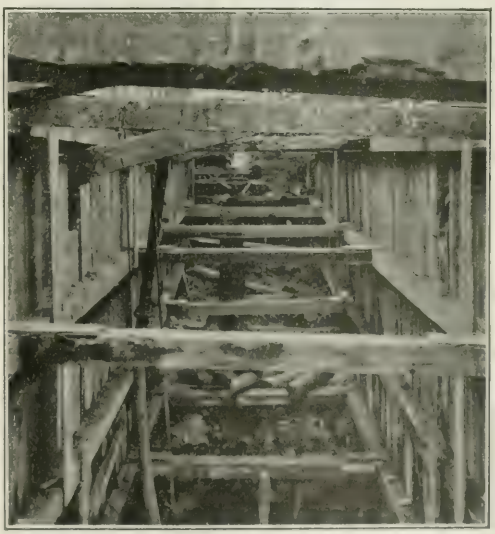


FIG. 3. BURIED TIMBER TAKEN OUT THROUGH TRENCH
The trench was backfilled after the dock cribbing and other old timber was removed and the caissons started above water level.

engine-room floor, the tops of the beams being held by the basement floor. These beams are nearly 30 ft. long. They were fully incased in concrete. In designing this wall, a hydrostatic pressure of 75 lb. per square foot was assumed, and a stress of 18,000 lb. per square inch was allowed. This is the first case I know of where the rock under pneumatic caissons has been so braced.

The entire construction, including the caisson sinking, blasting out 3,000 cu.yd. of rock in the cellar, bracing and erection, was carried out so carefully that there were very few accidents, and none of serious kind.

E. L. Young, president of the bank, gave this work his personal attention, assisted by James E. McKay. Alfred C. Bossom, New York, was the architect of the building; Arthur Zimm was general manager for the architect. John Lowry, Jr., was general contractor, with George A. Davis as superintendent in charge. Daniel Hughes was the superintendent for the foundation sub-contractors, Holbrook, Cabot & Rollins. Bigelow

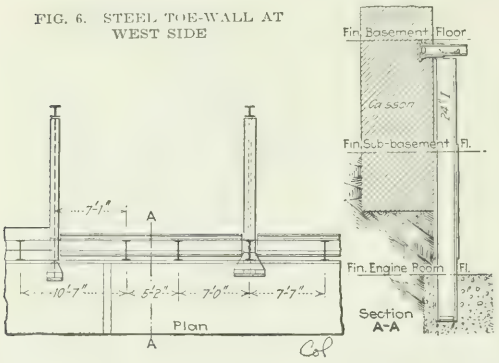


FIG. 6. STEEL TOE-WALL AT WEST SIDE

& Nichols were engineers and contractors for the steelwork. All these parties worked harmoniously and well together, which insured the first-class results that were obtained. The writer was retained by the architect as consulting engineer.

Jointed Concrete Pavement in New York State

New Design Calls for Separately Reinforced Slabs 33 x 9 Ft., Separated by Submerged Steel Plate Joints

A JOINTED-SLAB construction has been adopted for concrete roads in the State of New York. The new pavement for 1922 is an 18-ft. slab, with a submerged steel-plate joint down the middle and one across the slab every 33 ft., and a wide expansion joint at least every 300 ft. Heavy reinforcement particularly of corners and edges is required. With a richer concrete, these details definitely raise the quality of construction. Also, with two thicknesses of slab and two types of reinforcement, four different pavements are available to meet different traffic conditions. Figs. 1, 2 and 3 indicate the new designs in all essential particulars.

Division longitudinally of the pavement slab is the result of observation of recent pavements where this separation in complete or partial form has been tried out and of older pavements built as one slab. The older concrete pavements show the principal deterioration during the first five years to be the development of a zig-zag longitudinal crack. On the contrary two-strip slabs, with the strips not more than 10 ft. wide, show after four years few longitudinal cracks. In a similar way observation indicates the development of a cross-crack every 30 ft. or so. The theory of the new design is to forestall the longitudinal and transverse cracks by making joints in the slab, one down the middle and about three across the slab in every hundred feet. These joints are independent of the bitumen filled joints put in to take up expansion.

A steel plate, with its bottom bent out at right angles to form a flat base, as shown by Fig. 3, forms the joint. The only exception, considering expansion joints as out of count, is when the two strips of slab are built separately at least 14 days apart. In this case the second strip of slab is butted up against the hardened edge of the first strip without the intervening steel plate. The height of the steel plate is ½ in. less than the thickness of the slab, which is uniform in depth and 6 or 7 in. thick according to the design. All joint plates are, therefore, submerged ½ in. below the pavement surface. In case of the longitudinal joint a groove ½ in. wide is formed directly over the joint plate and deep enough to lay bare the top edge of the plate. At the transverse joints the slab is finished continuously over the joint plate.

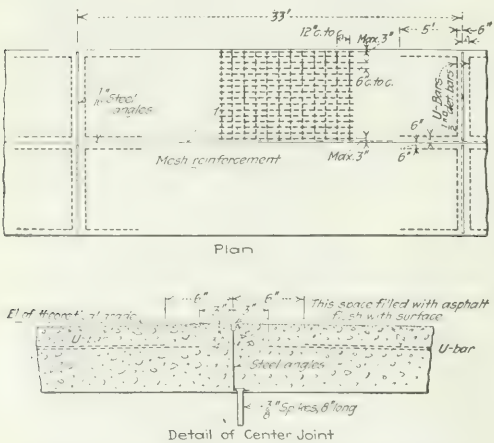


FIG. 1. MESH-REINFORCED SLAB AND SUBMERGED-JOINT CONSTRUCTION

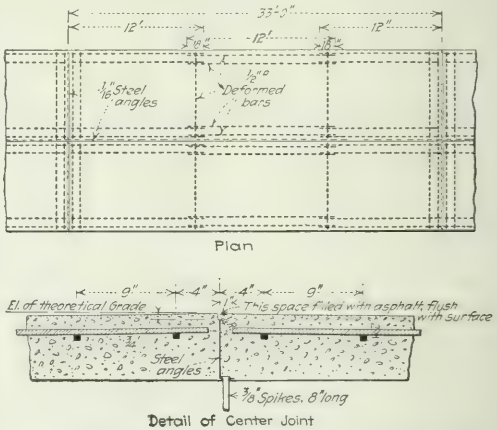


FIG. 2. BORDER REINFORCEMENT OF DEFORMED BARS

Great exactness is exercised in the construction of the joints. The plates are set exactly vertical and exactly to height and are firmly pinned to the subgrade as indicated by the illustrations. To keep the longitudinal plate in line and to give it lateral stiffness and also as a means of forming the groove, a cap-bar constructed as shown by Fig. 3 is fitted onto the top edge of the plate and when the concrete has set is lifted away. At transverse joints the longitudinal plate is broken; the transverse joints are formed by two plates each about an inch shorter than half-width of the slab. At all joint intersections, therefore, there is a complete break in the plate separators in both directions. Particular effort is made to see that the cross joints in

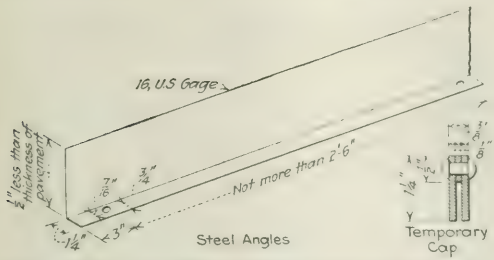


FIG. 3. DETAIL OF STEEL JOINT-PLATE AND GROOVE-CAP

opposite slab strips register exactly, for any offset in the joints in the two strips results in cracking as indicated by Fig. 4. The same thing happens if the longitudinal plate and groove fail to register. This groove is finished with a sidewalk groover and, when the concrete is dry, is cleaned and filled with bitumen.

Expansion joints are distinct from the crack-regulating joint system described. They are located at the beginning and ending of all horizontal and vertical curves, at points of suspension of work at noon and night, and at other intervals not exceeding 300 ft. A joint width of ½ in. for each 100 ft. of slab is called for; or a 1½ in. joint for a 300-ft. section. A pre-molded bituminous



FIG. 4. CRACKS CAUSED BY IMPROPER JOINT-PLATE LOCATION

When the two joints are exactly opposite as at AB, the crack opens up squarely over the steel plates and straight across the slab as intended by the design. Where the plate, as CD, in one slab "breaks joint" widely with that in the opposite slab a crack as CE continues the joint across the opposite slab. In the offset of the opposite joint plates is small, such as might follow from careless workmanship, the result is one or two spalling cracks as shown at FG. If the longitudinal plate and groove do not register, a spalling crack as at HJ results.

joint filler is required. Considering a 300-ft. section of pavement there is an expansion joint at each end and between them nine crack-regulating transverse joints and the continuous longitudinal joint, dividing the section into twenty separate slabs.

Partition of the pavement into separate slabs is further recognized in the design of the reinforcement. Two types of reinforcement are contemplated as indicated in Fig. 1 and Fig. 2. With both types each 33 x 9 ft. slab is reinforced as an independent structure. The reinforcement is not continued across joints nor are dowels employed. With mesh reinforcement the wires are required to have effective areas of 0.073 sq.in. longitudinally and of 0.029 sq.in. transversely. This gives a weight of reinforcement of 62 lb. per square and the addition of the U-bars to strengthen the slab corners increases the weight to about ¾ lb. per sq.ft. The bar type of reinforcement is indicated by Fig. 2. It will be noted that a border reinforcement of fairly large bars is employed.

Construction, except as indicated in connection with joints and reinforcement, follows ordinary practice. A 1:1½:3 concrete is sought, particularly of broken stone aggregate. The joint and reinforcement design as described has been developed by the engineers of the department, Fred W. Sarr, first deputy commissioner.

Progress in Water-Wheel Design

Reports from Manufacturers Abstracted by Hydraulic Power Committee of the National Electric Light Association

THE principal features of progress made during the past year in the design and construction of water-wheels and governors are: the further development of the high speed runner, the flaring draft tube, the further application of the overhung runner to the reaction turbine, the further development of the governor to meet operating conditions and the special requirements of remote control and automatic plants; and the further refinement of structural details of both wheels and governors.

The development of larger units and lower heads has increased the demand for wheels of high specific speed. To meet this demand the unshrouded or propeller type of runner is rapidly developing in various forms. Experience so far

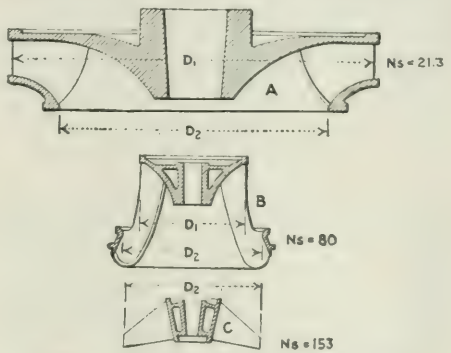


FIG. 1. RELATIVE SIZE OF FRANCIS AND PROPELLER TYPE RUNNERS

has well established the advantages for low-head work of this type in speed, strength, weight, few number of vanes, freedom of water passages, simplification of setting, possibility of using coarser racks and, on account of the low torque from closed gate leakage, its suitability for remote control and automatic plants. Although there has been among manufacturers a decided difference of opinion as to the liability of pitting with this type of runner, the Allis-Chalmers Company's experience so far indicates that comparative freedom from this feature can be obtained by proper attention to design.

The Hydraucone (White) and spreading (Moody) forms of draft tube, both for large installations and for low heads, have been further developed, and other forms of straight, flaring or spreading types designed to utilize both the whirling and axial elements of runner discharge are under consideration.

An interesting suggestion has been made (Taylor) that where future progress in higher specific speeds and higher heads may require the submergence of the runner below tailwater, excessive draft-tube excavation may be avoided by inverting the setting admitting water below and discharging upward and outward over a circular weir and syphon draft tube. Another adaptation of setting (Moody) to compensate for excessive rise of backwater during flood is the use of the ejector principle in bypassing part of the flow around the runner into the draft tube.

The development in governor has been largely to better meet operating requirements. Thrust bearings have seen little change.

The following statements have been submitted by various manufacturers.

The William Cramp & Sons Ship & Engine Building Co. I. P. Morris Department

High Speed Runner—The demand for higher speed runners has become more insistent, due to the trend for large

size units under moderate or low heads. Fig. 1 shows two Francis runners, and below at the same scale a propeller type. A comparison of these runners, which develop the same power at a given head but at speeds corresponding to their specific speeds, shows the great power developed by the propeller type compared to its dimensions. Specific speeds up to about 160 have been reached with this type with good efficiency. The advantages of the propeller over the Francis runner are: (1) Decreased first cost of development due to smaller generator, lighter shaft, lighter runner, lighter cranes, etc.; (2) greater strength in runner;

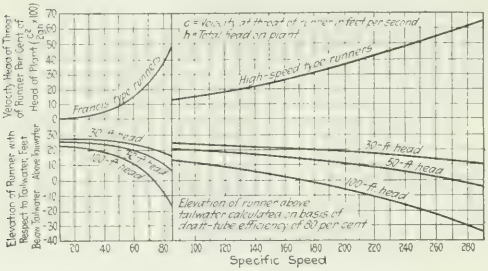


FIG. 2. COMPARISON BETWEEN FRANCIS AND PROPELLER TYPES

(3) non-clogging operation due to much greater clearance between vanes; (4) replaceable vanes; (5) less danger of corrosion due to more direct water passages and simpler vanes.

In Fig. 2 the curves of specific speed plotted against velocity head at discharge indicate the total energy discharged and show that the limit as to specific speed, which was being closely approached by the Francis design, has been for the present eliminated. The curve for Francis runners becomes very steep after a specific speed of 80, whereas with the propeller type much higher specific speeds are possible at relatively low outflow. The curves beyond a specific speed of 160 are theoretical, as propeller type runners have been developed only to about this speed.

Draft Tubes—As the water leaves all high-speed runners as a whirling mass, and a curved draft tube can regain only the axial component of the velocity, considerable losses result from using such tubes with high-speed runners. To regain efficiently the energy discharged the following requirements must be met: (1) The axis of the tube should be a straight line coincident with the axis of the turbine. (2) The walls should be surfaces of revolution about this axis. (3) The areas normal to the axial components should gradually enlarge and the tube spread out symmetrically from top to bottom, resulting in gradual deceleration of both axial and whirling velocities.

The Moody spreading draft tube meets all these requirements. Such tubes are not only desirable for high specific speed runners, but also prevent vibration in high head plants where low specific speeds are used as a whirling effect is present at part gate and the tube recovers this component and prevents the formation of the eddies and vortices which produce vibration.

Inverted Turbine—The lower curves of Fig. 2 show the possible elevation of runners with respect to tailwater for different heads and specific speeds. The elevation is governed entirely by the total draft head and, as this is made up of both height above tailwater and the velocity head at discharge of the runner, it is evident that as specific speed increases for a given head the runner must be lowered. Also as head is increased for a given speed the runner must be lowered. Although the propeller type has given more margin, the time will come when for higher heads, or if developed to higher speeds, the runner must be located close to or below tailwater. To overcome excessive draft tube excavation and permit of inspection without stoplogs in the mouth of the tube, H. B. Taylor, of the Cramp Compnay, has suggested inverting the turbine, admitting the water below and discharging it vertically upward. Fig. 3 shows an arrangement of inverted turbines with a circular weir and syphonic discharge, which permits of easy inspection by pumping.

Ejector Turbine — The Moody Ejector Turbine makes provision for admitting water from the casing directly into the draft tube below the runner. In times of flood and high backwater this high velocity by-passed water is used to increase the draft head and tends to maintain the power.

Mechanical Details.—(1) Sectional spiral casing. To prevent leakage in radial flanges of large volute casings under high heads, H. B. Taylor has designed a special casing in which the separate speed ring is eliminated and the speed ring vanes are cast in radial sections with longitudinal flanges for bolting to casing proper. This enables radila flange bolting to be carried into the throat and prevents leaking. The design is used on the 55,000-hp. units now under construction for the Queenston-Chippawa Development.

(2) Labyrinth Seals for Runner. Labyrinth seals giving six seals for leakage past the runner in high head units have been developed. These not only decrease leakage, but wear also.

(3) Disc Guide Vane. To prevent leakage between guide vanes and distributor plates, the Ovem disc vane utilizes discs cast at junction of vane and stems, which discs are set flush in distributor plates and effectually prevent flow above or below the vane.

(4) Operating Gear. A new type of operating gear has been designed by F. H. Rogers, in which the lever attached to the guide vane is offset from its usual radial position and, as the vane closes, turns further away from radial

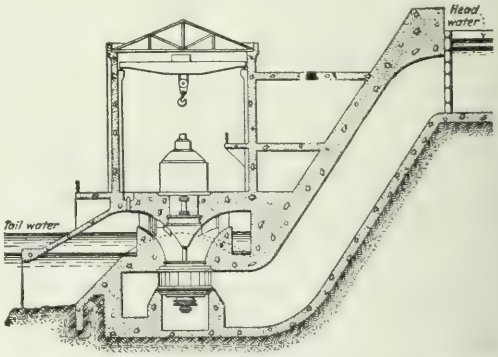


FIG. 3. PROPOSED INVERTED TURBINE IN POWER HOUSE
Devised by H. B. Taylor. Note that the wheel has a circular weir and siphonic discharge.

position. By using links in compression a toggle action is obtained which gives the desirable features of (1) greater angular turn of vane at large loads than at small loads and (2) maximum torque on vane in closed position, resulting in improved speed regulations. A shearing section in the links gives protection against injury due to a block vane.

(5) Lubrication of Internal Parts. For lubricating high head units H. B. Taylor has developed a large pneumatically operated grease gun with piping to guide vane bearings, etc., which insures sufficient pressures to force grease in against the head, which is difficult and slow with hand-operated cups.

Allis-Chalmers Manufacturing Co.

High Speed Runner Development—The operating data on Allis-Chalmers high-speed runner installations now available cover five years and thirty-four commercial installations. Runners range in discharge capacities up to those comparable with the Keokuk units, in size up to a diameter of 13 ft., in installed capacity up to a plant horsepower of over 8,000, in heads up to 35 ft., and in speed up to 3,600

revolutions. Complete test data have been obtained up to heads of 55 ft., and for draft heads up to 20 ft. Information on pitting under heads considerable enough to warrant looking for such effect is available over a period of operation up to four years.

Based on all data available, it is the present opinion of the Allis-Chalmers Co. that specific speeds in excess of 150 English System should not be utilized for heads greater than 30 ft.

Although a greater tendency toward pitting exists than with reaction turbines, there has been no case sufficiently extensive to warrant any fears but that this feature can be taken care of in perfecting design.

Efficiencies have steadily increased from initial figure of 86.95 at Holyoke in 1916, several per cent having been gained in improved design of runner and particularly through axial flow guide case settings. Specific speeds up to 240 have been reached with commercial efficiencies.

Regulation has shown no results at variance with those obtainable with reaction runners.

The non-clogging feature which permits wide rack spacing reduces not only the first cost of racks, but greatly lessens the necessity and cost of racking. This feature has proved of value in automatic plants.

The Wellman-Seaver-Morgan Co.

There have been no radical departures in turbine design during the last year, but rather perfecting and improving of mechanical details. A tendency is noted for some power companies to revert to oil bearings with babbitt linings for vertical shafts where there is sand in the water, special oil catchers and seals being necessary to prevent loss of oil. New breaking links and gate pins have been designed, and special study given runner seals to prevent leakage on high heads. Methods of heating gates to prevent ice clogging have been applied. Remote control for governors has been developed to a high degree.

For low head open flume turbines improvement in part gate efficiency and reduction of cost without losing heavy, rigid construction have been given much attention.

Draft tube design is being still further investigated.

The Pelton Waterwheel Co.

There have been no improvements of special importance in impulse wheel design during the past year and, as far as known to us, no notable installations other than the one 25,000-hp. double-overhung Pelton wheel, installed at the Big Creek Power House No. 2 for the Southern California Edison Company. This unit is of the auxiliary relief needle regulating type with speed regulating governor servo-motor mounted directly on the rear end of the power needle stem.

This year has seen the starting of the Kern River No. 3 Plant of the Southern California Edison Co., which contains two vertical Pelton reaction turbines, each developing 25,000 hp. operating under a head as high at times as 810 ft. This operating head establishes a world's record as far as known, and there are many features of special design that are worthy of mention. (1) The automatic equalization of pressure on the upper and lower sides of the turbine runner. (2) The automatic supply of cooling water to the shaft stuffing-box. (3) The automatic drain of seepage from top of casing. (4) The automatic continuance of oil pump operation by water-wheel drive, in the event of failure of electric motor service. (5) The automatic sharing of the available water supply by the two turbines during periods of low water. Water not required by one unit is automatically transferred to the other, which acts as a block load carrier. (6) The automatic adjustment of water consumption to conform to the available flow. The two turbines will not only automatically use what there is, but in addition use it constantly and without loss over the spillway during times of governor movement for speed and load regulation.

We have made important progress in the design of large horizontal reaction turbine units with overhung runners during the last year. The overhung type of horizontal turbine unit results in great simplification in the entire equipment of generator and turbine may be mounted in two bearings, the thrust collar being combined with the outboard bearing. Economy of floor space and maximum accessibility are the direct result of this construction. We have during the past year completed several large horizontal units of this type, varying from 12,000 to 20,000 hp. each.

Is Cost of Treating Ties Capital or Maintenance Charge?

Two Engineers Advocate Opposite Methods—What Is a "Betterment"—Changes in I. C. C. Accounting Rule Urged

AN ECONOMIC question in railway valuation and accounting is the method of charging the excess cost of ties due to preservative treatment. Opinions differ as to whether this item should be charged to capital account or to maintenance. A paper advocating the latter method was presented at the recent annual meeting of the American Wood Preservers Association by Earl Stimson, chief engineer of maintenance-of-way, Baltimore & Ohio R.R. Since then an article presenting the opposite or capital side of the case has been submitted by F. S. Schwinn, chief engineer of the International & Great Northern Ry. For the benefit of engineers engaged in maintenance and valuation work abstracts are given below of both of these papers. It is to be noted that under the present accounting system prescribed by the Interstate Commerce Commission this cost is chargeable to maintenance. Further, a treated tie substituted for an untreated tie is not considered to constitute a "betterment," although a metal tie thus substituted would be a "betterment." It is Mr. Schwinn's argument that this accounting feature should be changed.

Tie Treatment is Maintenance Charge

By Earl Stimson
Chief Engineer of Maintenance: B. & O. R.R.

Funds to pay the cost of treating ties may be obtained from money earned or from money borrowed. Which way is the more desirable depends on the degree of prosperity of the railroad. If the earnings are large, it is desirable to put a portion back into the property, and in what better way than to invest in treatment for prolonging the life of ties. If the earnings are low, resort to capitalizing of the excess cost of the ties due to the treatment would be a means of meeting the expense.

While no specific mention is made of treated ties in the Interstate Commerce Commission's classification of expenses it is evident that the Commission does not consider the treatment of ties a "betterment," which it defines as follows: "Betterments are improvements of existing facilities through the substitution of superior parts for inferior parts retired, such as the substitution of steel-tired wheels for cast wheels under equipment, the application of heavier rail in tracks, and the strengthening of bridges by the substitution of heavier members. The cost chargeable to the accounts of this classification is the excess cost of the new parts over the cost of current prices of new parts of the kind retired."

Since the substitution of a metal tie for a wood tie is allowed as a betterment (or the substitution of a superior part for an inferior part) it may be argued that a treated tie is superior to the untreated tie, as far as its life is measured by resistance to decay. On the other hand the metal tie is unquestionably a substitution of a superior part, as the tie is made of radically different and structurally superior material.

The Commission evidently considers all wood ties the same, whether of soft or hard wood and whether untreated or treated. A wood tie is no better structurally after treat-

ment. It will carry no greater load and will not better hold the spikes. Under severe usage it will no better resist rail and spike cutting and other forms of mechanical wear, unless it is specially protected with tie-plates and screw-spikes at considerable additional expense. Under very severe usage the treated tie is destroyed as quickly as the untreated tie. The increase in the life of the treated tie is the only point upon which its superiority can be based But the same point might be raised in favor of white-oak or long-leaf yellow-pine substituted for red-oak or short-leaf pine.

There are many kinds of treatment, varying widely in cost and effectiveness. Their effectiveness is not always in direct ratio to the cost and it varies with the different kinds of wood. It is difficult after a few years to identify a tie as treated or untreated, or to identify the process of treatment, unless an elaborate record and method of marking for identification be initiated. Without such record it would be impossible to accurately separate the charges. The rapid rise in price of timber has increased the price of the tie in much greater proportion than the cost of treatment has increased. Less expensive treatments that have been found adequate are being used more and more in place of more expensive treatments. The result has been that the ratio of cost of treatment to price of the tie has greatly decreased, not only making the treatment show great economies but also reducing the proportion the excess cost of treatment bears to the total cost of the treated tie. This should in itself stimulate the use of treated ties and not necessitate resorting to the doubtful expedient of capitalizing.

The steady increase of the use of treated ties until now a large percentage of ties used are treated, rather nullifies the idea that the present method of charging the cost of treatment to maintenance is preventing a more liberal use of treated ties. Nor does it appear that charging to "investment in road" (that is, capitalizing) the excess cost of the metal tie has brought about the extensive use of that tie or made it even a competitor of the treated tie.

The writer has treated this subject from the standpoint of the maintenance engineer. He has taken into his maintenance costs the expense of treating some 12,000,000 ties and is reaping the benefits of the price paid. He is not and will not be compelled to continually give up some portion of those benefits in payment of interest charges, or in other words to pay tribute to capitalizing. He favors the present practice of charging the cost of treating ties to maintenance.

Tie Treatment is Capital Charge

By F. S. Schwinn
Chief Engineer, International & Great Northern Ry.

The railway maintenance engineer can no longer limit his horizon in considering repairs and renewals necessary for the property in his charge, but must include the viewpoints of the financier, the executive and the accountant. The primary need of a railroad is to earn money for operating expenses, fixed charges, improvements and reasonable return on its securities. The lack of sufficient earnings for all of these requirements is first felt by the maintenance departments. Still, some of those most vitally interested advocate the charging into operating expense of amounts representing improvements to their property, including the charging of the cost of treating ties to maintenance.

It is true that the classification of investment in road and equipment as prescribed by the Interstate Commerce Commission does not permit a charge of investment covering the cost of treating a tie used to replace an untreated tie. We are led to infer that the excess cost of metal ties over the current price of wood ties removed is the only betterment that can be obtained in a tie system. Are we to believe that a treated tie is no better than an untreated tie?

Treated ties have proved superior to untreated ties in overcoming decay. Their use results in economies of operation probably even greater than those secured from the application of heavier rails, ballasting of tracks, reduction of grades or the development of terminal facilities. The treatment of ties ordinarily will double their life and in that way will reduce operating expenses. Can it be that this is not an improvement, or a betterment of the property under a proper definition of the word?

In its railway valuation work the Valuation Bureau of the Interstate Commerce Commission has not valued the untreated tie as highly as the treated tie because it recognizes the difference in worth. There would have been very strenuous objections from the carriers if the Bureau had done otherwise. But under the Commission's valuation order No. 3 a carrier which may have used one million treated ties to replace untreated ties since its valuation date, at an increased cost over the cost to replace in kind conservatively averaging 50c. per tie, cannot capitalize this $500,000 improvement but must charge its value into the operating accounts. Should not the Commission amend the present accounting rules as affecting treated ties? By so doing, it would not only allow the carriers to earn a larger net operating income but would materially decrease their operating expenses, which decrease would finally be reflected in lowered rates.

It has been suggested that it would not be practical to keep accurate account of treated ties. This can be done very simply by use of a marker so that treated and untreated ties can be identified and classified when retired. Variations in cost and effectiveness of treatment cannot be used as an argument against charging the increased cost due to treatment to capital account. The cost of the same kind and size of untreated ties varies in different portions of the country and the Valuation Bureau did not argue that a flat price should be used for each size and kind of tie, regardless of local conditions entering into its cost. Neither can the increasing ratio of the cost of the timber to the cost of treatment have any bearing upon the principle involved. The treated tie will always cost more than the untreated, and the excess cost due to treatment will always be an appreciable amount.

More general treatment of hardwood as well as softwood ties is being strongly advocated, and it will not be many years before practically all ties will have to be treated as an economic necessity. It is this necessity which has caused carriers to attempt, through treatment, to increase the tie life from 75 to 100 per cent, regardless of how the cost was accounted for. But can they be expected to continue this practice when the accounting classification throws the expense into operating accounts and the Transportation Act limits their income? It is essential to the continued use of treated ties in annually increasing quantities, that the excess cost be properly accounted for as a betterment and that inconsistencies in the classification of investment in road and equipment be removed.

Indianapolis Uses Old Asphalt for Patches

Indianapolis this year is utilizing old sheet asphalt for making patches. The following details regarding the methods, which are not new but are being used for the first time in the Indiana capital this season, have been supplied by J. L. Elliott, city civil engineer:

"The old material when removed from the street, if still in 'live' condition, that is containing enough oil, is placed in a suitable kettle, after having been broken up, and boiled in just enough water to soften to a point where it may be used. The mixture is boiled long enough to drive off all the water, which sometimes requires only one-half to three-quarters of an hour. The remaining plastic mass is tamped back in the patch after the base and sides of the old pavement have been properly painted.

"Some of the patches made this winter have ironed out until at the present time it is hard to distinguish them from the original street. With the present methods we are employing, I have not recommended this type of work for more than small patch work but believe that with a little development it will be possible to do a great deal of the asphalt patching by this method, and thus leave the present hot asphalt plant free to do larger work."

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Developing Agricultural Engineering

Sir—The editorial in *Engineering News-Record* of May 11, entitled "Possibilities in Rural Engineering" is much appreciated by one who has been interested in the development of agricultural engineering for some 17 years. It appears to me that your observations are sound and that the engineering profession has a splendid opportunity to be of service to the industry of agriculture.

Those of us who are vitally interested in the development of this new profession would like to secure a common recognition of the term "agricultural engineering." Perhaps there is little choice between the names agricultural engineering, rural engineering and even farm engineering, but since the majority have decided that agricultural engineering is the best term we would like to have it generally recognized. Like mining engineering, agricultural engineering is the engineering identified with an industry. Anything that you may contribute in this direction will be appreciated. The work in the Bureau of Public Roads is now styled "Agricultural Engineering."

It may be of interest to you to know that we have had for some time at Iowa State College a full four-year professional course in agricultural engineering. This has the same general foundation as other engineering courses but includes enough agriculture to secure an appreciation and sympathy for agriculture and considerable specialization in agricultural engineering subjects. We have graduated to date 122 men and are proud of their records. We have found, however, that the best positions are not as independent practising engineers but rather as service engineers for some kind of an organization.

J. B. DAVIDSON,
Professor of Agricultural Engineering,
Iowa State College.

Ames, Iowa, May 16.

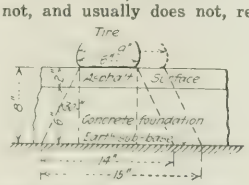
Wide Tires Not an Effective Remedy for Excessive Vehicle Loads

Sir—Readers of current literature on highways and highway transportation still meet with the assumption, stated or implied, that the effects of excessive wheel loading of power trucks may be obviated by increasing the width of tires somewhat in the same ratio as the loads. It appears to be not generally recognized that even if true with regard to the road surface—which in practice it usually is not—it is not true with reference to the foundation and is particularly erroneous with reference to the subfoundation (subgrade). Experience is teaching us that no small part of the failures of our improved roads chargeable to excessive wheel loads are due to the yielding of the subfoundation under pavements, depending largely upon its support.

The function of the pavement proper—the wearing surface and the foundation—is not only to resist the wear and tear of travel, but to transmit to and distribute the load-weight over a sufficient area of subgrade to carry it without such deformation as may deprive the overlying pavement of support, and thus cause its breaking down and failure.

The laws governing the transmission and distribution of force or weight through different materials are not yet well understood or defined. It is commonly assumed that the angle of spread of force passing through various substances is 45 deg.; but in the case of pavement surfaces and concrete foundations it may not exceed 30 deg. Assuming this as a fair average the distribution of pressure to a subgrade from a 6-in. tire over a prism or cross-section at right angles to the path of a truck wheel, through a pavement having a 2-in. bituminous wearing surface and a 6-in. concrete foundation, will be as shown in the attached sketch, over a width of 14 in. If a 9-in. tire be substituted the distribution on the subgrade will be over a width of only 17 in. Thus, while the 9-in. tire increases (theoretically) the bearing area on the surface 50 per cent, it increases that on the subgrade only 21.4 per cent. It may be claimed that the bearing area should be considered and figured as circular rather than cross-sectional, but even in that case while the substitution of the 9-in. tire would increase the surface bearing area 12.2 per cent if would increase that of the subgrade only 47 per cent.

Furthermore, increase of width of hard-rubber tires may not, and usually does not, result in an equal increase of bearing area even on the *surface* of the pavement. The circular contour of the surface of new pavements with the ordinary amount of crown causes the pressure from wide tires to be more or less concentrated along the inner edge of the wheel track. This is particularly the case where unusually high crowns are permitted in the utilization of old macadam roads or other old paved surfaces, as foundation for the new pavement. As a result the whole width of a wide tire may not be effective in distributing the weight. Tests made by me many years ago by the use of carbon paper under the wheels of a loaded truck with steel tires 4 in. wide, over comparatively new and hard sheet-asphalt pavement crowned one-sixtieth of its width, showed that the effective bearing contact between the wheel and road surface did not average a strip more than 3 in. wide. Also, it is to be considered that pavement surfaces, after a few year's wear, became more or less uneven or bumpy, so that the whole wheel load may be concentrated upon a very small area regardless of the width of tire.



RELATION BETWEEN WIDENED TIRE AND PRESSURE ON SUB-BASE

A consideration of these facts seems to disprove that apparently generally accepted proposition that widening the tires is an effective remedy for excessive loading or weak pavements.

S. WHINERY,
Civil Engineer.

New York City, May 3.

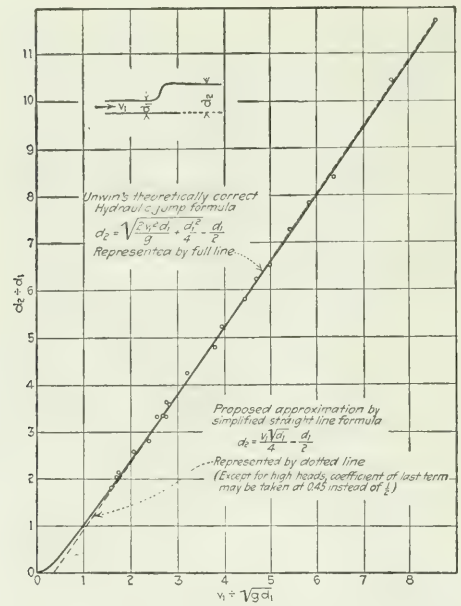
Early Studies of the Hydraulic Jump

Sir—I read with a great deal of interest Mr. Ewald's discussion, in your issue of May 4, p. 748, of the priority of his first experiments on the absorption of energy in the jump. I had occasion to review his 1914 report in the office of John R. Freeman.

Such studies were by no means new to Mr. Freeman's office at that time. The phenomenon first aroused his interest during the construction of the Wachusett Dam, twenty-two years ago, and the principle of its absorption of energy was frequently used thereafter, for example, in studies for the Mississippi River Power Co. at Keokuk and in the design of the high spillway dam at Holter, Mont., in 1910.

There are recorded a number of early experiments to determine the height of the jump but most of them are confined to relatively small heights and do not cover a wide enough range. For example they do not include such a condition as would exist at the toe of a high spillway. Two notable exceptions, both in 1914, and undoubtedly there are others, are those of Prof. A. H. Gibson of Dundee, Scotland, and those reported by Mr. Ewald.

The two experiments were of a different nature, however. Those of Professor Gibson were made in a smooth rectangular channel with the idea of a careful theoretical analysis of the general phenomenon. His results are plotted on the



FORMULAS FOR THE HYDRAULIC JUMP PLOTTED

accompanying chart and show remarkable agreement with the jump formula over a wide range.

Mr. Ewald's tests were of a much more practical nature with the definite purpose of studying conditions below a model of the high arched spillway of the proposed Cheoah Dam. As such they were very valuable and deserve much credit. It is unfortunate that there are not more experiments of this sort. However, they are not so valuable in helping to determine the correct formula for the jump.

The formula given in Mr. Ewald's letter, which, after correcting an obvious typographical error, is

$$d_2 = 2\sqrt{\frac{d_1 V_1^2}{2g}}$$

is known to be incorrect. The errors in its deduction were first pointed out in my paper on the subject before the American Society of Civil Engineers in 1915. Several analyses of the absorption of energy in the jump have been made, by Messrs. R. D. Johnson, B. F. Groat and others, all agreeing that the original Unwin Formula, found in Encyclopedia Brittanica, is correct.

I have plotted this formula on the accompanying chart, using the co-ordinates

$$\frac{d_2}{d_1} \text{ and } \frac{V_1}{\sqrt{g d_1}}$$

I have often found it very convenient to use a much simpler formula which is a close enough approximation,

$$d_2 = \frac{V_1^2}{4} \frac{d_1}{} - 0.45\, d_1$$

for low heads, as in flume and conduit discharge, and

$$d_2 = \frac{V_1^2}{4} \frac{d_1}{} - \frac{d_1}{2}$$

for a wide range of high heads.

Boston, Mass., May 12. KARL R. KENNISON.

Do Designers Use Diagrams?

Sir—In answer to your editorial inquiry of May 11th, "Do Designers Use Diagrams," the following discussion may be of interest.

Until a comparatively few years ago, the textbooks on reinforced-concrete design contained very few diagrams to assist the designer. The use of tables may have been an outgrowth of the practice in structural steel design but in any case the designers became accustomed to their use and in some cases have been slow to change their habits.

At the present time most designers use both diagrams and tables but use them to a varying degree. The lack of uniformity is in part due to the variety of stresses and other regulations in use which make the preparation of a satisfactory set of tables and diagrams for general use very difficult. Many diagrams are constructed according to local practice and would have to be altered for use in another location. Most offices have constructed such special diagrams which could not be used generally but might furnish valuable suggestions for the preparation of diagrams in other offices.

Every year there are a large number of men entering the field who are open minded and will use tables and diagrams prepared by others if they are satisfied with their simplicity and accuracy.

Tables and diagrams should be as comprehensive as possible without losing ease of application or hampering the designer in any way in the choice of sections or sizes. The completeness of the results obtained from a single diagram or table is also limited by the large number of variables encountered and the desirability of permitting a check on each operation. For example a table may well be prepared to give the total safe load on columns of desirable size and reinforcement but a table cannot well give the safe load on beams of concrete without placing undesirable limitations on the designer. In the latter case, there are too many variables to be handled in one operation and the problem is best solved by a combination of separate tables, diagrams or slide-rule operations, each of which may also be checked by inspection.

Tables, diagrams, and the slide-rule are all used for the purpose of simplifying the solution of formulas. In some cases the tables are the most appropriate and in others diagrams give more complete and satisfactory results because they often greatly condense the information and do away with the necessity of interpolating between the values of tables. For the solution of simple and easily remembered formulas the slide-rule is undoubtedly the easiest to use because the operation can be performed before the proper table or diagram can be turned to.

Of all the different operations involved in the design of a concrete structure, some are best suited to the use of tables some to diagrams and some to slide-rule while many can be equally well performed by two or more methods. It is quite natural that there should be a difference in the opinion and practice of designing engineers.

The design of concrete structures can never be standardized in the way that structural steel design has been. Both the monolithic structures of concrete and the material itself are more complex and one of the chief virtues of the material is the flexibility it allows in design. Tables and diagrams should be constructed with that in mind and although special diagrams may be made for particular jobs with certain factors fixed, their usefulness is limited.

It is the writer's opinion that all-embracing diagrams are not as suitable as separate diagrams which permit the effect of each variable to be noted and permit a check on each step as it is performed. All-embracing diagrams are more difficult to follow through and are specially dangerous in the hands of an inexperienced designer.

In the preparation of the "Concrete Designers' Manual," of which the writer is one of the authors, each operation involved in the design of a concrete structure was studied and the solutions presented either by table or by diagram whichever was judged from experience to be the most satisfactory method. Very simple operations were for the most part left to the slide-rule.

Milwaukee, Wis., May 14. CHARLES S. WHITNEY.

NEWS OF THE WEEK

New York, June 1, 1922

Propose a Study of Flood Outlets on Mississippi

Spillways Favored by Inhabitants Below Red River, Levees by Those Above

(Washington Correspondence)

Steps are being taken in Washington to insure a further investigation of the use of spillways at points a few miles below New Orleans in reducing the flood heights in the Mississippi River. Whether or not spillways can be used successfully for this purpose has been for many years a greatly controverted question in the lower Mississippi Valley.

On the Mississippi River above the Red River, there is great hostility to any proposal to supplement the levees as a means of flood control. This feeling is based primarily on the fear that it will dilute the appropriation for flood control and defer the time when all levees will be brought up to the grade and cross-section adopted by the Mississippi River Commission as standard.

The people below the Red River, however, are very determined, in view of the disasters accompanying this year's floods, to have a trial made of spillways. There is also agitation for the diversion of more water through the Atchafalaya River. The Atchafalaya offers the advantage of a route 150 miles nearer to the Gulf, but the diversion of more water would require the leveeing of the entire stream. In that connection there is more than the expense to consider because suitable foundations for large levees are not available on considerable stretches of the stream.

The Mississippi River Commission investigated spillway possibilities in 1913 and came to the conclusion that they could not be used to advantage. In summarizing its findings at that time, the commission held that such spillways as were proposed, constructed to carry 230,000 sec-ft., would be hazardous and expensive, with the disadvantages greatly out-weighing the possible benefits. Steps now are being taken looking to a further investigation of the spillway proposition independent of the Mississippi River Commission.

New Legislation Near

New flood-control legislation is to be initiated in the near future, but at the time of this writing the Senators and Representatives from the lower Mississippi Valley had not agreed finally on the exact form of the bill to be introduced. It is believed, however, that the plan of Senator McKinley, of Illinois, which provides that the federal government take the securities of the various levee boards and advance the money needed for a comprehensive scheme of flood control will be followed. The levee boards would pay four per cent interest, plus one per cent for amortization. In this way all the money for levee construction would be paid eventually by the states. Due to the heavy expenditures incurred during this high water fight, none of the levee boards is in a position at this time to float bond issues in the amount required for the work.

The states in the lower Mississippi Valley are not abandoning their contention that the federal government should bear a portion of the expense of levee construction since the flood waters come from many states. The federal government has acknowledged the national character of the flood control problem. In 1916 $45,000,000 was authorized as federal aid for the construction of levees. The money was appropriated however, in doles of $6,670,000 annually. Much larger annual installments could have been used to advantage and the failure of Congress to appropriate larger sums made possible, some contend, this year's disasters. All the crevasses and all the weak points that developed were in levees which had not been brought up to the grade and cross-section prescribed by the Mississippi River Commission. No standard levee, according to General Lansing H. Beach, the Chief of Engineers, showed the slightest weakness.

Jury in Cement Trial Disagrees After 34 Hours

Retrial as Soon as Presiding Judge Is Assigned; Reporting System Seems to Have Impressed Jury Strongly

AFTER having been out for more than 34 hours the members of the jury sitting in the criminal case against cement manufacturers of the Eastern district charged with a violation of the Sherman anti-trust law, were unable to reach a verdict and so reported late May 26 to Federal Judge Knox, of the Southern District of New York, before whom the trial was held. It is understood that the jury voted generally seven for acquittal and five for conviction. During its deliberations the jury asked for a reading of the court's instructions as to the interpretation of the forms used by the Cement Manufacturers Protective Association and its members in the statistical reporting system in use.

The case will be retired as soon as a presiding Judge can be assigned. In the meantime it is understood that the civil case against the cement makers, seeking primarily the dissolution of the Cement Manufacturers Protective Association, will proceed. The criminal case against the Mid-West manufacturers, it is also understood, will be pressed.

The trial began on April 6. Testimony and documentary evidence taken in the case covered more than 4,000 printed pages and more than 1,700 exhibits were offered in evidence by the government and the defense.

Accountants and others had been at work preparing evidence in the case many weeks before the trial opened and it is estimated that the trial has cost the government and the defense together in the neighborhood of $500,000. The indictment was returned on Aug. 8, 1921. Forty-four individuals and nineteen corporations were indicted.

Government's Case

It was the government's contention that the defendants had, first, entered into a conspiracy for the express purpose of unduly restraining interstate commerce (through fixing prices, uniform bag charges, uniform discount rates, bag-return allowances, etc.), when the Cement Manufacturers Protective Association was formed in the latter part of 1916, and, second, that that same restraint had existed at all times since the formation of the protective association.

The second count in the indictment (that charging the entering into a specific contract for the restraint of interstate trade by the control of production, fixing of prices at an unreasonable level, fixing uniform bag charges, discount rates and bin-test charges and uniform bag-return allowances) was dismissed upon argument after the government had finished its case. The defense was able to prove to the satisfaction of the court that if the formation of the Cement Manufacturers Protective Association did constitute an undue trade restraint, the specific contract was entered into in 1916, whereas the indictment was returned in 1921. The statute of limitations, therefore, outlawed the contract and the defendants were held not liable. However, the court adjudged the evidence of sufficient importance to allow the case to proceed under the terms of the first indictment, which charged that by their participation in the protective association's activities the defendants had engaged in undue trade restraint.

Twelve Points Cited

In his summing up the case before the jury Roger Shale, junior government counsel, pointed to "twelve outstanding points of evidence" the national association and its activities, the license agreements and what it sought to accomplish, the correspondence that passed among certain defendants after the dissolution of the license agreements and the formation of the Eastern Cement Association, the Eastern Association and its activities (it existed for only four months and was

Tunnel Workers Overcome by CO,

[illegible] National Ave., Milwaukee, Wis., on [illegible] men and three rescuers. Rescue was [illegible] by men wearing oxygen [illegible]

dissolved upon advice of counsel), the correspondence among some of the defendants after the dissolution of the Eastern Association and the formation of the Cement Manufacturers Protective Association, the minutes of the protective association, its system of reporting, the activities of checkers who followed up for manufacturers the amount of cement ordered by agents and dealers for specific jobs, the arbitrary freight basing points, the freight rate books, the general uniformity of price quotations and "the general secrecy of the whole thing."

Former Associations

The government was allowed to bring into evidence activities of the defendants in associations that were formed far outside of the legal limit established by the statute of limitations, merely to show what the general tendency of the defendants had been in the exchange of statistical information. Of such a class of evidence was that which had to do with the national association, correspondence that passed between that time and the formation of the license association (which had to do with the association of seven of the largest manufacturers of the Eastern district for the control of a then newly-patented process of burning limestone with powdered coal), the activities of the license association itself, correspondence previous to the organization of the Eastern Association and the activities of the Eastern Association. During most of this time there was a strong tendency toward business cohesion among the cement makers, a fact that was characterized as most sinister by the government.

In further summing up for the government Judge Fowler, senior government counsel, asserted that it was not necessary for him to prove that the defendants had actually signed an agreement to restrain commerce, but that the evidence had shown the defendants to have followed a system of exchanging statistical information that could not but lead to uniform prices. Since nearly every witness testified as to the uniformity of price, bag charges, discount rates, bin-test charges and bag return allowances, he felt the case was indisputably proven for the government.

System of Reporting

In holding to such a theory he stressed the reporting system used by the protective association. There were twenty-odd reports in use which can be described briefly as follows: (1) Card reporting contract, showing its number, date, purchaser's address, description of work, location, contractor, number of barrels, the price and the delivery point; (2) card showing changes in contracts already reported giving contract number and delivery point; (3) report of all sales, cancellations and modifications of contracts for each day showing contract number, purchaser's name and address, delivery point, description of the work, brand of cement ordered, date contract was closed, expiration date, number of barrels sold, the price and a letter indicating the class of work (this card was circulated by the association among its members); (4) a summary, accompanying the last-named form; (5) monthly summary of contracts let by each mill; (5) report showing the status at the particular time of contracts, cancellations, etc., (6) quarterly report giving a complete description of every live contract at the time the report was made; (7) form showing the percentage of committments of each company as compared with the previous month; (8) form showing total committments in each state, issued monthly; (9) report for any month compared with the corresponding month of the previous year; (10) report of each company on the total production for the month previous to the time the report was made, the percentage of clinker, etc.; (11) report of members to the association showing shipments for the preceding 15 days of the current month compared with the corresponding 15 days of the previous year; (12) the same information but compiled for all mills by the association; (13) analysis of contracts showing shipments on various classes of construction by states, issued quarterly; (14) form used by any member desiring a contract investigated; (15) form containing practically the same inquiries as on the foregoing but to be used by inspectors with reference to sidewalk and curb paving; (16) form notifying the member making the inquiry and any others interested; (17) monthly report from association showing total bags; (18) form provided by the association for reporting delinquent accounts; (19) summary of total passed-due indebtedness of each member; and (20) report by each member of accounts placed with attorneys.

Uniformity in Practices

Besides the elaborate system of reporting by which Judge Fowler accused the defendants of competing by telling their competitors "everything about their business" he said that the other parts of the system that must have meant conspiracy were certain uniform practices, the method of checking up on specific job contracts, and the meetings of the association.

As to uniformity of practice he pointed to the fact that in the eastern district there are three main points upon which mill prices of cement are based: the Lehigh, Universal and Hudson bases. Uniformity of price he said had been testified to many times, and particularly by the testimony of a Department of Justice accountant who said he had examined 50,000 contracts, selecting 928 at random. From these actual contract prices he had subtracted freight, bag charges and other known uniform charges, finding that the mill prices were uniform as between mills in the same district over a considerable period of time. Uniformity in practice also was evident from the testimony in bag charges, bin-test charges, discount rates, dealer differentials, etc. The use of freight rate books, wherein the rate from basing points to practically every rail point within the state for which the books were compiled, also evidenced uniformity of practice was the charge. Checking up on specific job contracts Judge Fowler asserted to be the best method of keeping track of every bag of cement, thereby controlling production.

Col. H. L. Stimson, chief defense counsel, in summing up his case, asserted that during the whole trial no clear statement as to what the indictment charged had been made by the government. He said that to prove the charge that the defendants had fixed excessive prices by agreement and that they had sold in quantities fixed by agreement, specific charges in the indictment, they would have had to follow one of three plans: (1) Pro-rate the production among the defendant mills from year to year according to the total production; (2) divide up the territory so there would be no competition as between mills in the same territory; or (3) pool earnings. No direct evidence had been introduced to substantiate any of these charges, was his contention.

The Cement Manufacturers Protective Association, he contended, was formed for the purpose of exchanging certain statistical and credit information and all of its deliberations had been set down in minutes which had been available to government inspection at all times. This point he emphasized—that the association had been investigated to a certain extent and complimented by the Federal Trade Commission for its activities in the establishment of certain standards of trade-association activities.

As to the uniformity of price that was testified to the defense maintained that competition often was so keen that a price uniformity was inevitable. Such a standardized product was susceptible of the same price uniformity as any other standard product, regulated from a central source as to quality of materials, standard tests, etc. As a prime example of the keen competition that had existed among the defendants was that in 1914 when Lehigh and Atlas fought for months in a price war. Cement started at 90 cents in December, 1914, and the price as cut by Lehigh in July, 1915, to 50 cents, the Atlas company refusing to go below 65 cents on the ground that that price was below manufacturing costs.

Basis of Defense Case

The defense based its case almost entirely on the theory that uniformity in price and in trade practices did not at all indicate the existence of a conspiracy. It held up as a principle of economics that the keener the competition the more uniform the price and the methods of disposing of the product. Competition had been so keen, it contended, that discounts had risen and that bin-test charges had been entirely eliminated.

As to the general charge that cement prices had been excessively high and that the manufacturers had profited liberally thereby the defense put in evidence figures compiled by the U. S. Bureau of Labor Statistics showing that of several score commodities cement had risen least of all, save beef cattle and crude rubber, and that during the time charged in the indictment the net return for most mills on invested capital as well as on plant value was under five per cent, whereas a return double that was considered more or less economically insufficient.

The defense case was enhanced by charts indicating production, shipments, stocks, etc, for each of the corporate defendants covering the past eight years and by other charts showing net earnings on invested capital and plant valuations. The defense defended the practice of basing prices on three or four points simply as one

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First Step Toward a St. Lawrence Canal Treaty

The United States government has formally approached the Canadian government in the matter of negotiating a treaty looking to the deepening of the waterways to enable ocean-going ships to reach the Great Lakes.

The note of the Secretary of State to the British Ambassador called attention to the fact that on Jan. 21, 1920, the governments of the United States and Canada referred to the International Joint Commission for investigation and report, under the terms of Article IX of the treaty of Jan. 11, 1909, the questions relating to the improvement of the St. Lawrence River between Lake Ontario and Montreal, both for navigation and the development of waterpower. It was pointed out that the Joint Commission had reported on Dec. 19, 1921.

Secretary Hughes, in his note, stated that "he is authorized to state that the President favors the negotiation of a treaty on the basis of this report of the International Joint Commission, or such modifications as may be agreed upon." He asked to be informed "whether the appropriate British and Canadian authorities are disposed to undertake the negotiation of a treaty."

In answer to an inquiry in the Canadian Parliament Premier King has announced that Canada is not, at the present time, prepared to enter into any treaty.

Cincinnati Double-Track Railway Bridge Opened to Traffic

The new bridge of the Southern Ry. across the Ohio River at Cincinnati, a double-track structure replacing the widely known old single-track bridge, was opened to traffic on May 1. The old structure, with trusses of Whipple type, designed by Bouscaren, was completed in 1880. It had three principal river spans, of which the channel span was 520 ft. long. In place of these the new structure has a continuous structure of three spans, resting on the old piers, slightly widened to take the double-track superstructure. The new steelwork was built around the old. The swing span of the old structure on the south bank is replaced in the new bridge by a vertical lift span.

Foundation work began in February, 1921, and steel erection was carried on during the past fall and winter, being completed in February. Ralph Modjeski was engineer for the new bridge, and the American Bridge Co. fabricated and erected the superstructure. The Foundation Co. reconstructed the piers for the new work.

Board Opposes Newark Bay Bridge

Permission to build a four-track railroad bridge to replace an existing trestle over Newark Bay from Elizabethport to Bayonne has been denied the Central Railroad of New Jersey by the State Board of Commerce and Navigation of that state.

The board objects to the maintenance of a bridge at this place on the ground that it will hamper the use of the waterway and the development of the adjoining port and industrial facilities.

The Engineer in Public Life

COL. EDWARD ORTON, JR.

As president of the Chamber of Commerce of Columbus, Ohio, Col. Edward Orton, Jr., an engineer graduate, class of 1884, of Ohio State University, is a leading spirit for civic advancement in his community. He was born in 1863 and after completing his collegiate work he became a surveyor in coal mines and later entered the metallurgical field, subsequently becoming draftsman, chemist, and superintendent of blast furnaces in Ohio and Virginia. One of his chief activities has been in the field of the manufacture of brick, and he was one of the organizers, in 1898, of the American Ceramic Society. Col. Orton was state geologist of Ohio for eight years and for fourteen years served as dean of the College of Engineering, Ohio State University. During the war he was a colonel in the Motor Transport Corps and was awarded the Distinguished Service Medal. Since the war he has retired from educational work and has devoted his spare time to various forms of public service in Columbus.



Lumber Association Starts Education of Retailer

A correspondence school course has been started by the National Lumber Manufacturers' Association to educate the retailer in the technical features of lumber and its uses. Fifteen letters are to be sent out. Some of the subjects are as follows: Structure of timber and grading rules, projections and plan reading, figuring stresses and sizes, specifications, fire-resistive construction, wood preservation and heavy timber construction. At the end of each letter is a series of test questions, answers to which will be corrected and returned with the succeeding lesson. The end sought is to equip the retailer to meet the competition of other materials on the technical basis.

Council of Federation Holds Meeting at Pittsburgh

The Executive Board of the American Engineering Council of the Federated American Engineering Societies met at Pittsburgh May 26 and 27. The council adopted the report of the committee on organization of engineers. Other matters discussed were employment conditions, federal water power, government reorganization, reforestation, jurisdictional awards on labor, patent legislation, aerial research, waste in agriculture and foreign relations.

It was announced that 20 societies are now supporting the federation, with individual members numbering about 60,000.

Highway Traffic Measures Approved at Convention

Reports Outline Plans for Uniform Marking and Increased Safety Especially at Curves

Approval was given by the National Highway Traffic Association at its annual meeting in New York, May 12, to measures, embodied in committee reports, looking to greater uniformity in marking highways and to increased safety, particularly at curves. The majority of the Committee on Regulation of Motor Trucks renewed its recommendation of a 28,000-lb. allowable gross weight limit, in which the highway engineer members refused to concur. Prof. Arthur H. Blanchard, of the University of Michigan, was re-elected president of the association, and Elmer Thompson was re-elected secretary.

Uniform Signs

The committee report on uniform highway signs, presented by Mr. Thompson, advocated the placing of signs from 5 to 8 ft. above the road surface and the use of block letters at least 4 in. high. Signs should carry not only the name of the nearest town, but of the nearest important city. In New England experiments are being made with the use of luminous paint on highway signs to aid night traffic. The committee favors numerals for marking trunk line routes, a practice which has been approved throughout the New England States and which, the committee hopes, may be extended, by divisions, westward throughout the country.

In describing the New England marking work, Mr. Reed of the Automobile Club of America, explained that odd numbers are assigned to east and west routes and even numbers to north and south routes. The roads are marked by numbers in black on a yellow background and are in the form of painted squares on telegraph poles. Mr. Reed opposes the plan of color bands for highway marking. By resolution the National Highway Traffic Association approved the numeral scheme of marking as agreed upon in the New England states.

A report by Hirschel C. Smith, of the University of Michigan, chairman of the Committee on Traffic Capacity and Width of Highways, presented the following conclusions: Any two-lane roadway carrying intensive traffic should have a width of 20 ft. and 5-ft. shoulders for carrying standing vehicles during temporary delays. A two-lane roadway should be increased to a four-lane roadway when the traffic is reduced to the speed of the slowest vehicles if the economic loss of time will justify the expense. The building of three-lane roadways should be discouraged on the ground of danger to the traveling public.

Safety at Curves

Chief interest at the meeting centered in H. Eltinge Breed's report for the Committee on Highway Curves. Approval was given to the recommendations as follows: (1) Banking on curves of more than 3 deg. ranging from nothing for a 3 deg. curve to 1 in. per foot of width for curves of 20 deg. or sharper; (2) on curves of more than

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Lumber Industry to Set Up Grade Standards

Producers and Users Favor National Standards and Guarantees to Protect Consumers

Resolutions favoring standardization of sizes and grades of lumber and nation-wide inspection and guarantees as to quality and quantity, together with concrete recommendations looking to these ends were adopted at a conference of lumber manufacturers and representatives of the principal lumber-using industries held in Washington during the last week at the instance of Secretary Hoover. The conference included producing and distributing lumbermen, representatives of the American Railway Association, American Electric Railway Association, wood-manufacturing industries, architects, and building engineers.

The final recommendation was "that all organizations representing producers, distributors and consumers of lumber be invited to appoint representatives to meet in a general conference on the call of the National Lumber Manufacturers' Association, with the assistance of the Departments of Commerce and Agriculture, for the purpose of arranging for holding meetings in as many sections of the United States as may be deemed necessary in order to arrive at definite recommendations concerning three subjects here under discussion, such recommendations to be placed before another general conference of all interests involved after the series of sectional conferences shall have been concluded." It is expected that the committee contemplated in this decision may be able to hold its first meeting within thirty days, and that a final conference may be held in the early fall to create the definite organization.

COMMITTEE REPORTS

The several committee reports approved by the conference, although representing the personal views of the committee members only, are considered to be in harmony with the views of the industry and it is expected that they will be ratified by the regional associations which compose the national association. The committee on names of grades recommended that the grading of all lumber be divided into three great subdivisions: A, representing the best qualities; B, representing the intermediate qualities; and C, representing the common qualities. The committee recommended that the National Lumber Manufacturers Association set up a competent committee with efficient engineering service to equalize grades in all woods.

The committee on standard sizes reported on the various items and sizes of stock on which agreement was reached, consideration having been given only such items as are manufactured in common by the various associations in which the finished sizes differ. The committee was not able to agree on the question of dimensions of 1-in. finish and common boards, S1 or 2 or 4 sides.

The committee on guarantee of quantity and quality held that the formulation of rules for grading and inspection is a function of the manufacturer and that grades should be made so as to allocate the available supply of timber to the various consuming industries in proportion to their needs. It recommended that the lumber industry as a whole provide for the manufacturers such inspection service and supervision as will guarantee quality to buyers. To accomplish this it urged that all grading be done by properly supervised inspectors, that in the case of complaint official association re-inspection be available, that buyers be furnished, at their own expense, certificates of inspection with each shipment, that a card be placed in each car specifying grade and content and that if found practicable an association, grade-mark be placed on a sufficient portion of each shipment to protect consumers, this mark to be such as to identify the producing mill.

Among those who participated in the conferences were Arthur T. Upson of the U. S. Forest Service; Albert T. Harris, of the American Institute of Architects; C. L. Warrick, president, and Herman von Schrenk, American Society for Testing Materials; Henry H. Snelling, American Society of Mechanical Engineers; W. H. Ham, American Society of Building Engineers; and R. B. Rayner, of the American Wholesale Lumber Association.

Electrical Engineers Elect

At the annual business meeting of the American Institute of Electrical Engineers held in New York City, May 19, F. B. Jewett, of New York, was elected president. The other officers elected were those named in *Engineering News-Record*, April 27, p. 700, as having been nominated to the respective positions which they now occupy.

Invitation to First Meeting of Construction Council

Lacking facilities at present for direct communication with the thousands of important men in the construction industry, the temporary directing committee of the American Construction Council begs leave through the columns of the engineering, architectural and construction press, to extend a personal invitation to each member of the industry to attend the organizing meeting in Washington, D. C., June 19 and 20.

The step contemplated, that of bringing together for co-operation in behalf of the industry and of the public all the elements of construction activity—engineers, architects, labor, contractors, manufacturers and dealers, and financial interests—is epochal in American industry. It deserves, and promises to have, the full support of the entire industry. A full representation at the organizing meeting will be the best testimony to the country of the desire for solidarity of construction interests.

Full details of the plan are set forth in a comprehensive pamphlet, procurable from the temporary office, 1053 Munsey Building, Washington. The meeting will be held in the Washington Hotel. Mr. Hoover will preside.

Temporary Directing Committee,
American Construction Council,
R. C. Marshall, Jr.

Pipe Break Floods Broadway

Flowing at a rate of 70,000,000 gal. per day water from a 36-in. cast-iron main of New York City's distribution system, which broke on the afternoon of May 29 at Broadway and 89th St., flooded streets and heaved up asphalt pavement at a number of nearby points. The main was located about 5 ft. below the street surface underneath a bank of ducts, the tops of which extended up close to the concrete base of the pavement. Department of Water Supply officials believe that the break may have been caused by the weight of heavy motor trucks transmitted to the water main through the overlying ducts.

Following a sudden drop in pressure at the 98th St. pumping station valves were closed at 92nd and 77th Streets. Emergency repair gangs were rushed to the scene and under the direction of William W. Brush, deputy chief engineer of the Water Department, the pipe was uncovered, disclosing a break in its side measuring about 60 x 30 in. The pipe was carrying about 45 lb. pressure and was part of the city's intermediate distribution service carrying both Catskill and Croton water. Repairs involved the taking out of the broken section and a half length of adjoining pipe and substituting new sections. The main was restored to service May 31.

Retain Supervising Engineer for Bridge on Salary

The New Jersey Highway Commission has disposed of a sharp public controversy over proper engineering charges in connection with the construction of a new highway bridge over Raritan River at Perth Amboy by retaining an engineer on salary "to supervise the design and construction." Clarence W. Hudson, consulting engineer, was engaged, the engagement to continue until completion of the structure. He will receive $18,000 per year, this sum not covering office and other expenses, which will be paid by the commission.

The original proposal before the commission was for an engineer to be retained at a fee of 6 per cent of the cost, the latter being estimated at $4,500,000. The crossing will include a draw span and involves foundations in soft ground about 100 to 125 ft. to rock.

New York Transit Company Must Run More Trains

Following up its announced purpose to improve the service rendered by existing rapid transit facilities in New York, the Transit Commission has issued two service orders to the Interborough Rapid Transit Co. One of these provides for an increase, effective May 31, of 246 trains per 24-hour period, and for lengthening of trains sufficient to increase by 2,014 the number of cars in service each day, together with a further increase, effective Sept. 18, of 114 trains per day. These increases will raise the total number of trains in operation daily from 2,773 to 3,133. It is estimated that the May schedule alone will effect an immediate increase of 20,935 car miles or 1,046,750 car seat miles per day. The second order directs the purchase of 350 new steel cars.

The Interborough Co. has accepted the orders and will abide by them.

Jury in Cement Trial Disagrees

(*Continued from p. 926*)

trade-practice expression of the keen competition that existed.

JUDGE'S CHARGE TO JURY

In charging the jury Judge Knox first reviewed the general propositions of the law governing the case, then read and explained the Sherman law indicating its specific application. As to the detailed consideration of the evidence he charged the jury that attendance at meetings of the protective association in itself was not incriminating; that participation alone in its activities, if it were a conspiracy, was a liability; that membership in either the Portland Cement Association or the Cement Manufacturers Protective Association did not constitute proof of knowledge that a conspiracy existed, if it actually did exist; that there were certain associations that did lawfully exist merely as clearing-houses for statistical and credit information; that the freight rate books, even with errors found in them, were lawful except as they may have been used as a means to price control; that uniformity of price might result from other causes than the existence of an express agreement, though such uniformity of price should be taken into account in weighing the whole evidence; that the good faith of the defendants in securing the advice of government officers in connection with their activities did not absolve them from blame if they actually did what they were charged with; and that shipments made by one mill for another had, on its face, no sinister meaning.

Judge Knox further charged the jury that the license agreement could not, in itself, convict the defendants, no matter how reprehensible their activities under that association might have been. He also said that the defense did not deny that there had been some trade restraint, but vigorously denied the existence of unreasonable restraint, which is made unlawful by the Sherman act.

As to the manner in which agreements to control prices are initiated Judge Knox said that conspirators rarely make express agreements. They are usually implied by some word, some act or some expression whereby the parties to the agreement understand what the terms of the conspiracy are to be. Even a meeting of minds under such circumstances constitutes a basis of guilt, he said.

In discussing trade practices Judge Knox asserted that some of them were innocuous. Discount rates, bin-test charges, charges for bags and bag-return allowances, and even a uniform price, might be harmless, he said, but if there was sufficient evidence to establish beyond any reasonable doubt an agreement was made to have a fixed price there was then constituted an unreasonable trade restraint.

In judging of the evidence he instructed the jury when trying to settle whether a conspiracy actually existed to determine, from the evidence, if the price had been excessive, if the production had been such that the price had been unreasonably controlled. "Individuals are free agents," he said, "and they can close their mills, ask any price they choose. All of the defendants might do the same lawfully, unless that simultaneous action is agreed to or done in concert."

Piepmeier Made State Highway Engineer of Missouri

B. H. Piepmeier, who has been appointed chief engineer of the Missouri State Highway Department to succeed Alexander Graham, resigned, is a native of Missouri but has been with the State Highway Department of Illinois for the past 14 years. He was born in Appleton City, Mo., in 1885, and was graduated from the engineering department of the University of Missouri in 1905.



For his first two years with the Illinois highway department he was in direct charge of road and bridge construction and in the next two years had supervision over the preparation of all road and bridge plans in the office. For two years he was district engineer for the southern half of Illinois and then held the position of road engineer for the department for two years, having general supervision over all road construction in the state. He was later made engineer of maintenance, in which position he organized a maintenance department and directed all details of the maintenance work.

During the past four years Mr. Piepmeier has been engineer of construction, with direct charge of all road and bridge construction done by the state. Since 1913, when he was made road engineer, the department has completed more than 1,400 miles of improved roads, besides a large number of bridges and considerable earthwork preparatory to future paving. The total money expended by Illinois for road building purposes since 1913 exceeds $30,000,000.

Mr. Piepmeier assumes his new position on June 1.

Dr. Elliott Is New Head of Purdue

Dr. Edward C. Elliott, chancellor of the University of Montana at Helena has been named president of Purdue University, Lafayette, Ind. He takes the place of Dr. W. E. Stone, who was killed last summer in a fall while on a mountain climbing trip in the Canadian Rockies. Henry W. Marshall has been acting as president of the university through his capacity as a member of the board of directors. Joseph E. Oliver, of South Bend, headed the committee of the trustees that obtained information concerning various educators and which has been working since shortly after the death of Dr. Stone. After months of inquiry they decided on Dr. Elliott. He was in a list of four [illegible]

Shipping Board Sells Lorain Housing Property

[illegible] Henry, director of sales, U. S. Shipping Board Emergency Fleet Corp. [illegible] the sale subject to the approval of the Shipping Board of the Fleet Corp.'s housing property at Lorain, Ohio. The property for which a total of $543,250 has been realized, consists of approximately 43 acres, 2-3 dwellings, 2 store and apartment buildings. The houses are of frame construction with slate roofs. Total original cost was $1,[illegible]

Lake Austin Dam Franchise Sold

All title, rights and interests in the Lake Austin dam franchise at Austin, Texas, were sold to a representative of the bondholders of the City Water Power Co. of Hartford, Conn., at auction held under a federal court order foreclosing against the franchise and property in every way connected with the dam. After the sale announcement was made that a new organization would be formed to complete the dam and deliver it to the city of Austin, since the result of the sale is that the title to the franchise and properties is cleared and goes into the hands of the bondholders of the company, which became bankrupt before the completion of the dam. This clears the way to the ultimate completion of the structure as specified in the contract between William D. Johnson, original contractor, and his assignee, the City Water Power Co.

Los Angeles Pays $12,044,370 for Electric Wire System

Negotiations for the purchase by the City of Los Angeles of that part of the electric light and power distribution system of the Southern California Edison Co. within the city limits were consummated May 16 and the city paid the company $12,044,370 for the property. The 120,000 consumers of the company will be supplied by the municipal Bureau of Power and Light, utilizing (1) current generated on the Los Angeles aqueduct and (2) current bought from the company. The city agrees not to sell current (1) outside of its present and future limits; (2) or the City of Pasadena; or (3) Inyo County. The company agrees not to sell domestic and industrial current within the territory named.

Landis Award Committee to Continue for Two Years

Terrorism and killing of police in Chicago over the labor situation has made the large committee to enforce the Landis Award decide to back the executive group's policy of non-recognition of the so-called outlaw unions to the end. For this purpose the committee has organized for a two-year campaign. The important significance of the decision lies in the fact that the jurisdiction of the Landis award expires in June, 1923, and there will then be a competent body to represent the public's interest.

At a meeting of the committee last week T. E. Donnelley, chairman, stated that the building industry was now free from graft, that the leadership of the Chicago Building Trades Council a year ago was worth $100,000 annually but now it is hard to find a man to take the job. Strikes have about ended, only three or four occurring this year and when the men quit the committee replaced them. The crime angle has prolonged the fight much longer than was at first expected and Mr. Donnelley pointed out that it would be fatal to stop activities prematurely. Numerous offers of concessions from the two outlaw unions placed on the open-shop list have been rejected.

Building permits taken out are setting a new record. The volume for April was $17,070,500 compared with about $3,000,000 for April, 1921. For the first 17 days in May it was $14,571,800.

Local Court Upholds Error Claim in Columbus Dam Bid

The Court of Common Pleas of Franklin County, Ohio, has ordered returned to the Columbus Construction Co. its certified check for $100,000 submitted with its bid for the construction of the O'Shaughnessy dam for the water-works of Columbus, Ohio. The company, which was the lowest of 12 bidders for this work by $114,000 on April 20 declined to sign the contract which was awarded to it for the work, alleging that it had made errors totalling $73,500 in its bid computations (see *Engineering News-Record*, May 18, p. 845).

Traffic Measures Approved

(*Concluded from p. 927*)

4 deg. the pavement on the inside should be widened ½ ft. for each degree increase in curvature; (3) center-line marking on curves; (4) posting danger signs at a distance of 500 ft. from each end of curve; (5) legislation making it a misdemeanor for a motor vehicle to pass another going in the same direction on a curve, either horizontal or vertical, where unobstructed line of vision is less than 500 ft.; (6) minimum radius of curves to be 300 ft.; (7) earth slopes to be carried out at a 4-to-1 slope, otherwise a guide rail to be placed on inner edge of curve; (8) gravel or crushed stone shoulders 2 ft. wide and 4 in. deep on each side of the road, with application of hot tar or asphalt, if possible; (9) limitation of signs to those posted by official authority;—(10) inauguration by every state highway department of a definite plan with annual appropriations, for grade crossing elimination.

Truck Weights

The Committee on Regulation of Motor Trucks agreed upon all sections of its report, presented by George H. Pride, chairman, except the one making 28,000 lb. the allowable gross weight limit. The report recommended allowable limits of 96 in. for width, 12 ft. 6 in. for height, 30 ft. for length of one vehicle, 800 lb. pressure per inch width of tire and 22,000 lb. for load on one axle. Commissioner Synan, of the Massachusetts State Highway Department, took exception to the 28,000-lb. gross weight and said that Massachusetts was now engaged in a campaign to increase motor vehicle taxes and to reduce truck weights to 10 tons gross. Mr. Pride, arguing for the 28,000-lb. limit, pointed out that whereas highway construction and maintenance costs amount to millions annually, the operating costs of motor vehicle traffic run into the billions. Real economy, he believes, justifies the expenditure of considerable sums on highway improvement to carry trucks of great weight if transport costs can be thereby lowered.

Following the annual dinner of the association, addresses were made by Col. Arthur Woods, president of the Automobile Club of America; Prof. Blanchard on "The Railroad as an Operator of Highway Transport"; by F. W. Fenn of the National Automobile Chamber of Commerce, on "Highway Transport Franchises," and by Tom Snyder of Indianapolis, on "Highway Transport Clearing Houses"; and by Prof. W. K. Hatt on "Research."

Conservancy Act for Flood Control at Pueblo, Colo.

To provide adequate protection against such destructive floods as occurred in 1921 the city of Pueblo, Colo., needed the legal right to organize a flood-control district which could issue bonds for the necessary work. To meet this emergency a conservancy act has been passed by a special session of the state legislature. This law is modeled on that of the Miami Conservancy District in Ohio and as consulting engineer for flood-control work the city has retained Arthur E. Morgan, who planned and carried out the notable work of the Miami district.

The new law provides for the organization of conservancy districts for preventing floods, regulating stream channels, regulating the flow of streams, diverting and controlling water courses and protecting public and private property from inundation. Such a district may build reservoirs, canals, levees and other works, reclaim or fill lowlands and lands subject to overflow, and remove, regulate and prescribe the location of improvements upon land. It may also maintain, operate and repair any of the construction works.

A petition for a district must be signed by 200 landowners or a majority of the owners within the territory affected. It may be signed by the governing body of any public corporation, such as a municipality, and when so signed is binding on the owners of the land as they appear upon the tax rolls. Protest petitions may be signed by a majority of landowners and filed with the county clerk. An organized district becomes a political subdivision of the state. The district court has jurisdiction over a conservancy district and appoints three directors who are empowered to engage engineers. No power is given to operate irrigation systems or administer water rights. Three freeholders constitute a board of appraisers for the assessment of all benefits and damages, and for recommendations as to lands included. This board is subject to the approval of the court.

Three funds are provided for financing the undertaking: (1) the preliminary fund not to exceed one mill on the dollar from proceeds from a levelrate assessment; (2) a construction fund based on benefits as appraised; (3) a maintenance fund which is a special assessment levied annually and must not exceed 1 per cent of the appraised benefits of any one year.

Conservancy bonds may be issued in an amount not to exceed 90 per cent of the total construction fund assessment and money may be borrowed at not to exceed 7 per cent to facilitate the work.

Colorado Passes Moffat Tunnel and Pueblo Flood Bills

A law providing for the construction of the 6-mile Moffat tunnel on the Denver & Salt Lake Ry. by an assessment district to be organized on the same basis as drainage and irrigation districts was passed by the Colorado legislature on April 28. The house vote was 48 to 9 and the senate vote 28 to 3. Since the low-grade tunnel will be a great benefit to local commerce and industry, but the railway company cannot finance the project it has been decided to carry it out as a public improvement. A former plan to issue state bonds for the project was defeated by public vote (see *Engineering News-Record*, April 18 and Dec. 30, 1920, pp. 716 and 1,302). At the same session the legislature passed the bill for flood prevention works for the protection of the city of Pueblo, Col.

Engineering Societies

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Annual Convention, Salt Lake City, Utah, June 5-7.

NATIONAL CONFERENCE ON CITY PLANNING, Boston, Mass.; Annual Meeting, Springfield, Mass., June 5-7.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Annual Convention, Portsmouth, N. H., June 21-22.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, University of Pittsburgh; Annual Convention, University of Illinois, June 20-23.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual Meeting, Atlantic City, N. J., June 26-30.

The Engineering Society of Akron, Ohio, had as its principal speaker at the May meeting Prof. Albert E. White of the University of Michigan, and his subject was "Responsibility of the Engineer, Our Colleges and the State of Research." Prof. White is director of the department of engineering research of the University of Michigan.

Personal Notes

John J. Crimmin has resigned as general superintendent of the Chas. R. Hedden Co., Newark, N. J., and has accepted a similar position with the Kenneth Mackey & Co., Inc., general contractors of Yonkers, N. Y.

Albert O. True, until recently special assistant engineer with the Pennsylvania State Department of Health, has been retained by the Proximity Manufacturing Co., Greensboro, N. C., as sanitary engineer.

William E. Stanley, for the past twenty months field engineer for Pearse, Greeley & Hansen, Chicago, in carge of the construction of the impounding dam for the additional water supply of Decatur, Ill., has been made assistant engineer in the Chicago office of that consulting hydraulic and sanitary engineering firm.

Dr. Howard M. Raymond, for twenty-seven years dean of engineering of Armour Institute of Technology, has been appointed president of the Institute, succeeding the late Dr. Frank W. Gunsaulus, who died last year. Dr. Raymond has been serving as acting president since the death of Dr. Gun-

saulus. Dr. Raymond is a graduate of the University of Michigan.

EARL G. MARSH, who for the past seven years has been engaged in making surveys of proposed park extensions in Washington, D. C., has been appointed by the Secretary of War as superintendent of public parks of the District of Columbia.

J. C. NAGLE, dean of the engineering department of A. & M. College, Texas, has tendered his resignation to become effective September 1. Thereafter he will devote his time to consulting practice as a member of the Nagle, Witt, Rollins Engineering Co. During the summer, however, Dean Nagle will tour Europe where he will make a thorough study of engineering problems.

THOMAS TAYLOR, for the past ten years with the Department of Works, Toronto, Canada, principally as designing and construction engineer, was recently appointed engineer of railways and bridges of the Department of Works. Mr. Taylor was designer of the Bloor Street viaduct in Toronto.

WILLIAM HUGH COVERDALE, member of the firm of Coverdale & Colpitts, consulting engineers, New York City, has been appointed president of the Canada Steamship Lines, Ltd.

RALPH W. WYMER has been appointed sewage-disposal plant engineer at Barberton, Ohio. He succeeds E. B. PATTERSON who resigned recently.

JOHN D. WILLIAMS, who has been connected with the Indiana state government continuously since 1906, and whose most recent position has been chief clerk of the state highway department, has been named director of the highway department. Mr. Williams succeeds LAWRENCE LYONS, new Republican state chairman, whose resignation was handed to the commission May 16.

R. T. BROWN, chief field engineer, South Carolina Highway Department, has resigned and has entered the contracting business with J. T. PLOTT of Greensboro, N. C. Mr. Brown joined the highway department in 1917 and has successively held the positions of assistant highway engineer, chief of surveys and plans, and chief field engineer.

WILLIAM H. LEWIS has resigned as manager of the sluicing department Puget Sound Bridge and Dredging Co., Seattle, Wash., and has associated himself with W. C. MORSE, as hydraulic engineer and contractor, with offices in the Thompson Building, Seattle. Mr. Lewis was president of the Lewis-Wiley Co. which did the regrading work in Seattle and Portland. With Mr. Morse he originated the Lewis-Morse shearboard method of controlling material deposited by hydraulic sluicing, which was used in building Westover Terraces in Portland, the Ochoco Dam at Prineville, Ore., and the stadium for the University of Washington. The new firm will give special attention to sluicing work, to the application of wet methods in the transportation of earth and to the building of high and stable embankments.

W. F. JORDAN, principal assistant engineer of the New York Central R.R. Co., has been transferred from the Grand Central Terminal offices, New York City, to Albany. Among his other new duties Mr. Jordan will have supervision over the Hudson River Connecting R.R.

BUSINESS NOTES

CHICAGO ENGINEERING ASSOCIATES is the new name of an association of existing organizations to render engineering and construction service. James N. Hatch is chief engineer, and Edward N. Lake is general manager. The offices are in Chicago.

THE GUARANTEE CONSTRUCTION CO., New York City, announces the retirement of its former vice-president, W. G. Hudson. No other change has been made in the organization of the company.

THE MISSISSIPPI VALLEY STRUCTURAL STEEL CO. announces its formation by the merger of the Decatur Bridge Co., Decatur, Ill., and the Christopher & Simpson Iron Works Co., St. Louis, Mo. These two plants have a combined capacity of 40,000 tons annually. W. M. Wood, Decatur, Ill., is president of the company and C. R. Dick, secretary.

THE ASQUAM CONSTRUCTION CO., Toledo, Ohio, has been recently organized to engage in general construction and engineering. Incorporators are Theodore Tenscher, Leet J. Deibel, Manuel F. Felt, William Felt Tenscher and Charles W. Davis.

OBITUARY

WILLIAM G. CHARLESON, a contractor of Ottawa, Canada, died in Toronto May 18.

ARTHUR LAGRON, who was for a number of years the city engineer of Freeport, Ill., died recently in Peoria, Ill., aged 85 years. He was a native of France.

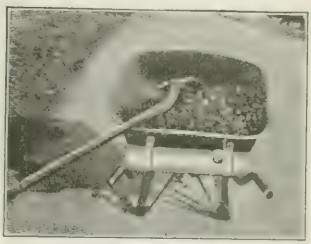
HENRY A. WATTERSON, contractor of Los Angeles, Cal., died recently in that city at the age of 76 years. Mr. Watterson's company had constructed several large engineering projects in and around Los Angeles, including the Hill Street tunnel.

GEORGE P. BRADISH, for the past fourteen years city engineer of La Crosse, Wis., died recently in that city very suddenly, aged 69 years. Mr. Bradish received his early education in La Crosse, later attending Lawrence College at Appleton, Wis., for one year. He then went to the University of Wisconsin from which institution he was graduated in civil engineering in 1876. After graduation he was employed by the Northwestern R.R. in construction work through the Dakotas, Minnesota, Nebraska and other Western States. In 1891 he was appointed city engineer of La Crosse in June, 1891, upon the resignation of W. E. Woods.

EQUIPMENT AND MATERIALS

Heated Wheelbarrow for Bituminous Road Repair Materials

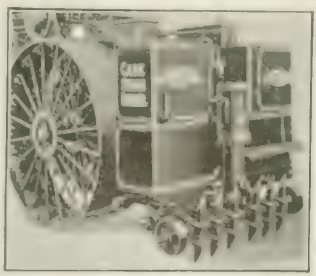
A gasoline-heated wheelbarrow for handling bituminous materials used in road repair work has been developed by the Road Repair Equipment Co., 165 Broadway, New York City. The wheelbarrow has a capacity of 3 cu.ft. and is equipped with a tank holding sufficient



gasoline for 10 hours continuous operation. The equipment is designed particularly for road patrol work and can also be employed for transporting roofing material, concrete in freezing weather, pipe jointing. Dumping of the barrow does not interfere with the operation of the heating device.

New Steam Scarifier

A new steam scarifier to be attached to a road roller has been announced by the J. I. Case T.M.Co., of Racine, Wis. The scarifier is attached to the rear of the roller and the same operator handles both. The additional weight of the complete attachment is about 1,850 lb. A steam pressure cylinder which is under instant control of the operator is employed to raise and lower the teeth by manipulating a four-way valve. The teeth are forced into the ground under a steam pressure of four tons and are



held there by a steam cushion. The picks can be raised or lowered in passing over cross walks, manhole covers and other [illegible]. Six hooked scarifier teeth are used of 1½-in. x 2½-in. section and 22 in. long. The picks are adjustable for depth, and gage wheels prevent them from digging below the required depth in case the rear rolls drop into a hole in the road. The width of cut may be varied from 40 in. to 84 in. by spacing of the picks, or any of the picks desired can be removed.

Business Side of Construction

Facts and Events that Affect Cost and Volume

May Contracts Reflect Business Revival

Increase of $63,105,640 Over Corresponding Period of 1921—Miscellaneous $4,160,916 Heavier

An increase of $63,105,640 in important engineering contracts in the United States during the month of May over the corresponding period of 1921, is indicative of the business revival of the country. Last month's contracts amounted to $172,010,171 in comparison to $108,904,531 in 1921, and $165,870,787 in 1920. These figures and those in Table I are compiled from Construction News, where minimum projects reach $25,000 each on public work and $150,000 in the case of commercial buildings.

Interesting to note, is the large gain in miscellaneous construction, which increased $4,160,916 over May, 1921, but fell $5,804,262 under 1920 figures.

Business Briefs

Petroleum products are active, excepting kerosene, which is seasonably stagnant, market reports throughout the country say. Gasoline is in greatest demand and the tank-car price for it now has advanced to an average of 22 cents. Turpentine substitutes are firm and scarce.

Bituminous coal exports during April fell nearly 400,000 tons under March, according to the Department of Commerce. A total of 714,959 tons, valued at $3,479,041, were exported, compared with 1,187,313 tons, worth $6,311,540, in March and 1,443,091 tons, worth $9,135,379, in April, 1921.

Output of beehive coke in April dropped to 528,000 tons from 732,000 tons in March; by-product coke, on the other hand, increased 90,000 tons over March, with a total of 2,227,000 tons in April.

Labor Board Announces Cut in Railroad Wages

Maintenance-of-Way Labor Affected by Decision That Will Save More Than $48,000,000

Wage reductions affecting 400,000 railway employees and aggregating more than $48,000,000 are authorzied by a Railroad Labor Board decision announced May 28. Although these cuts apply mainly to maintenance-of-way employees decisions affecting other classes of labor are now pending.

The cuts authorized for the various classes of labor are as follows:

Bridge, building, painting, construction, mason and concrete, water supply and plumber foremen, except certain water supply and plumber foremen coming under the provisions of the cut authorized last July: decrease of 5 cents an hour.

Assistant bridge, building, painting, construction, mason and concrete, water supply and plumber foremen and coal wharf, coal chute and fence gang foremen, pile driver, ditching and hoisting engineers and bridge inspectors, except asssitant water-supply and plumber foremen coming under certain provisions of the cut of last July: decrease of 5 cents an hour.

Section, track and maintenance foremen and assistant section, track and maintenance foremen: decrease of 3 cents an hour.

Mechanics in the maintenance of way and bridge and building departments, except those that come within the scope of agreements with the federated shop crafts: decrease of 4 cents an hour.

Mechanics' helpers in the maintenance of way and bridges and building departments except those that come within the scope of agreements with the federated shop crafts: decrease of 1 cent an hour.

Track laborers and all common labor-

Engineering News-Record Construction Cost Index Number

June, 1922	166.62
May, 1922	164.62
June, 1921	209.82
Peak, June, 1920	273.80
1913	100.00

Engineering News-Record's Construction Cost Index Number is two points higher than last month, due principally to a stiffening in labor rates. Demand for steel continues fair, but less urgent than recently, price for structurals unchanged at $1.60. Lumber generally higher. Cement advanced in the East, but is firm elsewhere. Average hourly rate for common labor is 43c. Thus, general construction cost is 21 per cent cheaper than one year ago and 39 per cent under the peak; it is 67 per cent above the 1913 level.

Engineering News-Record Construction Volume Index Number

Monthly	
May, 1922	179
April, 1922	150
May, 1921	107
1913	100
Yearly	
1921 (entire year)	88
1920 (entire year)	91
1913	100

Engineering News-Record's Construction Volume Index Number is 179 for the month of April, and 88 for the whole of 1921, as against 100 for 1913. This means that the actual volume of construction in 1921 (not the mere money value of the contracts let that year) is 12 per cent under the volume of construction for 1913. Our monthly volume number, 179, for April, 1922, is really the increment of construction, and indicates the rate at which contracts are being let as compared with 1913 awards.

Excavation and dredging was the only classification which in May, 1921, exceeded the value for the same month in 1922.

May's total value of contracts exceeds April contracts by $147,249,327, March contracts are $6,416,829 heavier than for May, and February contracts are $120,948,171 less than for the month of May. January contracts were $93,459,218 less than in May.

Crude oil production in the United States in the week ending May 13, is reported to have averaged 1,422,400 bbl. daily, according to statistics of the American Petroleum Institute. This is an increase of 14,950 bbl. daily, compared with the preceding week.

Automobile production in 1921 amounted to 1,668,550 vehicles, representing a total value of $1,260,000,000.

VALUE OF CONTRACTS LET IN THE UNITED STATES IN MAY, 1922

	New England	Middle Atlantic	Southern	Middle West	West of Mississippi	Western	Total
Waterworks	$125,000	$482,000	$360,000	$959,000	$1,025,000	$617,000	$3,568,000
Sewers	.....	2,992,000	598,000	1,720,000	290,000	122,000	5,722,000
Bridges	28,000	5,674,000	636,000	579,000	1,153,000	50,000	7,920,000
Excavation and dredging	.....	.....	344,000	126,000	291,000	15,000	776,000
Streets and roads	1,759,000	16,609,000	4,864,000	10,794,000	5,043,000	3,215,000	42,284,000
Industrial works	3,865,000	5,826,000	425,000	2,539,000	162,000	1,001,000	13,818,000
Buildings	10,941,000	38,564,000	7,887,000	18,310,000	4,343,000	5,658,000	85,703,000
Fed. gov't. wks	106,000	645,000	1,291,000	.....	.....	1,327,000	3,369,00
Miscellaneous	172,000	4,669,000	743,000	502,000	1,246,950	1,064,000	8,396,950
Total	$16,996,000	$75,461,000	$17,148,000	$35,329,000	$13,553,950	$13,069,000	$171,556,950

ers in and around shops and roundhouses not otherwise provided for; decrease of 5 cents an hour.

Drawbridge tenders and assistants, piledriver, ditching and hoisting firemen, pumper engineers and pumpers, crossing watchmen or flagmen and lamplighters and tenders: decrease of 5 cents an hour.

Laborers employed in and around shops and roundhouses, such a engine watchmen and wipers, fire builders, ashpit men, flue borers, coal passers, except those coming under certain provisions of the decrease of last July, and coal chute men: decrease of 5 cents an hour.

Next Week—Production and Stocks of Materials Throughout the Country.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for in Construction News, pp. 273 to 284 are the following large projects:

A high school at Columbus, Ohio, $1,000,000.

A crypt at Washington, D. C., $5,000,000.

Elevation of grade crossings, St. Paul, Minn., $4,000,000.

University buildings at London, Ont., $1,000,000.

Coming — First five months of construction, classified geographically and as to kind of work. Contracts let, bids desired, proposed. Construction News has reported contracts let worth $604,000,000 *with just as much coming along.*

Labor Rates and Conditions Throughout the Country

Steady and sustained gains in employment throughout the United States are shown in reports of the President's Conference on Unemployment. For every 100 jobs listed during April there were 150 applicants as against 182 in March; 205 in February and 226 in January. This represents a decrease of 33 per cent in the number of applicants for employment during the first four months of the year. Unemployment has decreased about 61 per cent since May 1, 1921, according to the National Industrial Conference Board.

Actual increases in rates are making their appearance in building trades wage schedules; due no doubt to increasing shortage of skilled mechanics. For example, carpenters in Pittsburgh and bricklayers in Detroit have been granted an increase of 12½c. per hr., effective June 1. No wage decreases for skilled labor are noted in twenty-one cities reporting to *Engineering News-Record*, though slight reductions and adjustments are reported for common labor in New York and Minneapolis.

With the 1921 wage scale still in effect in New York City and premium wages being offered many of the skilled building trades, the unskilled rates seem to range between 44c. and 60c. per hr., which is considerably below the 1921 schedule. This is plainly an instance of cutting under the established rate for union common labor and applies to conditions such as those existing in reinforced-concrete construction.

New Orleans' present wage scale expires June 15. No negotiations, known to the public, are pending between men and employers, although plumbers are reported to have accepted the new schedule of 90c per hr., effective June 15. Unemployment has diminished 55½ per cent this year; there are 4,000 unemployed men in *New Orleans* as against 9,000 in December, 1921. Heavy rains, flooding the lumber camps, have thrown many out of unemployment in the timber section. Day laborers receive as low as $1.50 per day; mechanics demand $5.

The largest industrial concern in the *Birmingham* district has increased the coal miners' wage rate 10 per cent and that for ore miners 15 per cent, effective May 15. Wage rates in other trades remain unchanged.

Pittsburgh reports hoisting engineers, hod-carriers and common laborers plentiful, but there are just enough bricklayers and structural ironworkers to meet the demand. Carpenters are scarce and many are coming in from out of town.

Conditions in all trades have about reached normal in *Detroit*, with supply equal to the demand. The Associated Building Employers have arranged to open an employment bureau which will be operated on the American plan.

Very little unemployment in *Los Angeles*. Normal supply of bricklayers; other skilled building trades are operating under fairly satisfactory conditions. Common labor situation improving gradually; present conditions much better than a month ago.

Apartment house and residence building continues to be the feature of construction in *Atlanta*. Labor is in good demand and available at the lowest wage rates prevailing in any of the twenty American cities reporting. Hod-carriers, however, are obtained at a slightly lower rate in *Birmingham*, at 15c.@25c. as against 30c. in *Atlanta*.

No unemployment among bricklayers, carpenters or hod-carriers in *Denver*. Large increase in employment of piledrivers, structural ironworkers and common laborers.

Labor plentiful in *Montreal* and *Minneapolis;* no unemployment among building trades mechanics in the latter.

(Higher rates indicated by +, decreases by—)

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$0.[illegible]	$0.70	$0.70	$0.[illegible]		$0.[illegible]	$0.20
Baltimore	1.[illegible]	[illegible]	.87	[illegible]	$0.71	1.00	.30
Birmingham	1.00	.75	.60@1.00	.15@.25		1.00	.15@.30
Boston	[illegible]	.90	.90	.60	[illegible]	.90	.55
Cincinnati	1.25	[illegible]	[illegible]	.72½	.77½	.95	.40
Chicago	1.10	1.00	1.10	[illegible]	1.00	1.05	.72½
Cleveland	[illegible]	1.00@1.20	1.04	[illegible]	.91	1.10	.57½
Dallas	1.00	1.00	1.00	[illegible]	1.00	[illegible]	.25
Denver	1.[illegible]	1.00	1.00	.75@.81½	1.[illegible]	1.00½	.35@.50
Detroit	[illegible]	[illegible]	.80@.90	[illegible]	1.00	[illegible]	.50
Kansas City	1.07½	1.00	1.00	.80	1.07½	1.07½	[illegible]
Los Angeles	1.[illegible]	[illegible]	1.00	1.12½	.87½	1.00	[illegible]
Minneapolis	1.00	.80	.80	[illegible]	[illegible]	.80	[illegible]0
Montreal	[illegible]	.60	.50	.3[illegible]	.50	[illegible]	.20@.30
New Orleans	1.00	.88	[illegible]	.40	.80	1.00	.30
New York	1.[illegible]	1.12½	1.25	.87½	1.00	1.12½	[illegible].60
Pittsburgh	1.[illegible]	[illegible]	1.00	.80	1.00	1.00	.35@.60
St. Louis	1.[illegible]	1.12½	1.12½	.[illegible]	1.[illegible]	[illegible]	[illegible]40
San Francisco	1.12½	1.[illegible]	1.00	.75	1.00	1.12½	47½@.50
Seattle	1.[illegible]	.80	.90	.70	1.00	80@.90	[illegible].60
Philadelphia	1.00	.90	.90	.75@.90	1.00	.90	.25@.35

$250,000,000 To Be Saved by Freight Rate Cut

By H. M. Cunnington

That the effect of the order by the Interstate Commerce Commission for a general 10 per cent reduction in freight rates, effective July 1, will be an annual saving to shippers of from $200,000,000 to $250,000,000, is the opinion of many traffic experts throughout the country.

Railway officials compute that compared with the rates effective after the last increases, in August, 1920, the reduction is approximately $450,000,000. Since then, there have been various reductions, some voluntary, some ordered, equivalent to perhaps, $200,000,000, these reductions including those on Southern hardwood. In railway opinion, the net reduction, below the return from existing rates, caused by the 10 per cent rate reduction of last week, is $250,000,000.

Slight effect on Stock Exchange prices has been noted. It is significant that railway stocks have not advanced with the general list in this season's rise. Further explanation of the philosophy with which the freight cut has been received lies in the fact that most railway men have felt that the rate advance of 25 and 40 per cent in August, 1920, was too heavy for the traffic to bear.

The cut in freight rates, horizontal instead of on specified commodities, is the first general reduction since the period of government control. By territorial groups, the commission's proposed new rates are as follows:

In the eastern group, including Illinois, 26 per cent above rates effective before August, 1920, instead of the 40 per cent increase effective since then.

In the western district, and between it and Illinois, 21.5 per cent above 1920, instead of the 35 per cent authorized since then.

In the southern and mountain Pacific groups, 12.5 per cent above 1920, instead of the 25 per cent authorized then.

On territorial traffic, 20 per cent above 1920, instead of the 33⅓ per cent authorized then.

The railroads have until May 31 to determine whether they intend to contest the order. Not a representative of the railway executives has commented on any such action. It is said that the executives want to give full study to the decision and all its angles.

The Interstate Commerce Commission, officials of that body say, acted in the conviction that modification of the transportation rate level would encourage resumption of normal traffic and stabilize the conditions governing commerce and industry, contributing to business revival. That the railroads can stand the decrease is the conviction of the Commission, notwithstanding the argument and evidence to the contrary submitted by the carriers.

"We are of opinion," says the report of the Commission, "that general reduction in the rate level, as substantial as the condition of the carriers will permit, will tend not only to lessen the transportation burden, but also to equalize and stabilize the conditions under which commerce and industry are carried on, with consequent fuller assurance to the carriers of realizing the fair return contemplated by the law."

Freight Loadings Increase 28 per Cent in Week

In the week ending May 13, 1922, the total revenue freight loaded was 777,359 cars, an increase over the week of May 6 far in excess of the decline suffered in that week from the week of April 29. Every classification participated in this advance save live stock and merchandise, l.c.l., wherein the decreases were not, however, marked. Coal and coke, despite the effect of the sixth complete week of the miners' strike, both showed a good gain, while the ore loading climbed back to the record of the second week preceding. The miscellaneous loading jumped 10,933 cars—an indication that the miners' strike has not as yet adversely affected general business. Compared with the preceding year, the 1922 performance was an increase of 26,173 cars, a comparison which indicates the extraordinary depression which business was under a year ago. The decrease compared with the same week of 1920, when business was booming, was 65,786. The serviceable surplus of freight cars for the week ended May 15, 1922, was 343,689, a decrease of 9,550 compared with the week ending May 8. The box surplus was 84,640, the decrease over the previous week being 1,964. The coal car surplus was 218,466, or 7,810 fewer.

Monthly Prices of Construction Materials

Ups and Downs of the Market

Pig Iron—No. 2 Foundry iron up $1 in Birmingham; No. 2 Foundry Southern advanced $8 in Chicago. Advances $2 to $5 per gross ton at other principal furnaces. Coke production in Connellsville district gained 6 per cent during third week of May. Much imported pig iron being used.

Railway Supplies—Light rails quoted at $30@$32 as against $30 per ton, f.o.b. Pittsburgh; standard spikes quoted at a minimum of $2.25 per 100 lb. at mill. Spikes and track bolts up 10c. per 100 lb. in Birmingham. Railroad buying of freight car materials and rails continues a trifle heavier than the pre-war rate.

Pipe—Continued rise in pig iron reflected in cast-iron pipe which advances $1 in San Francisco and $2 per ton in New York. Sewer pipe advanced 1c. per ft. in Birmingham and Atlanta. Rise in Pittsburgh on standard sewer pipe in sizes above 24-in. Chicago, Minneapolis, Philadelphia, Cincinnati and Detroit quotations based upon double strength sewers.

Road and Paving Materials—Asphalt, in bulk, $21.35 as against $19.95 per ton, in Minneapolis. Granite paving blocks, 5-in., $131.75 delivered in New York as against $130 per 1,000; Montreal quotes $100 as as compared with $125 per 1,000 last month. Wood blocks up 30c. in Philadelphia and down 4c. per sq.yd. in Minneapolis.

Sand, Gravel and Crushed Stone—Prices very firm throughout the country, in view of constantly increasing volume of construction.

Lime—Hydrated finishing lime in Atlanta $22.50 as against $18; hydrated common, $13 as compared with $12.50 per ton, one month ago; common lump lime up 50c. per bbl., 180-lb. net. Hydrated common lime up 50c. in Philadelphia and down 50c. per ton Boston.

Cement—New York quotes $2.40@$2.50 as against $2.40, delivered, without bags and $2.10 as compared with $2 per bbl., alongside dock to dealers. Price in San Francisco $2.83 as against $2.73. Drop of 2c. per bbl. in Milwaukee and Montreal and 5c. in Atlanta. Mill advances, owing to coal situation, of 10c. at Hudson, N. Y., and 20c. per bbl. at Northampton, Pa.

Structural Material—High fuel costs coupled with possibilities of labor shortage and higher wages, as well as shorter working hours, hold price firm at $1.60 per 100 lb., f.o.b. mill. Steel bars, however, show upward tendency. Structural rivets, ¾-in., quoted at minimum of $2.25 and cone-heads, ½-in., at $2.35, Pittsburgh. Steel sheets firm at mill but up 10c. per 100 lb. at New York warehouses.

Brick and Hollow Tile—Common brick, New York, $20 per 1,000 wholesale, alongside dock, as aganist $17; $23.50 delivered as compared with $20.40 per 1,000, one month ago. Shortage continues. Atlanta quotes rise of $1; Minneapolis, $1@$2, and Birmingham, $2 per 1,000. Slight rise in hollow tile in Chicago, Minneapolis, Birmingham and Pittsburgh; down in Montreal.

Lumber—Long-leaf yellow pine, base sizes, up $3@$6 in Chicago; stable in New York. Increased demand has forced lumber prices upward, $1@$5 per M. ft. in more than a dozen important cities in the United States. Declines reported in Montreal.

Scrap—Stove plate and rails for rerolling rise 50c. per gross ton in New York; scrap prices otherwise firm.

Manila Rope—Prices up 1c. in Philadelphia and ½c. per lb. in New Orleans for ¾-in. rope.

Explosives—Decline of 2c. in 40 per cent and 3c. in 60 per cent gelatin dynamite in Los Angeles; 60 per cent gelatin down ½c. per lb. in Atlanta.

Linseed Oil—Raw linseed oil quoted at $1.03 as against 90c. per gal. (5-bbl. lots) in Chicago, one month ago. Prices farily stable elsewhere throughout the country.

Price advances since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Per Gross Ton—Quotations compiled by The Matthew Addy Co.:

	Current	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25 @ 2.75)	$25.52	$28.75
Northern Basic	25.02†	26.52
Southern Ohio No. 2 (silicon 1.75 @ 2.25)	22.50†	27.52
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25 to 2.75)	28.56†	34.26
BIRMINGHAM		
No. 2 Foundry (silicon 2.25 @ 2.75)	17.50†	24.00
PHILADELPHIA		
Eastern Pa., No. 2X, (2.25 @ 2.75 sil.)	26.36†	26.26*
Virginia No. 2 (silicon 2.25 @ 2.75)	28.34†	27.00*
Basic	23.50@25.50†	25.00†
Grey Forge	25.00†	25.00*
CHICAGO		
No. 2 Foundry Local (silicon 1.75 @ 2.25)	23.50†	23.00
No. 2 Foundry Southern (silicon 2.25 @ 2.75)	24.17†	29.67
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley (silicon 1.75 @ 2.25)	24.16†	26.46
Basic	25.00†	24.46
Bessemer	26.96†	26.96

*F.o.b. furnace. † Delivered.

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh			
	Current	One Year Ago	Birmingham	Chicago
Standard bessemer rails	$40.00	$45.00	.....	$40.00
Standard openhearth rails	40.00	47.00	$40.00	40.00
Light rails, 8 to 10 lb	30@32	2.30*	1.60*	1.60@1.70*
Light rails, 12 to 14 lb	30@32	2.25*	1.60*	1.60@1.70*
Light rails, 25 to 45 lb	30@32	2.20*	1.60*	1.60@1.70*
Rerolled Rails	28.00	.....	.....	.....

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8 Ft.	7 In. x 9 In. by 8½ Ft.
Chicago, White Oak	$1.35	$1.50
Chicago, Hardwood and Red Oak	1.20	1.30
Chicago, Empty Cell Creosoting (add'l)	.45	.50
San Francisco, Green Douglas Fir	.85	1.10
San Francisco, Empty Cell Creosoted, Douglas Fir	1.86	2.30
St. Louis, White Oak*	1.10	1.44
St. Louis, Red Oak*	.97	1.17
St. Louis (creosoted)	No. 1, $0.86	No. 2, $0.96	No. 4, $1.28

*Standard specifications 38c. per tie additional. Zone chemical process 27c. per tie additional.

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh					Pur. Dis.
	Current	One Year Ago	Chicago	St. Louis	Cincinnati	Birmingham
Standard spikes, ⅝-in. and larger	$2.25	$3.30	$3.15	$3.00	$3.15	$3.20
Track bolts	3.00@3.50	4.35	3.60	4.25	4.00	4.15
Standard section angle bars	2.40	2.50	2.40	3.00	4.00	3.25

PIPE

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the latest Pittsburgh basing card:

BUTT WELD

Inches	Steel Black	Steel Galv.	Iron Black	Iron Galv.
1 to 3	71	58½	2 to 1½ 44½	29½

LAP WELD

2	64	51½	2	25½
2½ to 6	68	55½	2½ to 4	27½
7 to 8	65	51½	7 to 12	27½
9 to 12	64	50½		

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1½	69	57½	¼ to 1½	44½
2 to 3	70	58½		30½

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	62	50½	2	40½
2½ to 4	66	54½	2½ to 4	43½
4½ to 6	65	53½	4½ to 6	42½
7 to 8	61	47½	7 to 8	35½
9 to 12	55	41½	9 to 12	30½

STEEL—From warehouses at the places named the following discounts hold for steel pipe:

	Black		
	New York	Chicago	St. Louis
1 to 3 in. butt welded	66%	62½%	59%
2½ to 6 in. lap welded	61%	59½%	56%

	Galvanized		
	New York	Chicago	St. Louis
1 to 3 in. butt welded	53%	48½%	45%
2½ to 6 in. lap welded	47%	45½%	42%

Malleable fittings, Class B and C, from New York stock sell at list less 10%. Cast iron, standard sizes, *32-5%* off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	Birmingham Mill	New York One Year Ago				San Francisco
		Current		Chicago	St. Louis	
4 in.	$38.50	$51.80	$68.30	48.10@48.60	$43.70	$55.00
6 in. and over	34.50	48.80@49.80	58.30	44.10	39.70	51.00

Gas pipe and Class "A," $4 per ton extra; 16-ft. lengths, $1 per ton.

CLAY DRAIN TILE—The following prices are per 1000 lin. ft.:

	New York					
Size, In.	Current	One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	$40.00	$50.00	.....	$50.00	.....	$55.00
4	50.00	60.00	$80.00	60.00	$76.50	65.00
5	80.00	90.00	.....	80.00	97.75	84.00
6	100.00	115.00	140.00	100.00	127.50	110.00
8	150.00	185.00	200.00	150.00	212.50	181.00

SEWER PIPE—The following prices are in cents per foot for standard pipe in carload lots, f.o.b., except as otherwise stated:

Size, In.	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3	$0.14	$0.087	.....	.....	$0.12	$0.12	.....
4	.14	.087	$0.09	$0.0875	.12	.15	$0.18
5	.21	.1305	1125	.....	.18	.18	.165
6	.21	.1305	135	.1225	.18	.21	.25
8	.35	.203	225	.20	.28	.30	.35
10	.52	.3045	2925	.28	.42	.42	.....
12	.67	.3915	3825	.36	.54	.54	.80
15	1.15†	.522	5625	.52	.72	.90	.....
18	1.55†	.725	765	.68	1.00	1.32	.....
20	1.98†	.87	.....	.92	1.20	.....	.....
22	2.64†	1.16	.....	.....	1.60	.....	.....
24	2.97†	1.305	1.50	1.20	1.80	2.16	2.40
27	4.50†	2.34	.....	2.00	3.75†	3.00	.....
30	5.00†	2.59	.....	2.45	4.75†	3.60	.....
33	6.55†	3.51	.....	3.00	5.50†	.....	.....
36	7.50†	4.00	.....	3.25	6.00†	.....	.....

	3	5	8	12	24	36
Boston	$0.105	$0.1575	$0.245	$0.4725	$1.575	$4.608
Minneapolis	.....	.....	.40	.72	2.55	5.661
Denver	.135*	.18*	.27	.42	1.70	.....
Seattle	.13	.....	.321	.63*	2.34	.....
Los Angeles	.11*	.165*	.275	.495	1.65	.....
New Orleans	.....	.106	.27	.459	1.755	.....
Cincinnati	.096	.144	.224	.43	1.44	4.3821
Atlanta	.085*	.1275*	.21	.355	1.37	.....
Montreal, *delivered*	.30*	.45*	.70*	1.35	4.50	.....
Detroit	.099	.1485	.231	.4455	1.935	5.125†
Baltimore	.1225	.2275	.35	.6370	2.29	5.23
Kansas City, M	.15*	.21*	.335	.60	2.41	4.74
Philadelphia	.105	.1575	.245	.4725	1.575	3.5825

*4-in., 6-in., 9-in., respectively. †Double Strength.

ROAD AND PAVING MATERIALS

ROAD OILS—The following are prices per gallon in tank cars, f.o.b. place named:

		Current	One Year Ago
New York, 45% asphalt	(at terminal)	$0.05	$0.06
New York, 65% asphalt	(at terminal)	.045	.06
New York, binder	(at terminal)	.055	.07
New York, flux	(at terminal)	.05	.06
New York, 75% asphalt	(at terminal)	.06	.08
St. Louis, 50-60 asphalt, f.o.b.		.05	.021*
Chicago, 40-50 asphalt		.05	.06
Chicago, 60-70 asphalt		.051	.064
Dallas, 40-50 asphalt		.10	.10
Dallas, 60-70 asphalt		.13	.13
Dallas, 75-85 asphalt		.15	.15
San Francisco, binder, per ton		13.60†	15.00

*Carload, $21.75 per ton to Wyoming [illegible]
†f.o.b. Tulsa, Cal. Freight to [illegible] .80 per ton

ASPHALT—Price per ton in packages (350-lb. bbls. or 425-lb. drums) and in bulk in carload lots.

	Package	Bulk
New York (Bayonne, N. J.)	$25.00	$15.00
Boston	No quotations	
Chicago	24.35	18 0
San Francisco, *f.o.b. refinery*, Oleum, Cal. (natural)	19.50*	13.50*
Dallas	35.00	27.00
Seattle "D" *grade*	23 75	27.25†
Denver	40 00	
Minneapolis *f.o.b. Twin Cities*		21.35
St. Louis (natural)	22.35	14 00
Baltimore	25.00	20.00
Los Angeles, *at factory*	22 50	15.00
Montreal	28.00	21.00
Atlanta	28.00	....
Detroit (petroleum asphalt)	25.00	19.00
Cincinnati	32.00	28.00
Maurer, N. J. (natural asphalt)	36.00	33.00
Maurer, N. J. (artificial asphalt)	22.00	20.00
Philadelphia	24.00	17.50
Kansas City	28.83	22 83

*Freight to San Francisco, 80c. per ton.

†Petrolastic XX.

NOTE.—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums. Rebates of about $1 per bbl., no rebate for drums.

PAVING STONE—

New York *delivered*	5-in. granite, 28@29 blocks per sq.yd.	$131.75 per M
Chicago	About 4x8x4 dressed	3.20 sq.yd.
	About 4x8x4 common	3.00 sq.yd.
San Francisco	Basalt block 4x7x8	70.00 per M
Boston	5-in. granite	125.00 per M
Atlanta	Granite	2.00 sq.yd.
Detroit	Granite, 26½ blocks per sq.yd.	3.05 sq.yd.
Baltimore	Granite	2.00 sq.yd.
Montreal	Granite	*100.00* per M
New Orleans	Granite, 4 x 8 x 4	3.25 sq.yd.
Cincinnati	Granite	3.84@4 sq.yd.
St. Louis	4x8x4 dressed	3.35 sq.yd.
	4x8x4 common	3.00 sq.yd.
Kansas City	No. Granite	3.95 sq.yd.
Philadelphia	Granite	125.00 per M.

FLAGGING—

New York	Bronx	$0 25	sq.ft.
	Manhattan, 4 ft.	.26	sq.ft.
	Queens, 5 ft.	.26	sq.ft.
	6x20-in. cross-walk	1.00	lin.ft.
Chicago	18 in. wide	.99	lin.ft.

CURBING—Bluestone per lineal foot, in New York, costs 77c. for 5x16 in., 88c. for 5x18 in.; in cargo lots.

WOOD BLOCK PAVING—

	Size of Block	Treatment	Per Sq.Yd.
New York (*delivered*)	3	16	$2 04
New York (*delivered*)	3½	16	2.17
New York (*delivered*)	4	16	2.36
Boston	3	16	2.17
Chicago	4	16	3.00@3.25
Chicago	3½	16	2.50@2.75
St. Louis	3½	16	2.50
St. Louis	4	16	3.00
Seattle	4	16	Off market
Minneapolis	3½	16	*2.09*
Atlanta	3½	16	2.30
New Orleans	3	16	1.60
New Orleans	3½	16	1.80
New Orleans	4	16	2.00
Dallas	4	18	3.90
Baltimore	3½	16	3.44
Montreal	4	16	4 50
Detroit	3	16	2.84
Detroit	4	16	3.00
Cincinnati	4	16	2.10
Kansas City	4	16	2.15
Philadelphia	3½	16	3 80

CONSTRUCTION MATERIALS

SAND AND GRAVEL—Price for cargo or carload lots to contractor is as follows, per cu.yd.:

	Gravel ½ In. Current	Gravel ½ In. One Year Ago	Gravel 1 In. Current	Gravel 1 In. One Year Ago	Sand Current	Sand One Year Ago
New York	$1.75	$2.50	$1.75	$2.50	$1.00	$1.25
Denver	2 50	2 00	2.50	1.80	1.10	1 60
Chicago	1.80	2.25	1.80	2.25	1.80	2.25
St. Louis, *f.o.b.*	1.25	1 55	1.30	1.60	1.10	1.60*
Seattle	*1.25*	1 50	*1.25*	1.50	*1.25*	1 50
Dallas	2 25	3.50	2.25	4.00	2.25	3 00
Minneapolis	1 50	2 00	1 50	....	1.00	1 00
Cincinnati	1.87½	2.36	1.87½	2.36	1.43	1.86
San Francisco	2.25	2.25	2.25	2.25	1.50	1 50
Boston	2.40	2.65	2.40	2.65	1.65	2.00
New Orleans	2 08‡	2.85	2 08‡	....	1.35	1 65
Los Angeles, per ton	1.50†	1 45†	1 50†	1.45†	1.35†	1 30†
Atlanta, per ton	1.85	2 80	1 85	....	1.15	1.62½
Detroit	2.00	2.50	2 00	2 50	2 00	2 50
Baltimore, per ton	1.40	1.40	1 60	1.60	2.00	70
Montreal, per ton	1 25	1.50	1 50	1.50	1.25	1.25
Birmingham, per ton (Crushed slag used instead of gravel)					1.25	1.45‡
Philadelphia	1.50		1.55	....	1.60	....
Kansas City	2.00	3.25	2.00	3.75	1.20	1.25

* Fine white sand: Pacific, $5 per ton; Ottawa, $6.

† Freight from quarry to Los Angeles is 85c. per ton, and is included in above price.

‡ Per cu. yd.

CRUSHED STONE—Price for cargo or carload lots f.o.b. city, unless stated otherwise, is as follows, per cu.yd.:

	1½ In. Current	1½ In. One Year Ago	¾ In. Current	¾ In. One Year Ago
New York	$1.65	$1.90@2.00	$1.75	$2.15
Chicago	1.60	2.50	1.60	2.50
St. Louis *delivered*	1.65	2.60*	1.65	2.60*
Dallas, *delivered*	2.73	2.80	2.73	2.80
San Francisco	2.25	2.25	2.25	2.25
Boston, *delivered*	3.00*	3.00* (del.)	3.00*	3.00* (del.)
Minneapolis, *at plant*	2 00	2.00	2.25	2.25
Kansas City, *at plant*	2.10	1.25	2 10	1 40
Denver	3.50		3.50	
Seattle *delivered*	3.00	3.50 (del.)	3.00	3.50 (del.)
Atlanta	1.90*	2 50*	1 90†	
Cincinnati *delivered*	1.75	3.24	1.75	3.24
Los Angeles	1.75*	1.70*	1.85*	1.80*
Detroit	1.90*	2.00*	1.90*	2.00*
Baltimore	1.75*	1.75*	1.65*	1.75*
Montreal	2.00*	2.00*	*1.60**	2.10*
Birmingham *delivered*	3.20	....	3.10	....
Phildelphia	1.70*		1.55*	
Pittsburgh	2.85	....	2.85	....
Cleveland	*3.00**	....	*3.00**	....

*Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plants:

	1½-In.	¾-In.	Roofing	Sand
Youngstown District	$1.30	$1 30	$2.00	$1.30
Steubenville District	1.40	1 40	2.00	1.40
Ironton District	1.40	1.40	2.00	1.40
Emporium, Pa.	1.25	1.25		1.25
Easton, Catasauqua, Pa	1.00	1.00	2 00	0.90
Birmingham, Ala	*0.90*	*1.00*		*0.50*
Buffalo, N. Y., and Erie, Pa.	1.25	1.25	2 25	1.25
Cleveland, Ohio	1.20	1.20		1.00
Eastern Pennsylvania and Northern New Jersey	1 20	1 20	2 00	1 20
Western Pennsylvania	1.25	1 25	2 00	1.25

LIME—Warehouse prices:

	Hydrated, per Ton Finishing	Hydrated, per Ton Common	Lump, per Barrel Finishing	Lump, per Barrel Common
New York	$15.80@$16.80	$12.50	$3.68*	$2.75@$3.18*
Chicago	18 00			1.40†
St. Louis	23.20	20.00	2.35†	
Boston	23 00	*19.00*	3.30†	3.00†
Dallas	25.00			2.50†
Cincinnati	15.10	12 50	10 75‡	12.50‡
San Francisco	22.00	18.00	....	1.75†
Minneapolis	29.00	22.00 (white)	1.70†	1.40†
Denver	24.00			2.70†
Detroit	18.00	16.00		17.00‡
Seattle *paper sacks*	*24.00*		2.80†	
Los Angeles	30.00	30.00	3.00*	3.00*
Baltimore	15 00	13.00		12.00‡
Montreal	21.00	21 00	15.00‡	11.00‡
Atlanta	22 50	13 00	2.00†	1.75†
New Orleans	....	17.25	1.75†	....
Philadelphia	13.00	12.00	10.50‡	9.50‡

*Per 280-lb. bbl. (net). †Per 180-lb. bbl. (net). ‡Per ton—Refund of 10c. per bbl. Minneapolis quotes brown common lump lime; Kelly Is. white is $1.70, Sheboygan $1.55. New York quotes hydrated lime "on cars" in paper sacks; lump lime "alongside dealers docks" or "on cars."

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, f.o.b., exclusive of bags:

	Current	One Year Ago
Minneapolis (Rosendale)	$2.80	$2.80
Kansas City (Ft. Scott)	1.60	1.60
Atlanta (Magnolia)	11.00 ton	11.00
Cincinnati (Utica)	1.77	2 75
Boston (Rosendale) per bag	.80	3.00
St. Louis (Carney hydrated)	2.10	

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b. points listed *without bags*. Cash discount not deducted.

	Current	One Month Ago	One Year Ago
New York, del. by truck	$2.40@2.50	$2.40	$2 80
New York, alongside dock to dealers	2.10	2.00	2.40
Jersey City, del. by truck	2.32	2.12	2.89
Boston	2.50	2.50	2.86
Chicago	1.97	1.97	2.17
Pittsburgh	2.02	2.02	2.17
Cleveland	2.26	2.26	2.43
Detroit	2.17	2.17	2.43
Indianapolis	2.21	2.21	2.43
Toledo	2.20	2.20	2.49
Milwaukee	*2.16*	2.18	2.39
Duluth	1.94	1 94	2.10
Peoria	2 08	2 08	2.45
Cedar Rapids	2 21	2.21	2.51
Davenport	*2.14*	2.16	2.47
St. Louis	2 20	2 20	2 60
San Francisco	2 83	2.73	3.09
New Orleans	3.00	3.00	3.36
Minneapolis	2.24	2.24	2 41
Denver	2 90	2.90	3.10
Seattle	2.94	2.94	3.10
Dallas	2.25	2.25	2.60
Atlanta	*2.34*	2.39	2 80
Cincinnati	2.35	2.35	2.57
Los Angeles	3.30	3.30	3.21
Baltimore, del. by truck	2.50	2.50	3.58
Birmingham	2.27	2.27	3.05
Kansas City	2.40	2 40	2.55
Montreal	*2.58*	2.50	3.44
Philadelphia	2.21	2 21	....
St. Paul	2.24	2.24	2.41

NOTE—Bags 10c. each, 40c. per bbl.;

Current mill-prices per barrel in carload lots, without bags; to contractors:

Buffington, Ind	$1 70	Mason City, Ia.	$1 95
Universal, Pa	1.75	Hudson, N. Y	2 00
Steelton, Minn	1.75	Leeds, Ala	1.85
Fordwick, Va	1.95	Hannibal, Mo	1.85
Mitchell, Ind	1.95	Lehigh Valley District	1 90
LaSalle, Ill	1.70	Kingsport, Tenn	1 95
Iola, Kan	1.95	Richard City, Tenn	1.95

TRIANGLE MESH—Price per 100 sq.ft. in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq.ft.	Warehouse: Pittsburgh, Mill	New York	Chicago	Dallas	San Francisco
032	22	$0 68	$0 95	$0 76	$1 15	$1 15
049	28	87	1 23	98	1 46	1 48
068	35	1 05	1 48	1 18	1 80	1 80
093	45	1 35	1 91	1 52	2 30	2 32
126	57	1 65	2 35	1 87	2 86	2 87
153	68	1 97	2 81	2 23	3 40	.....
180	78	2 26	3 22	2 56	3 93	.....
245	103	2 99	4 25	3 38	5 15	.....
287	119	3 45	4 90	3 90	5 96	6 01
336	138	4 00	5.69	4 52	7 32	.....
395	160	4.64	6 60	5 20	8 00	.....
		PAVING				
036P	17	$0 52	$0 72	$0 58	$0 88	.....
053P	24	.73	1 02	82	1 24	.....
072P	31	.91	1 29	1 00	1 57	.....
097P	40	1 18	1 67	1 29	2 02	.....
049R	24	.73	1 02	67	1 24	.....
067R	31	.91	1 29	1 00	1 57	.....
089R	40	1 18	1 67	1 29	2 02	.....

In rolls 16-, 20-, 24-, 28-, 32-, 36-, 40-, 44-, 48-, 52-, and 56-in wide and in 150-, 200- and 300-ft lengths. Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in wide x 150 ft. long, or 600 sq. ft.

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted are as follows:

Gage	Weight	*New York	Chicago	St. Louis	San Francisco	Dallas
27BB	2 3	$21 20	$20 39	$21 25	$23 87	$25 50
26BB	2 5	22 65	22 00	22 75	26 21	27 56
25BB	3 0	25 30	...	27 10	...	30 71
24BB	3 4	27 10	26 33	29 25	27 90	33 16
22PO	4 33	31 75	31 00	31 75	...	35 10

* Price to contractors at warehouse or delivered on job in Manhattan, Bronx or Brooklyn.

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Inches	Warehouse, Uncut: Pittsburgh Mill	Birmingham Mill	New York	Chicago	St. Louis	Dallas	San Francisco
¼ and larger	$1 60	$1 75	$2 48	$2 38	$2 47½	$3 50	$2 55
⅜ and larger	1 65	1 80	2 53	2 43	2 52½	3 55	2 60
½ and larger	1.70	1.80	2.58	2.48	2 57½	3 60	2 65
⅝ and larger	1.85	1.85	2 63	2.63	2 72½	3.75	2 80
¾ and larger	2 10	1 85	2 68	2 88	2 97½	4.00	3.05

Includes 15c charge for cutting to lengths of 2 ft and over.
Twisted bars cut to length take extra of 27½c. per 100 lb.

ROLLED FROM RAILS

	Chicago	St. Louis	Dallas		Chicago	St. Louis	Dallas
¼ and larger	$1.60	$2 25	$3 25	¼	$1 85	$2 50	$3 50
⅜ in.	1.65	2 30	3 30	½	2 10	2 75	3 75
½	1.70	2 35	3 35				

BRICK—Contractors price per 1,000 in cargo or carload lots as follows:

	Common: Current*	One Month Ago	One Year Ago	Paving Block: 3-inch*	4-inch*
New York (del.)	23 50	$20.40	$18 40	$44 50†	$49 50†
New York (at dock)	20 00	17.00	14@ 15		
Chicago	11 00	11 00	12 00	34 00	42 00
St. Louis, salmon	14 00	14 00	15 00		28 00
Denver, salmon	12 00	12 00	14 00		
Dallas	11 15	11 15	15 00	no market	
San Francisco	15 00	15 00	18 00		
Los Angeles (del.)	15 00	15 00	15 50	not used	
Boston (del.)	16 00	16 00	21 00	46 50†	52 60†
Minneapolis (del.)	16@ 17	15 00	17@ 18		43 00
Kansas City	14 50	14 50	17 50		
Seattle	14 00	14 00	19 00	44 00	
Cincinnati	15 00	15 00	19 00	41 00	36 50
Montreal (del.)	16 00	16 00	18 00		68 00
Detroit (del.)	16 50	16 50	17 50	36 50	39 50
Baltimore (del.)	20 00	20 00	25 00	36 00‡	
Atlanta	10 00	9 00	12 50		
New Orleans	12 50	12 50	14 50		
Birmingham	11 50	9 50			
Philadelphia	16 50@ 17 50	16 00			42 00
Pittsburgh (del.)	16 00	17 50			

* Per M brick: 3½x8; x3 and 3½x8½x4 respectively. † f.o.b. ‡ Vitrified f.o.b. plant, Baltimore.

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York: Current*	One Year Ago	Chicago	Philadelphia, delivered	St. Louis	San Francisco	New York
4x12x12	$0 11	120 $0 11	96 $0 0	095	$ 0	35 $0	
6x12x12	16@20	13@5	0973		12	244 $0	17@23
8x12x12	20@40	17@4	1326	175	12		21@30
10x12x12		23@2	1621		16		27@30
12x12x12		35@7	1853		18@		27@30

* 5 per cent off for cash.

	4x12x12			12x12x12
Boston	$0 24	$	1 52	$0 244
Minneapolis (f.o.b. cars)	072	11875		210
Minneapolis (delivered)	082	13@25		235
Cincinnati	0670	12@1		175
Kansas City	085	14@7		220
Denver	08	14@		21
Seattle (delivered)	12	2		30
Los Angeles (factory)	095	11@		22
New Orleans	12	2		30
Detroit (delivered)	070	18@		225
Montreal	09	1		30
Baltimore	14	2		30
Atlanta	0 07	1126		
Dallas	115			
Birmingham	10	17		
Pittsburgh (del.)	068	128		179

San Francisco, Philadelphia, Atlanta, New York quotations sell on partition b...

STRUCTURAL MATERIAL—Following are base prices f. o. b. mill, Pittsburgh and Birmingham together with quotations per 100 lb. from warehouses at places named:

	Pittsburgh, Mill	Birmingham Mill	New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in.	1.60	$1 85	$2.58	$4 00	$2 57½	$2 48	$3 10
Channel, 3 to 15 in.	1 60	1 85	2 58	4 00	2 57½	2 48	3 10
Angles, 3 to 6 in., ¼ in. thick	1 60	1 85	2.58	4 00	2 57½	2 48	3 10
Tees, 3 in. and larger	1 60	1.85	2 58	4 00	2 57½	2 48	3 10
Plates	1 60	1 85	2 58	4 00	2 57½	2 48	3 10

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Warehouse: Pittsburgh, Mill	New York: Current	New York: One Yr. Ago	Chicago	St. Louis	San Francisco	Dallas
½ in. and larger	$2.25	$3.50	$4.65	$3 10	$3 09½	$4 50	$5 50

CONE HEAD BOILER

½ in. and larger	2.35	3.60	4 75	3 20	3.19½	4 60	5 65
⅝ and ¾	2.50	3.76	4 90	3 35	3 35½	4 75	5 80
⅞ and 1	2.75	4 00	5 15	3 60	3 59½	5 00	6.05

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in. take an extra of 25c.

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh, Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire	$2 40@2.50	$3 15	$3 90	$5 00	$3.25	$4 95
Cut	2.25	5 80	5.90	7.75		5 00

PREPARED ROOFINGS—Standard grade rubbered surface, complete with nails and cement, costs per square, f.o.b., as follows:

	New York: 1-Ply l.c.l.	2-Ply l.c.l.	3-Ply l.c.l.	Philadelphia: 1-Ply l.c.l.	2-Ply l.c.l.	3-Ply l.c.l.
No. 1 grade	$2 10	$2 55	$3.00	$1 90	$2 35	$2 80
No. 2 grade	1.85	2 15	2 55	1 70	2 00	2 40

Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs $1.95 per roll in carload lots and $2.20 for smaller quantities f.o.b. Philadelphia.

Single shingles, red and green slate finish, cost $5.50 per square in carloads; $5 75 in smaller quantities, in Philadelphia.

ROOFING MATERIALS—Prices f.o.b. New York:

Tar felt (14 lb. per square of 100 sq.ft.) per roll of 432 sq.ft	$2 00
Tar pitch (in 400-lb. bbl.), per 100 lb	1.60
Asphalt roofing (in barrels), per ton, f.o.b. plant*	40.50
Asphalt felt (light), per ton, f.o.b. plant*	64.50
Asphalt felt (heavy), per ton, f.o.b. plant*	68.50

* Delivered in Metropolitan Dist., $3,00 additional.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill.

Blue Annealed	Pittsburgh, Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No 10	$2 40	$3 62½	$3 38	$4 15	$3 48
No 12	2 45	3 67	3 43	4 20	3 53
No. 14	2.50	3 72½	3 48	4 25	3 58
No. 16	2 70	3 82½	3 58	4 35	3 68
Black					
*No. 18 and 20	3 00	3 70	4 10	5 47	4 15
*No. 22 and 24	3 05	3 85	4 15	5 00	4 20
*No. 26	3 10	4 00	4 20	5 15	4 25
*No. 28	3 15	4 30	4 30	5 65	4 35
Galvanized					
No. 10	3 95	4 90	4 90		4 35
No. 12	4 00	4 90	4 90	5 90	4 45
No. 14	4 05	4 90	4 90	5 90	4 45
No. 16 to 21	4 15	4 90	4 90	5 90	4 75
No. 22 and 24	4 20	4 95	4 95	6 00	4 90
No. 25 to 26	4 35	5 00	5 00	6 20	5 05
No. 28	4 45	5 00	5 00	6 20	5 35

*For painted corrugated sheets add 30 cents to base for 16 to 28 gage. 25c for 19 to 24 gage; for galvanized corrugated sheets add 10 cents per gage.

LINSEED OIL—These prices are per gal...

	New York: Current	Year Ago	Chicago: Current	Year Ago
Raw in barrel (5 bbl. lots)	$0 91	$0 80	$1 03	$0 75

WHITE AND RED LEAD—Base price in cents per pound:

	Red — Current		Red — 1 Year Ago		White — Current Dry or In Oil	White — Yr. Ago Dry or In Oil
	Dry	In Oil	Dry	In Oil	In Oil	In Oil
100-lb. keg	12 25	13 75	13 00	14 50	12 25	13 00
25 and 50-lb. kegs.	12 50	14 00	13 25	14 75	12 50	13 25
12½-lb. keg	12 75	14 25	13 50	15 00	12 75	13 50
5-lb. cans	15 25	16 75	16 00	17 50	15 25	16 00
1-lb. cans	17 25	18 75	18 00	19 50	17 25	18 00

LUMBER

Prices wholesale to dealers in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in carload lots to dealers at yards. To contractors, $2 per M ft. additional.

	6–8 and 12 Ft.	10–16–18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$24 00	$24 00	$25 00	$30 00
3x6 and 8	25.00	25.00	26.00	31.00
4x4–6 and 8	25.00	26.00	27.00	32.00
3x10 and 12	25.00	26.00	27.00	32.00
3x14	29.00	30.00	31.00	33.00
4x10 and 12	25.00	26.00	27.00	32.00
4x14	29.00	30.00	31.00	33.00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft
6x10	$27.00	$30.00	$32.00
6x14	29.00	32.00	34.00
8x10	27.00	30.00	32.00
8x14	29.00	32.00	34.00

New York and Chicago—Wholesale prices to dealers of long leaf yellow pine.

	New York* — 20 Ft. and Under	New York* — 22–24 Ft.	Chicago — 20 Ft. and Under	Chicago — 22–24 Ft.
3x 4 to 8x8	$38 00	$39 00	**$39 00**	**$41 00**
3x10 to 10x10	41.00	42.00	**42 00**	**44 00**
3x12 to 12x12	43.00	44 00	**45 00**	**47 00**
3x14 to 14x14	47.50	48.50	**48 00**	**50 00**
3x16 to 16x16	52 50	53 50	**52 00**	**54 00**
3x18 to 18x18	60 00	61 00	**59 00**	**61 00**
4x20 to 20x20	70.00	71 00	**68 00**	**70 00**

*Wholesale price to dealers; to contractors, delivered from lighters or cars to job, $5 additional. Short leaf pine up to 14 x 14 costs $15 per M. less.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12 x 12 and under, for sizes over 12 x 12 add $2, for merchantable add $2 to sizes 10 x 10 and under. For pine add $2 to the price of merchantable for all sizes.

Other Cities

	8 x 8-In. x 20 Ft. and Under — P.	Fir	Hemlock	Spruce	12 x 12-In. 20 Ft. and Under — P.	Fir
Boston	$50 00	$52.00	$55.00	$45.00	$54 00	$52.00
Seattle	.....	**21.50**	.....	.....	.....	**21.50**
New Orleans	**26 50**	.....	.....	.....	**30 00**	.....
Baltimore	36 45	.....	.....	.....	38 50	.....
Cincinnati	39.00	50 00	.....	.....	40 00	64 00
Montreal	78.00	55 00	35 00	35 00	78 00	47.00
Los Angeles	.....	**44 00**	**43 00**	.....	.....	**44 00**
Denver	.....	35 75	35 75	35.75	.....	36 75
Minneapolis	**43 00**	**40 00**	**39 00**	.....	47 00	**40 00**
Atlanta	**32 00**	.....	.....	.....	**38 00**	.....
Dallas	33 00	.....	.....	.....	34 50	.....
Kansas City	33 00	34 00	.....	.....	36 00	35.00
Birmingham	21 00	.....	.....	.....	26 00	.....
Philadelphia	**36 50**	**39.00**	**42 00**	**47.00**	**46 50**	**38 50**
Detroit	40 00	45 00	.....	.....	45 00	44 00
St. Louis	35.00	.....	.....	.....	38 00	.....

	1-In. Rough, 10 In. x 16 Ft. and Under — P.	Fir	Hemlock	2-In. T. and Gr. 10 In. x 16 Ft. — P.	Fir
Boston	$47 00	$48 00	$32 00	$45 00	$48 00
Seattle	.....	**17 00**	.....	.....	**19.50**
New Orleans, at mill	**70 00**	.....	.....	**37 00**	.....
Baltimore	35.00	.....	.....	36 45	.....
Cincinnati	62 50	80 00	.....	33 50	.....
Montreal	35 00	48 00	35 00	80.00	45 00
Los Angeles	.....	37 00	36 00	.....	48 00
Denver	.....	30.75	**30 75**	.....	30.25
Minneapolis	**42 50**	37 25	**35 25**	**38 75**	**37.75**
Atlanta	**20 00**	.....	.....	**23 00**	.....
Dallas	34.00	30 00	.....	36 00	.....
Kansas City	35 00	34 50	.....	20 00	31 00
Birmingham	**20 00**	.....	.....	**22 00**	.....
Philadelphia	**29.50**	**37.00**	**43.00**	**32 50**	**37.00**
Detroit	42 00	33 75	.....	38 50	36.25
St. Louis	36 00	.....	.....	35.00	.....

Montreal—Up to 32 ft.; over which, $3.00 per M. increase up to 30 ft.
Birmingham—Quotes carload lots, f.c.b. sidings. $2.00 additional per M. ft. to contractor.
Boston and Cincinnati—Prices to contractors in carload lots, f.o.b.
Denver—Quotes dealers prices to contractor on large projects.
St. Louis—Wholesale price to contractors, $4.50@$6 per M ft. additional.

FREIGHT RATES

On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

Baltimore	$0 35	Detroit	$0 32
Birmingham	76½	Kansas City	81½
Boston	40½	New Orleans	51½
Buffalo	29½	New York	38
Chicago	38	Pacific Coast (all rail)	1 66½†
Cincinnati	32	Philadelphia	36
Cleveland	24	St. Louis	47½
Denver	1 32*	St. Paul	66

*Minimum carload, 40,000 lb.

†Minimum carload, 50,000 lb., structural steel only; 80,000, lb. for other iron steel products.

CONTRACTORS' SUPPLIES

STEEL SHEETPILING—The following price is base per 100 lb. f. o. b. Pittsburgh, with a comparison of a month and a year ago:

Current	One Month Ago	One Year Ago
$2.00	$2.00	$2.55

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern Territory New York and East of Missouri River
Hercules red strand, all constructions	30%
Patent flattened strand, special and cast steel	30%
Patent flattened strand, iron rope	15%
Plow steel round strand rope	45%
Special steel round strand rope	40%
Cast steel round strand rope	32½%
Round strand iron and iron tiller	15%
Galvanized steel rigging and guy rope	17½%
Galvanized iron rigging and guy rope	+2½%

California, Oregon, Nevada and Washington Discount 5 points less than discount for Eastern territory.
Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.
Arizona: Discount 10 points less than discount for Eastern territory.
Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.
North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ¾-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ¼-in., 8 ft., ½-in., 6; ¾-in., 4½; 1-in., 3½; 1¼-in., 2 ft. 10 in.; 1½-in., 2 ft. 4 in. Following is price per pound for ¾-in. and larger, in 1200-ft. coils:

Boston	$0 20	New Orleans	**$0 17½**
New York	.17	Los Angeles	.16½
Chicago	.19	Seattle	.18
Minneapolis	19½	St. Louis	.21
San Francisco	.17	Montreal	30
Atlanta	.21	Detroit	.19½
Denver	.20	Baltimore	.20
Cincinnati	.20	Kansas City	18½
Dallas	.29	Birmingham	.20½
Philadelphia	.17@.18		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin — 40%	Gelatin — 60%
New York	$0.2950	$0.3250
Boston	.24	.275
Kansas City	.24	.2750
Seattle	.1875	.2125
Chicago	.2450	.2750
Minneapolis	.2144	.2347
St. Louis	.2475	.2775
Denver	.2250	.2550
Dallas	.29	.375
Los Angeles	.23	.26
Atlanta	.2575	.2875
Baltimore	.2550	.27
Cincinnati	.2350	.255
Montreal	.215	.255
Birmingham, *delivered*	.155	.175
New Orleans	.2725	.3075
San Francisco	.195	.23
Philadelphia	.24	.27

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York.

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.13	$0.17½
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	0.17½	0.22
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	0.19½	0.24
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	0.23	0.32
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	0.25	0.34
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	0.32	0.38

SCRAP—The prices following are per gross ton paid to dealers and producers in New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

	New York	Chicago	St. Louis
No. 1 railroad wrought	$13.00	$11 50	$12.00
Stove plate	**12 50**	12 00	13.50
No. 1 machinery cast	18.00	16.50	14.50
Machine shop turnings	7.00@7.50	4.00	5.00
Cast borings	9.00@9.50	5 50	6.75
Railroad malleable cast	11 00	12 50	10.25
Re-rolling rails	**11 50@12.00**	13 00	15 00
Relaying rails	28.50@28.50	30.00	15.00

SHIP SPIKES—Current prices per 100 lb.:

In	San Francisco — Galv.	San Francisco — Black	Seattle Black
½	$6.75	$5 50	$8 55
⅝	6.30	5 05	8 25
¾	6.15	4.90	8 30

Pittsburgh base in lots of 200 kegs or more $2.50

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, President

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren, Editor

Volume 88 — NEW YORK, JUNE 8, 1922 — Number 23

Plain Tales from the Valley

SUPPLEMENTING the general account of the fight against the Mississippi flood, presented by our western editor in the issues of May 18 and May 25, we offer, in this issue and the next, two close-up views of unusual interest. L. R. Parmelee, who contributes the first of these, relates a stirring tale of how one community organized overnight to cope with a threatened levee break. A. L. Dabney, whose story will appear next week, tells of a struggle with the "devil's hole," an extraordinary maelstrom that gnawed and gnawed incessantly at a crumbling levee despite every expedient and every effort to subdue it. Engineers will know how to appreciate these stories, so well told by their professional brethren who have been serving in the thick of things.

Politics and the St. Lawrence

WHILE a different complexion is put on the St. Lawrence waterway situation by the statement of the Canadian premier that his country is not now prepared to enter into a treaty for the joint development of the river, the jubilation of the waterway's opponents over what they seem to consider the quietus of the scheme is somewhat hasty. Politics is not an unknown science, even in Canada, and there, as in this country, there are sectional "blocs" which have to be placated. Premier King's present stand means only that in Canada, too, there is division about the St. Lawrence and that this is not a propitious time to force the issue. It ought not, however, interfere with the economic investigation of the project which should be made and it will serve to convince a number of people of the untruth of the insinuation that the scheme is a Canadian effort to make the United States pay for a Canadian development.

"Competition" that Maintains Prices

BEWILDERED, we turn from a reading of Judge Gary's testimony before the Lockwood Committee in New York. The Steel Corporation, it appears, working at half capacity makes 45 per cent of the steel output of the country. Thanks to great volume and superior efficiency, it could sell its product for at least $3 per ton less than it does and still make money. If it should double its output and cut its price it might play havoc with its competitors; might, in fact, put them out of business. But, Judge Gary explains, that would never do, for then it would run the risk of dissolution by governmental action. Now, unified large-scale production is justified in economics on the ground of lower costs, and competition is designed to insure the lowest price warranted by the demand. But in our feeble efforts to guard against the possibility of an oppressive monopoly we follow a policy that withholds from the consumer the benefits of lower costs and taxes him to support a "dummy" competition of which the net result is to maintain prices to the considerable profit of the Steel Corporation. If we must interfere with the operation of economic processes is it not possible to devise a plan that will avert the danger we fear without denying to ourselves the benefits of large volume production and efficient management? Or is this the price we must pay for immunity from a possible abuse of industrial power?

A Different Power House

HYDRO-ELECTRIC power-house layout is naturally changing along with prime-mover design. The most obvious developments have been in the draft tube though there are suggestions as to siphonic discharge, accompanying inverted turbines, which make some difference in the power-house arrangement. A decided variation, with many points to commend it, is the layout adopted for the Mitchell plant on the Coosa River described on another page. Mr. Thurlow's ingenious adaptation of the hydraulic jump to avoid backwater has resulted in a distinctly different kind of power house in which each wheel has a setting separate from the others, in effect, a mass of concrete extending upstream from the dam. This permits an economy of machine space and of power-house structure, the latter being only a low removable roof over which travel the control cranes. The resulting structure is economical and compact, an admirable solution of the low head plant.

The Ultimate Producer

THE news from Europe indicates that Germany is making a strenuous effort to set her financial house sufficiently in order to justify a foreign loan. She proposes, for example, to stop printing paper money, to prevent the exportation of her own capital and to impose upon herself a régime of rigid economy, subject to supervision by her creditors. The loan, however, is not yet assured, nor will it be assured until it has won the confidence of the man in the street; for after all, it is the individual investor who must be satisfied as to Germany's ability and willingness to pay before he will lend her his savings. Again we are reminded that when all is said and done the economic world is beyond the control of statesmen and bankers. They may plan the engine and set it up—they may even guide it and manage it; but the motive power flows wholly from the hopes and the fears, the understanding and the energy, the distrust and the confidence of the plain people.

Estimating Brickwork Costs

SUCCESSFUL estimating of a construction job must be more than a rough approximation of the general items of expense. Nevertheless there is too great a tendency in preparing estimates to disregard minute details and to cover them by flat percentage additions. On the other hand, extraordinary refinements in making a bid are unnecessary. A proper balance, it ap-

pears, would be that system which makes, in effect, a self-sustaining contract out of each of the separate processes found on one construction job. Personal experience and tireless investigation of printed data only can adduce the information upon which to base safe and sound estimates. It is not often that a man makes an analysis of his own work except as he may benefit personally. When such analyses are made and published they are of inestimable value to the profession. This Mr. Dingman, whose treatise on estimating the cost of brickwork appears in this issue, has done. It is one of those articles which contractors will clip and display prominently when bids are being prepared.

A Novel Bridge Design

MOST exceptional in design is the 350-ft. arch of the Oregon City bridge described elsewhere in this issue. Concrete encased self-supporting steel arches for reinforcement of bridges are not new, the most recent example being the Springfield bridge described in these pages a few months ago, but gunite coating acting in effect as a heavy long-lived paint is unique for so large a structure. As Mr. McCullough points out in the article the problem, both as to topography and clearance and as to needed protection, was unusual and the design was adopted only after careful weighing of the various alternatives. It is apparent, however, that the suspected danger from the corrosive action of gases prevalent in the neighborhood was the governing factor which led to the substitution of gunite for paint, at what must have been a considerable excess cost. Whether there is an additional gain in appearance which might also justify the expedient must remain a question of individual preference or, at least, cannot well be decided until the bridge is completed.

To Chambers of Commerce

PRACTICALLY all of modern business is housed in fireproof office buildings. Erected during the last quarter century at a cost of untold millions of dollars, these structures are commonly believed to afford the contained business offices complete protection against destruction by fire. Unfortunately for this belief, the armor of the fireproof building is quite vulnerable. The fact has been known, though not very concretely realized, for a number of years, but the Burlington building fire of three months ago demonstrated it so plainly that the problem now is before us in definite terms.

It is a problem jointly of the business man and the fire-protection engineer. The latter is fully awake to the situation but the business man, who is not as closely in touch with the facts of the situation, still needs to be stirred to action. This work devolves on his own business organizations, the chambers of commerce; it is up to them to recognize the existence of the problem and bring it up for thorough discussion in business circles.

Virtually every office building is powerless to resist the fierce attack when fire in a neighboring building or group of buildings develops intense heat. Under such attack, windows will break or melt, and many stories simultaneously will be entered by fire and their contents destroyed utterly. A large factor of the result, moreover, is the heat produced by the contents of the building attacked; the current impression that there is little to burn or produce heat in a modern office is sadly in error. An office building surrounded by other fireproof buildings is virtually free from this exposure danger. But few are so fortunately placed. And, as the combustible building, and perhaps even worse, the building with highly combustible occupancy, are still common in even our best business districts, it is evident that many office buildings will continue to be subject to the exposure fire danger for years.

Lest the preceding be construed as making it appear that the fireproof building gives no protection whatever, it may be well to set down what it does and what it does not do in the way of protection to its contents. The modern office building is incombustible and indestructible; it furnishes no fuel to sustain a fire, except what its contents provide, and the most intense fire in one part of it will not wreck it and bring down the rest of the building. It affords absolute safety to human life; provision for egress and the protection of stairs and elevators have been worked out in brilliantly successful manner. Each floor is completely isolated from other floors with respect to fire transmission, so that one floor might burn out completely and not do injury on the floors above and below; indeed a fire might start anywhere in the building and everything outside of a relatively small compartment would be secure. The internal fire danger as a whole has been disposed of. The outside fire danger largely remains. Against mild exposure the building is fairly secure, by virtue of its incombustible walls. It is secure even against moderately severe exposure on those sides where its windows are glazed with wire glass (which is not generally the case with street fronts). But even with wire glass it is likely to succumb to a very severe exposure, and fire will then enter the window openings and will start intense fires in the papers and other combustibles of the contained offices, in which event the building is no better than a good furnace.

To the preceding we should add that the widespread custom of arranging full open floors without fire-wall subdivision increases the destruction when fire once enters. Interior fireproof partitions can be built, and many buildings have them; such partitions insure the safety of that portion of the building away from the outside exposure. Far greater danger attaches to the open floor construction. But even where there are interior partitions to stop the progress of a fire when one side of the building is attacked, the destruction of those offices directly adjoining the exposed side is sufficiently disturbing a contingency to warrant anxious care in providing safeguards.

More than the direct money values, the appraisable risk, it is necessary to consider the indirect values at risk. These lie in the business importance of office contents as part of a going machine, and the extensive disorganization that may follow the destruction of an office. Activities of great scope are likely to be paralyzed, or at least thrown out of gear for a time. Business is becoming increasingly interrelated, and year by year the individual office is likely to become more intimately interwoven with manifold business and industrial activities. It is therefore the concern of the entire business community, and ultimately of the entire country, to seek to attain more complete protection of the office building.

The risk of outside fire attack to which any one building is exposed is about as small as the chance of a dwelling being struck by lightning. Yet we insure against that and we put up lightning rods.

Several means are available to protect the office building against outside exposure. Window protection is the great difficulty to be dealt with. A minor one is the subdivision of floors by fireproof partitions. If windows can be protected perfectly, the whole problem is solved, provided those who own and occupy office buildings are willing to incur the necessary expense for this protection. If only imperfect protection of windows can be realized, the interior separation will be a further safeguard of great importance.

Wire glass is the first safeguard and the most necessary one; yet at the same time it is the least complete. It will not protect fully, but wire glass in metal frames represents a long step toward full protection against even maximum exposure, and is all that is needful against mild exposure. Automatic rolling shutters are a much more powerful resource, and in the opinion of some give promise of being the most ultimate complete protection. Water sprays arranged so as to play over the outside of the glass surface are reported to be highly effective, and inside sprinklers have shown considerable merit, though sufficient water supply is not easily provided and failure of supply means failure of the protection.

None of these protective means, however, are of any use until they are applied. They will not be applied unless business men and building owners quite generally appreciate the need for protection. To bring about this appreciation is no concern of the insurance companies, for the major loss in the destruction of office building contents is the uninsured loss which falls on the businesses involved and on the interests depending upon them.

The real interest in office building protection centers in organized business, and chiefly in those association of business men whose function it is to deal with the needs and problems of business. Chambers of commerce, in other words, carry the main burden of responsibility for making known the true situation with respect to the exposure danger of office buildings and for bringing about a study of the magnitude of danger and of protective means. If chambers of commerce will take care of the psychological part, there is little doubt that the fire protection fraternity will be found willing and eager to deal with the physical part of the problem.

Rivet Service and Tests

ELABORATE tests of rivet steel and rivets just reported by the Joint Committee on Sulphur and Phosphorus in Steel invite the structural engineer's attention for the information they may give on rivet quality. The primary purpose of the tests was metallurgical: to determine whether or not sulphur has a harmful influence on soft steel. However, as the committee chose for the work a series of steels approximating commercial rivet steel (except in point of sulphur), and as it used some of the samples for making rivets and subjected these to bending, heading-up and flattening treatment, the results afford extensive data on the mechanical properties of rivet bars and rivets. These data bring to the front the knotty question of how to predict rivet service by tests, a question never satisfactorily answered, we believe.

At first glance the newly reported test results create a confusing impression. The committee presents numerous plottings of the results of various kinds of test, but for unknown reasons it defers interpretations and analysis, without which a set of tables and diagrams is apt to contain many traps for the unwary. Further, as the plottings are all on a sulphur base, it is not easy to perceive the influence of other variables. But the tables of chemical composition show decided variations in carbon and manganese, and a study of the diagrams suggests that many of the ups and downs in mechanical properties match the manganese and carbon rather than the sulphur variations. From one point of view it may be said, therefore, that the committee investigated a rivet-steel range rather than a sulphur-content range.

The report covers a diversified list of mechanical properties, including not only the customary tensile strength, yield point, elongation and reduction of area, but also hardness, notched-bar impact, plain impact shear, cold bending, head flattening, and shearing strength (of riveted joints). Generally the values of all of them are seen to hold up well throughout the variation of conditions, except that yield-point strength is lowered by annealing and raised by quenching, while notched-bar impact is further affected unfavorably by increasing impurities. Forgeability, tested by the making of rivets, and cold-bend and cold-forging properties show no pronounced effect, though some of the high-sulphur bars when quenched—an abnormal treatment —could not be bent over flat. It should be remarked also that elongation varied much more than reduction of area, being more seriously affected by high sulphur, for example.

From the practical engineer's standpoint the first point to be settled in connection with such a series of tests is which of the samples are to be classed as acceptable rivet steels, and which, if any, ought to be rejected. Is tensile yield-point the main criterion? Can a certain figure be set as the minimum permissible elongation for rivet service? Does the bend test or the Charpy impact test mean anything for rivet use, since rivets are not subjected to any extreme bending or to notched-bar-impact conditions? If the practical requirements for good rivets are suitability for tight driving, high shearing strength, and ductility (both hot and cold) enough to insure against cracking and heads flying off, what is the simplest way of checking up on these requirements by advance test?

There are excellent reasons why such questions should be answered, if possible, in connection with the present test series. First, if any conclusions are to be drawn from the tests with respect to the influence of sulphur on rivet steel, it would seem to be necessary to know what constitutes good rivet steel, from the user's point of view. Second, if good rivet performance is adequately defined by certain ones of the tests, the present series of tests offers the best possible opportunity for shelving the unnecessary or purely fanciful tests.

The questions thus presented address themselves to the engineer rather than the metallurgist, but they are equally important to the latter, for only after they are answered in a practical way will the metallurgical findings from the tests have effective meaning. Incidentally, the answers will tend to improve present practice in specifications for rivet steel, whose variations indicate that they were developed from a knowledge of what properties ordinary commercial steel possesses, rather than from definite conviction as to the requirements of rivet service.

Large Steel Arch Bridge Ribs Encased in Gunite

Oregon Highway Bridge Has Central Span of 350 Ft. Made Up of Structural Steel With Thin Concrete Covering—Comparison of Alternate Designs Considered

By C. B. McCullough
Bridge Engineer, Oregon State Highway Commission, Salem, Oregon

A STEEL arch, 360 ft. between pier centers, 350 ft. between skewbacks, and encased in concrete applied with a cement gun is now being built by the Oregon State Highway Commission, as the main span of a concrete and steel bridge across the Willamette River at Oregon City, Ore. This unique type of bridge structure was decided upon only after an extensive comparative investigation into different types for the crossing. The considerations which governed the objection of the other types and the selection of this one, and the details of the bridge now being built are the subject of this article. The methods of erection, which also required some comparative study, will be discussed in a later article.

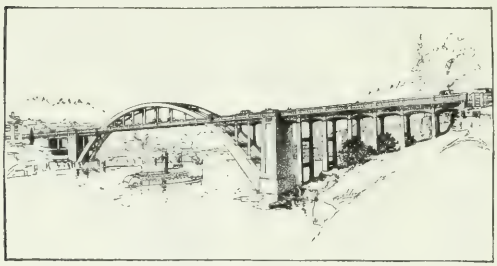


FIG. 1. SKETCH OF BRIDGE AT OREGON CITY

The bridge, 850 ft. in over-all length, is to carry the main Pacific Highway traffic over the Willamette River, and is located between the cities of West Linn and Oregon City. The site selected for this structure takes advantage of the natural topography, being the narrowest channel point within the limits of variation possible with the highway location; in fact, this point is one of the narrowest necks in the river for a very considerable distance either way. The Willamette at the bridge site flows in a well defined and very deep channel bounded by high cliffs of basaltic formation, the maximum stream depth at mean low water being over 100 ft.

The bridge crossing is, unfortunately, located in the immediate vicinity of certain large industrial plants employing sulphurous acid as a reagent, with the result that, at times, the atmosphere is more or less densely charged with sulphurous anhydride (SO_2). Corrosive action in this atmosphere appears to be considerably stimulated, and it was thought that an unprotected steel structure might impose an undue burden of maintenance upon the state. The city of Oregon City is located but 15 miles from Portland and is one of the biggest industrial and manufacturing towns in the state. The bridge, which will be a link in a highway surfaced on either side with heavy traffic pavement, will, therefore, be subjected to exceptionally heavy truck traffic as well as a large volume of pleasure traffic and pedestrian travel to and from the large paper mills that lie on the West Linn side. The waterway is navigable and fairly busy as regards river traffic, requiring a horizontal and vertical clearance not less than that shown in Fig. 1.

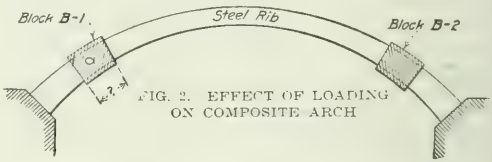


FIG. 2. EFFECT OF LOADING ON COMPOSITE ARCH

In order to meet the conditions above outlined and, at the same time, take advantage of the narrow and rock bound character of the stream crossing, preliminary studies were made for seven distinct types of construction and covering a period of nearly two years, with the following results:

Type A. Suspension Span—Abandoned because of the cost of making such a structure rigid enough to carry the heavy truck traffic without injury to the roadway pavement, and also because no feasible method of protecting the metal against corrosive influences presented itself.

Type B. Cantilever Span—Type C. Simple Truss Span and Type D. Spandrel Braced Framed Arch, were each tried successively, and were abandoned owing to the difficulty encountered in securing a suitable type of encasement or protective covering at a reasonable cost.

Type E. Reinforced-Concrete Arch—This type was abandoned owing to the great cost of supporting the centering for the extremely heavy and massive concrete rib. The great depth of the water coupled with the fact that the channel must be kept open at all times for navigation rendered the use of falsework out of the question. In this connection investigation was made of the use of suspended centering which was also discarded in favor of the more practical and positive method outlined under Type G below.

Type F. Steel Arch Rib With Poured Concrete Encasement—This type was considered a long time and complete details were at one time worked out for the same. Some very interesting problems were encountered a very brief mention of which may be in order.

The first scheme for this type employed an encasement designed to take a portion of the rib stress, in other words, the steel rib was simply utilized for supporting the formwork for a nearly solid concrete rib. The rib sections were to be poured block by block loading each rib simultaneously and symmetrically. It is readily seen that, as this load is placed, stresses of ever increasing magnitude are set up in the rib steel. When the rib itself is swung the stress at any point a has a certain value S_1 which may be easily determined. (See Fig. 2). Having the rib swung, the first voussoir or

rib block *B*-1 may now be poured. As soon as concrete pouring commences the rib starts to deflect under the additional dead-load so that at the end of this pour the stress in the steel is at some new increased value S_2. The concrete in the meantime is in a semi-plastic condition so that, if precaution is taken to thoroughly spade and "rod" the mass we may reasonable assume that at the end of the pour the stress in steel $= S_2$ and the stress in concrete $= 0$.

The addition of a second block *B*-2 anywhere along the rib now operates to increase the stress in the steel at point *a* to a new value S_3, the rib length L, is therefore shortened and a stress S_c, where

$$S_c = \frac{(S_3 - S_2)\,(E_c)}{E_s},$$

is at once set up in the concrete. Stresses of this kind, imposed upon *green* concrete undoubtedly shatter and break the initial set for which reason it would seem essential that each block be poured and allowed to set before any additional load was placed upon the rib. This scheme required so much time that it was abandoned in favor of a very thin, poured encasement, designed merely as a *protective coating* and not in any way as augmenting the stress carrying capacity of the steel rib.

This thin encasement presented a very difficult construction problem as regards pouring. It was felt that an encasement such as this would undoubtedly give the public a sense of security and that this must not be *false* security, in other words there must be no porous pockets with the consequent danger of the steel rusting underneath the concrete. An encasement, designed to insure the degree of density and positive protection considered essential, proved very costly and also imposed a very severe dead-load on the rib.

Before finally abandoning this type altogether, experiments were made looking toward the adoption of a *light-weight* aggregate. At one time this seemed to be the answer, however Type G described below had so much to recommend it, both in cost and serviceability that it was chosen as the final solution.

Type G—Steel Rib Arch Gunite Encasement—This design, which was the one finally adopted, contemplates the construction of a main channel span 360 ft. center to center of piers, flanked on either end by approaches of the reinforced column and girder type (see Fig. 1). At the Oregon City end is a retaining wall and fill, the wall being of the cellular type of comparatively thin concrete sections, heavily reinforced. The span carries a roadway 19 ft. clear width and two 4 ft. 6-in. sidewalks. It is designed as a half-through span to provide the required vertical and lateral clearances for navigation. The following loadings were used in the design:

Concentrated loading consisting of two trucks abreast of the following dimensions and weights:

Total weight	[illegible]
Weight concentrated on rear axle	[illegible]
Distance between centers of axles	[illegible]
Distance between centers of wheels	[illegible]
Length of roadway occupied	[illegible]

That portion of the roadway not occupied by the truck loading as above, was assumed as loaded with a uniform load of 70 lb. per square foot. The sidewalks

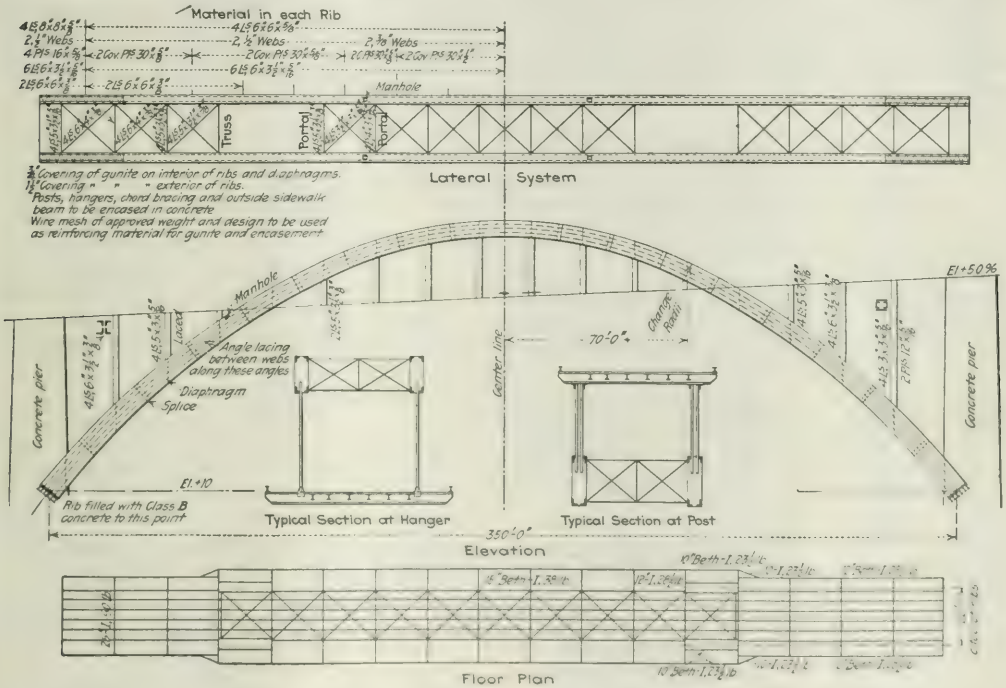


FIG. 3. STRUCTURAL STEEL MAKE-UP OF MAIN ARCH

were loaded with a uniform load of 60 lb. per square foot.

The stress analysis was made after the method of variable "rotation loads" or "elastic weights" described by the writer in *Engineering News-Record*, April 1, 1920, p. 675. Arch reaction and stress influence diagrams were plotted and the above loading placed in such manner as to produce the maximum rib stresses.

The main arch rib is of structural steel designed with particular attention to the requirements enumerated below:

1. To produce a rectangular section, thoroughly rigid, and with top and bottom cover plates to support the gunite encasement, which section at the same time would be accessible for field and shop riveting from the inside.

2. To so detail the section that all diaphragm angles and stiffeners would be inside leaving a plane rectangular surface for the application of the wire mesh and gunite encasement.

3. To allow for inspection of the interior of the rib both during and after construction.

The steel ribs are to be erected first, and swung as a three-hinged arch. Fig. 4 illustrates the nature of the temporary construction hinge provided in the design. A similar arrangement will be used at the crown.

As soon as the ribs are swung and the lateral system in place, 30 ft. of the rib at each skewback will be completely encased and filled with Class B concrete, thus rigidly fixing the ends. The crown hinge will next be replaced by a heavy splice connection designed to transmit the maximum thrust, moment and shear at the crown. The rib then becomes a fixed or hingeless arch under all additional dead and live loadings.

The main arch rib consists of a box girder section composed of four flange angles, two web plates and six to eight longitudinal stiffener angles riveted inside the rib. For the solid concrete section (extending out about 30 ft. from the skewback) four flange plates are added and the section laced top and bottom. For the balance

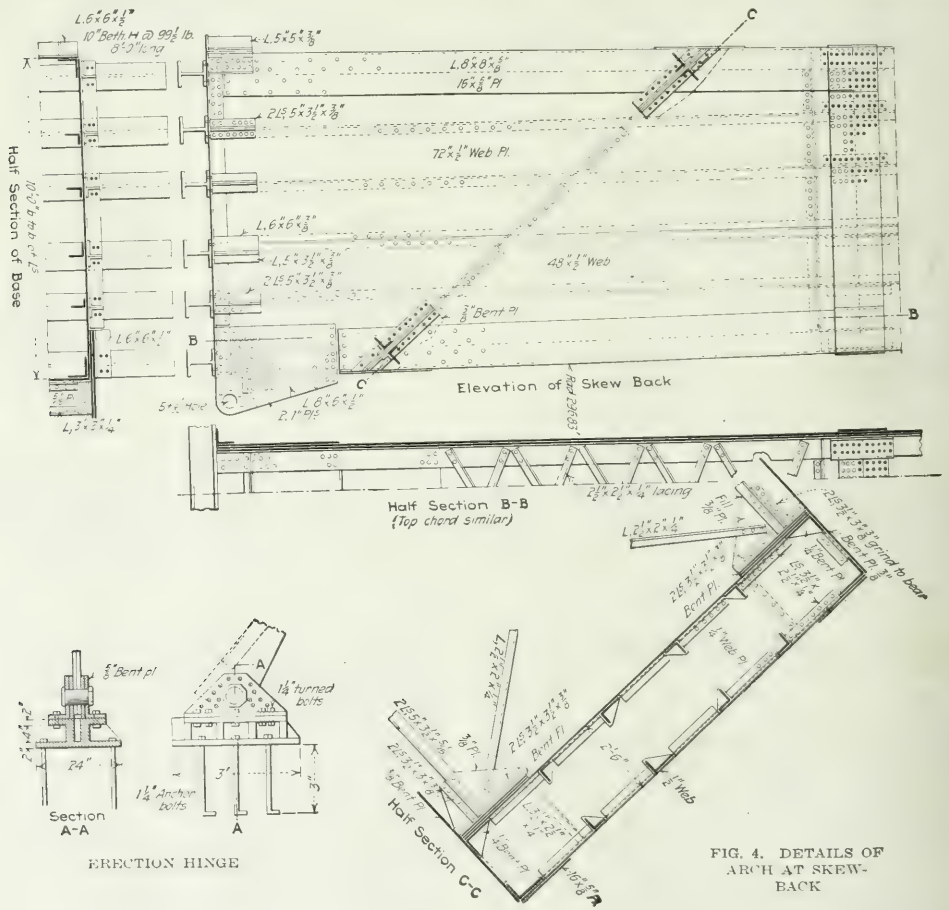


FIG. 4. DETAILS OF ARCH AT SKEWBACK

of the rib top and bottom cover plates are used in order to carry the encasement of gunite. Diaphragm plates are used to stiffen the rib as shown in Fig. 4, these being apertured with manholes to aid in construction and also to permit maintenance inspection from time to time. Manholes will also be left in the top cover plate at convenient points to permit access to the interior of the rib for future inspection of the condition of the

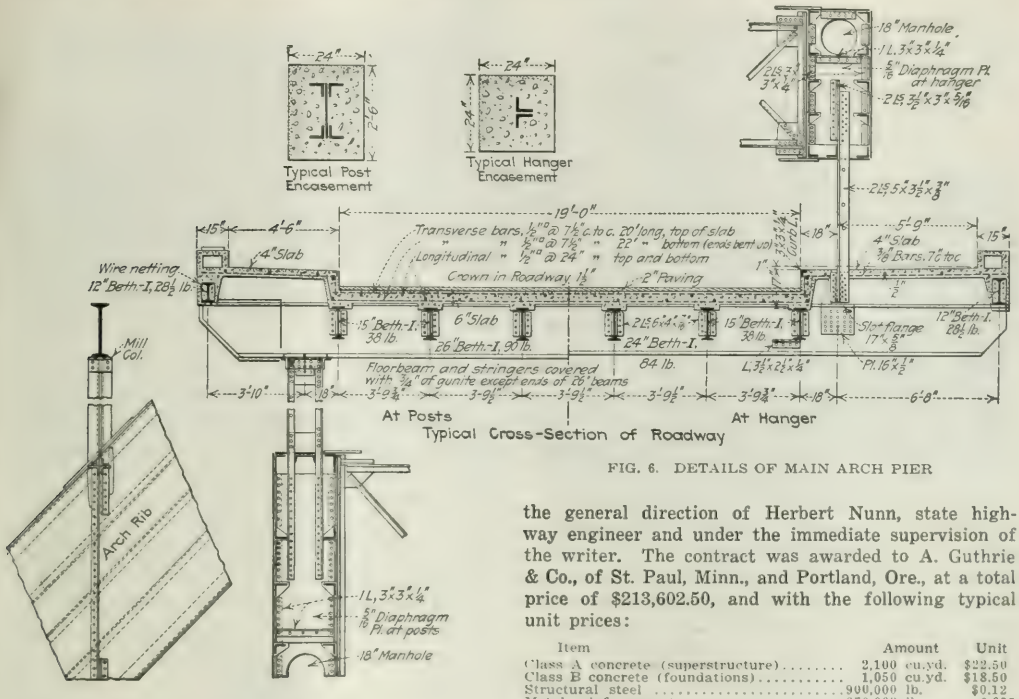


FIG. 6. DETAILS OF MAIN ARCH PIER

gunite. These manholes will, of course, be covered by removable hatches of non-corrosive material.

The general make up of the rib is shown in Fig. 3, and it has the following make up:

RIB

4	flange angles	8	x	8	x	in.
2	web plates		x 120			in. (approx.)
4	flange plates	16	x			in.
6	longitudinal stiffener angles	6	x		x	in.
2	longitudinal stiffeners	6	x	6	x	in.

CROWN

4	flange angles	6	x	6	x	in.
2	cover plates	30	x			in.
2	web plates	72	x			in.
6	longitudinal stiffener angles	6	x	3	x	in.

The inside of the section is to be covered with a ¾-in. gunite encasement, the exterior is to be covered with wire mesh and given an encasement of gunite 1½ in. in depth, finished with a carpet float.

The hangers and columns as well as all portal and lateral frames are to be completely encased in a solid poured concrete encasement. The structural frame used for the portal is to be encased in a curved and panelled portal beam. The entire lateral system is of similar construction. The floor system is of structural members encased in gunite as shown in Fig. 5.

Fig. 6 illustrates the general design of the arch piers. Under each pier provision is made for comfort stations and observation balconys which are entered from the floor elevation by stairways leading from the upper balcony. The fixtures for these rooms will be furnished and installed by the cities of West Linn and Oregon City.

The design and construction of this bridge is under the general direction of Herbert Nunn, state highway engineer and under the immediate supervision of the writer. The contract was awarded to A. Guthrie & Co., of St. Paul, Minn., and Portland, Ore., at a total price of $213,602.50, and with the following typical unit prices:

Item	Amount	Unit
Class A concrete (superstructure)	2,100 cu.yd.	$22.50
Class B concrete (foundations)	1,050 cu.yd.	$18.50
Structural steel	900,000 lb.	$0.12
Metal reinforcement	270,000 lb.	0.055
¾-in. gunite	23,000 sq.ft.	0.17
1½-in. gunite	22,000 sq.ft.	0.29

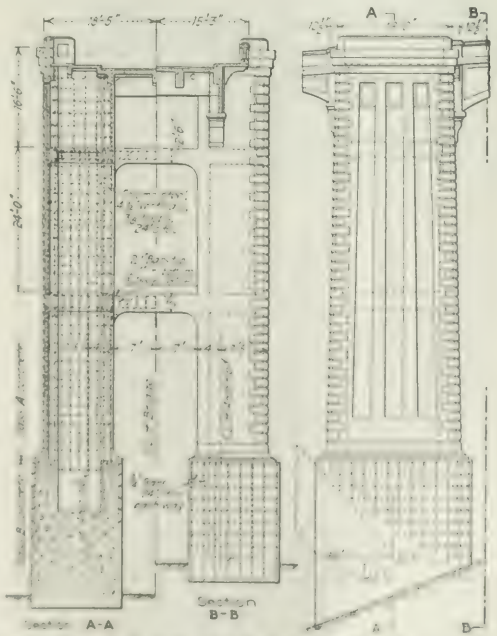


FIG. 6. DETAILS OF MAIN ARCH PIER

Fighting the Mississippi Flood at Oldtown, Arkansas

How One Community Managed To Hold Caving Levee — A Close-up of One Episode in the Battle Along the Mississippi

By L. R. Parmelee
Civil Engineer, Helena, Ark.

Oldtown, Ark., an old boat landing, is 20 miles below Helena, on the Mississippi River. One mile farther down the river at milepost 21-22 of the Cotton Belt Levee District occurred one of the most serious of the highwater fights that took place during March, April, and May, 1922. The Oldtown fight was successful.

Milepost 21-22 is on the outside of a great turn in the river known as Oldtown Bend. The channel of the river, in the bend proper, has moved westwardly about 2,000 ft. in the last 25 years. High velocities prevail. About 16 years ago abattis dikes were built by the government several miles upstream from milepost 21-22 in an effort to change the line of direction of the current and thereby break its force away from the Arkansas shore. The bend has been revetted throughout mile 21 and for some distance above and below it. This revetment consists of the usual willow mat weighted with stone, accompanied by either stone or concrete paving for some width up the bank. It was done in the years 1907 to 1910 inclusive and has had some replacements since.

On March 23, with the river reaching flood stage at this point, sections of the revetment had failed and the bank had caved angularly to within 39 ft. of the levee crown. On March 29 the caving had entered the levee, still angularly, to within 16 ft. of the levee crown, and on the night of March 29 it caved into the crown. On the night of March 31, 150 ft. of the crown itself caved, leaving a face along the banquette, and on April 2, April 12, April 22, May 5, and May 13, further caves occurred penetrating the banquette 20 ft. in two places and leaving it exposed along a front of 250 ft. The overall width of the caving at this time was 500 feet.

From the time of the first caving, preliminary steps were taken to control it but it was not thought that the situation was very serious until the caving of the night of March 31. At this time, considering the intervals between the previous caving and the wide front suddenly exposed, it was reasonable to presume that caving would continue through the banquette, within 72 hours unless it was greatly retarded.



FIG. 2. BREAK IN MAIN LEVEE

The men on the left are walking on the first sub-levee which was thrown around the break just in time to hold the river. The upright sticks in the left background are in the core-wall of the second sub-levee.

Plans were made immediately to stop, if possible, the erosion on the front; to build a sub-levee of sandbags on the banquette; and to start a second sub-levee of sandbags, with a timber core-wall, as far back as conditions would permit. These sub-levees were started from a point immediately behind the center of the exposed face and carried in both directions to connect with the main levee. Until the sub-levee on the banquette was completed efforts were concentrated on that work, but from very nearly the beginning of the fight the three phases of the work were carried on simultaneously, or in the following order: completion of sub-levee on banquette, protection of face of levee, and the building of the sub-levee with the core-wall.

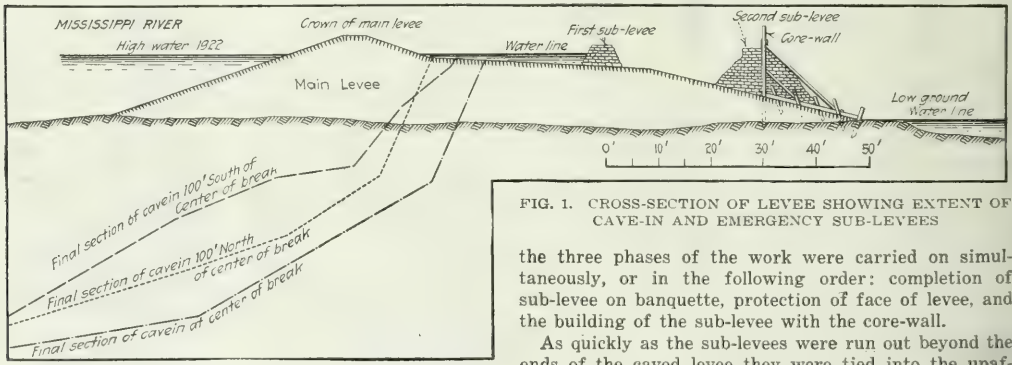


FIG. 1. CROSS-SECTION OF LEVEE SHOWING EXTENT OF CAVE-IN AND EMERGENCY SUB-LEVEES

As quickly as the sub-levees were run out beyond the ends of the caved levee they were tied into the unaffected crown of the main levee. When the first enclosure was being made from the sub-levee on the banquette the river had already begun to pour in. The space between the first sub-levee and the crown of the main levee where it was intact, and between the first and second sub-levees was divided into chambers by means of cross walls so that the fight could be centered on the particular chamber into which the caving might penetrate.

The work on the front, the making and placing of the "mattettes," required some experimenting. At first they were built of cotton bagging sewed on steel mesh, which in turn was fastened to a framework of steel bars. They were made 8 x 40 ft. in size. It was found, however, that they were not flexible enough to fit the section of the caving face. So they were next made of 1-in. mesh chicken-wire covered with two layers of cotton bagging with a 2 x 4-in. stick laced in as a cross-piece at one end, and a 12-in. cylinder compactly filled with rock and then sealed, at the other. The mattette proper was wrapped tightly around the cylin-



FIG. 3. GENERAL VIEW OF BREAK SHOWING TWO EMERGENCY SUB-LEVEES

This picture was taken looking along the first sub-levee, which held the flood. The break in the main levee may be seen in the left middle-ground while on the right appears the second sub-levee with its timber core-wall. The cross-levees shown in Fig. 4 were built later. The ropes crossing the first sub-levee hold the "mattettes" hung over the caving face to protect it against further erosion. Some of these may be seen on the crown of the main levee.

der, and a ¾-in. tie-line attached to the 2 x 4-in. stick. The roll was then carried to the place at which it was to cover the caving face, eased into the water and held until it was thoroughly saturated and all the air had been excluded from the cylinder, and then turned loose to unroll. The mattettes took the position intended for them very nicely. The later units were 5 ft. wide and 50 ft. long, and had ½-in. steel cross-bars every 10 ft. of length.

As a rule they rolled out until the weight of the cylinder could be felt. They were then securely tied back with the ¾-in. rope. The mats were lapped one over the other, and at some points laid in layers. Just how much good they were is problematical. It is significant, however, that after their use was begun the caving was retarded from 48-hr. intervals to 10-day intervals.

The entire job, as outlined and carried out, involved the moving by hand of 4,000 cu.yd. of dirt in bags, an average distance of 700 ft., the erection of a timber core-wall containing 60,000 ft. b.m. of lumber, fabrication and placing of mattettes consisting of 10,000 lb. steel bars, 10,000 sq.yd. bagging, 5,000 sq.yd. of poultry wire, 12,000 lin.ft. of ¾-in. rope; two electric light units, carbide lamps, tools, equipment, etc., and the



FIG. 5. FRONT VIEW OF BREAK IN MAIN LEVEE

This shows clearly the "mattettes" spread over the caving face of the levee to prevent further erosion.



FIG. 4. [illegible]

[illegible]

feeding and sleeping of 1,000 men. Sixty per cent of this work was done within 72 hours, during which time there was a rainfall of 2 in., and the remaining 40 per cent during the following 3 weeks as the conditions demanded. Eighty per cent of the equipment, tools, and supplies were brought from Helena, a distance of 18 miles. Sacks came 100 miles from Memphis. The light units came 150 miles from Little Rock.

Work was organized and carried on as follows: The serious break of March 31 occurred at 11 p.m. The commissioners for the Levee District were immediately notified, and after they had made a rapid reconnaissance of the damaged levee they called a meeting of about 25 of the representative business men of Helena. These men included plantation owners, millmen, and [illegible] and professional men. The situation was made plain, the need of immediate action emphasized, and a request made for the entire co-operation of all present. The result was that men, tools, and material were rolling towards the scene of the threatened break within three hours.

An office was established in Helena and one at the site of the work. Special telephone service was arranged. Order clerks were appointed, a truck fleet organized, and riders put on the route of the line of supplies. A quartermaster department was established in a large quarterboat furnished by the government. There was some confusion during the first few hours, after which, however, things moved smoothly and surely. Dawn of April 1 saw 600 laborers filling, sewing, carrying and placing sacks in the first sub-levee. Soon afterward carpenters had made a good start on the core-wall of the second sub-levee. Supplies had been delivered to the quartermaster, who fed several hundred at breakfast, and 600 at noon. The men were fed at the rate of 100 every quarter-hour.





FIG. 6. PLACING "MATTETTES" TO PROTECT FACE OF CAVED BANK

This shows the placing of a mattette as originally designed with a wire mesh reinforcement. This was found to be not sufficiently flexible to conform to the face.

Here is shown the placing of a "mattette" of revised design, in which chicken-wire was used to reinforce the cotton bagging. Each unit was 5 ft. and 50 ft. long.

As stated in the beginning the fight was successful and the impending breach did not occur. No intricate engineering problems were involved—no work under ground or above ground. In fact it was all very much on the ground. The job was a problem of organization and execution. Furthermore, it was a problem of organization and execution dependent on the citizenship of the community. We believe that it came through.

It is well to remark here that the success of the fight was due, in a great measure, to the fact that one of the improved highways of the county runs to within one mile of the seat of the trouble. This particular highway has a mixed bituminous wearing surface on a 5-in. concrete base. It connects Helena and Oldtown, and all supplies, materials and men were hauled over it.

The Cotton Belt Levee District is in the Second District of the Mississippi River Commission in charge of Major J. M. Hodges, C. of E., U. S. Army, with headquarters at Memphis. Luther Y. Kerr is assistant in charge of levees, and M. Gardner assistant in charge of channel work. W. K. Monroe is assistant engineer to Mr. Kerr and the writer was retained by the commissioners of the district as engineer. The commissioners of the district are W. F. Craggs, president, H. D. Moore, secretary, and W. H. Howe, all of whom were on the ground in direct charge of the work.

Highway Bridge Survey by U. S. Engineers

A compilation of data on bridges in the Louisville district is to be made by the U. S. Engineer Office at Louisville, Lt.-Col. G. R. Lukesh in charge. City and county engineers in the district are aiding the government in the compilation.

On the Proper Value of Kutter's *n* for Sewer Computations

Existing Data Based on Actual Sewer Conditions Scanty—Overlooked Federal Bulletins —Suggestion for *n*

By Charles W. Sherman
Of Metcalf & Eddy, Consulting Engineers, Boston, Mass.

CONTRARY to general impression, the commonly accepted values of n used in computing flow in sewers are not supported by many experimental data. Most of the experiments upon which reliance is placed have been made with clean water, rather than sewage, and by far the greater part of the determinations of n for flow in pipes have been based upon flow in closed pipes under pressure, and upon other materials than those used for sewers. The values of n adopted have been assumed after comparison and upon the basis of analogies, real or fancied, between the conditions existing in the tests and those likely to exist in sewers; or else the coefficients have been adopted by making arbitrary allowances for the assumed effect of the different conditions. The following review of existing data, particularly the too-generally-overlooked Scobey and Varnell-Woodward bulletins of the United States Department of Agriculture, is designed to show (1) that $n = 0.015$ should be used in pipe sewer design; (2) that n for concrete sewers should be 0.013; (3) that tests under actual working conditions should be made to remove such doubts as to the proper values for n as still exist; and (4) that for pipe sewers not flowing full, n is not a constant and therefore Kutter's formula is not properly applicable.

Among the best of the lists of values of n applicable to various cases, is that of Robert E. Horton, published in *Engineering News* of Feb. 24 and May 4, 1916, and reproduced in King's "Handbook of Hydraulics." Mr. Horton recommends for vitrified sewer pipe the value of 0.013 for pipe in good condition and 0.015 in fair condition; for clay drainage tile, 0.012 and 0.014; for brick sewers, 0.013 and 0.015; for cement mortar surfaces, 0.012 and 0.013; for concrete pipe, 0.013 and 0.015. No modification of the value of n is given in case sewage instead of clean water is flowing.

Significance of Slight Change in n—Many engineers do not appreciate how much difference in computed velocity or capacity may result from a slight change in the value of n. Within the ordinary range of sizes

of common sewers, it may be stated that the computed capacity using $n = 0.013$ is approximately 22 per cent greater, and with $n = 0.011$, 50 per cent greater, than with $n = 0.015$.

Of the experimental values quoted in Hering and Trautwine's translation of Ganguillet and Kutter's book but few are in any way applicable to conditions existing in sewers unless the cast-iron pipes under pressure be assumed as comparable. The list includes one earthenware pipe 1.5 ft. in diameter, run under a slight head (Bidder, 1853). Experiments of Eliot C. Clarke, in 1885, upon the Dorchester Bay sewage tunnel of the Boston sewerage system, with the tunnel 7½ ft. in diameter running full and under pressure, showed values of n = approximately 0.014 for a mixture of sewage and salt water, and ranging up to 0.020 for sewage only. Experiments of Fteley and Stearns in 1880 on flow in the Sudbury aqueduct of the Boston waterworks may also be applicable to brick sewers, although allowance should be made for the fact that the experiments were made with clean water.

Metcalf and Eddy's "American Sewerage Practice," Vol. I, p. 80 and following, contains data upon experiments for determining values of n but they relate largely to flow in streams and canals. Those most applicable to sewers relate almost wholly to large conduits and only two of the eight in the list, given below, refer to pipe sewers:

Theodore Horton, 1901. Boston Metropolitan sewers, from 6 to 9 ft. diameter (brick sewers).
F. C. Coffin, 1906. Cambridge water-works conduits 3½ ft. diameter (concrete).
Bureau of Surveys of Philadelphia, 1909. Large brick and concrete sewers.
James A. Cushman, 1911. Wachusett aqueduct.
John Ericson, 1911. Chicago water-works tunnels, brick lined.
C. F. Schultz, 1912. Cleveland water-works tunnels, brick lined.
H. D. Newell, 1913. 16-, 30-, and 100-in. concrete pipes (no water).
T. Chalkley Hatton. 24-in. vitrified pipe sewer at Carlisle, Pa.

The Only Record Based on Sewer in Use—A search through periodical literature since 1915 has brought to light but one record from which some information as to the actual value of n in sewers can be obtained. H. D. Silliman, in a letter to *Engineering News*, Dec. 2, 1915, describing sewer gagings at Seattle, says:

> The running time . . . . was calculated by using Kutter's constants, $n = 0.013$ for pipe sewers, and $n = 0.015$ for brick sewers . . . . In all the velocity measurements that I have made, I have not found an old sewer that had more than 90 per cent of its calculated velocity using the foregoing constants. Some ran as low as 75 per cent of the calculated velocity.

If we assume observed velocity in a 12-in. vitrified pipe as 85 per cent of the computed velocity, as above, this would correspond approximately to the result obtained by using $n = 0.015$ instead of 0.013. In other words, Mr. Silliman's measurements may be assumed to indicate the actual value of n in pipe sewers to be approximately 0.015.

Valuable Federal Bulletins—In view of the unfortunate scarcity of experimental data available to pipe sewers and to concrete sewers of small and moderate sizes, which have hitherto been available, two recent professional papers of the United States Department of Agriculture deserve the attention of hydraulic engineers, comparatively few of whom seem to be aware of their existence. Reference is made to "The Flow of Water in Concrete Pipe," by Fred C. Scobey and "The Flow of Water in Drain Tile," by D. L. Yarnell and S. M. Woodward, both published in 1920.

Mr. Scobey's Paper describes a number of experiments made by him and also brings together all of the available data relating to other experiments on flow in concrete pipes and conduits, not only when flowing full under pressure, but also when flowing part full, the latter being especially applicable to conditions ordinarily obtaining in sewers. These include one 10-in., one 22-, and one 31-in. pipe, but no others less than 36 in. in diameter; and the data compiled are, therefore, inadequate upon which to base conclusions with regard to flow in concrete sewers of small size, although they are reasonably complete for large conduits. Mr. Scobey's conclusions regarding the proper value of n are as follows:

> For first-class pipes and conduits carrying filtered water, or water from which deposits or growths do not accrue, both surface and joints being practically perfect, $n = 0.0115$;
>
> For well made pipes and conduits with first class joints, smooth monolithic pipes or conduits when new and clean, with thoroughly good surfaces but not as smooth as those classed as glazed, corresponding in general to the surface obtained by a wash coat, $n = 0.012$;
>
> For well made pipes carefully jointed or monolithic, without appreciable irregularities at the joints, or for waters containing a small amount of sewage, $n = 0.013$.

It should also be noted that the experiments indicate that the value of n increases slightly with the size of the conduit, or with increased values of r for the same conduit; or, put another way, a slightly larger value of n should be assumed for a 6-ft. conduit than for a 2-ft. conduit with similar interior surfaces.

The present writer concludes from these experiments that for concrete sewers with clean interior surfaces, made on metal forms, with thoroughly good workmanship, the value of n should be taken at about 0.0125; and that making allowance for the effect of a surface coating of grease, and possible small deposits of sewage solids, a value of not less than 0.013 should be used.

The Yarnell-Woodward Bulletin—The most significant available data upon actual values of n in pipe sewers are those given by Yarnell and Woodward in their already-mentioned paper. The drain tiles experimented upon were of concrete and clay, nearly all in 1-ft. lengths, and the joints were made without mortar by butting the pipes together. The experiments were made with the greatest care, the pipes being laid in a wooden trough and surrounded by earth. Proper grades were obtained by changing the inclination of the trough, and uniform depth of water was maintained by adjusting movable dams. Experiments were made for various depths of flow, from approximately half-full to substantially full, and with pipes from 4 to 12 in. in diameter. A few experiments were also made with 10- and 12-in. pipe purposely laid with bad alignment.

These experiments show that with pipes well laid and running substantially full the value of n in Kutter's formula was approximately 0.011. Clear water was used in the experiments and a higher value of n would necessarily be assumed for sewage.

Bearing in mind the fact that drain tile are not distorted in burning to the extent that is common in vitrified sewer pipe, and that the surface is rougher in sewer pipe than in most drain tile, it is probable that

further allowance should be made for this in designing sewers, by using a higher value of n. The experiments with 10- and 12-in. drain tile in poor alignment indicated values of n of about 0.012 and 0.013, and these may probably be assumed as more nearly the correct values for sewer pipe with clean water flowing.

Experiments upon the flow of sewage in sewer pipe seem to be entirely lacking (except Mr. Silliman's gagings, the details of which are not reported), and the still further allowance which should be made in assuming a proper value of n for design, on account of the difference in character of the liquid, and also because of the effect of the coating of grease and slime upon the inside of the pipes, and possible deposits of grit or of organic matter, can only be estimated approximately. It seems to the writer that it would be prudent to assume not less than 0.015 for n in pipe sewers.

When Pipes Not Substantially Filled—Yarnell and Woodward's experiments show that when the pipes are not substantially filled, materially higher values of n obtain, and no general formula by which the flow for any depth could be satisfactorily computed was discovered. In general, the values of n ranged from 0.011 to 0.014 with pipes partly full when using clean water, in the case of the well-laid pipes, and from 0.011 to 0.020 for poorly-laid pipes, but no consistent relation between the depth of flow or the hydraulic mean radius and the value of n was developed. The authors suggested several formulas which represent the results of their experiments with a fair degree of accuracy, one for 0.5 depth, another for 0.6, and so on; but how far any of these might be applicable to estimating flow in sewers is questionable, as there seems to be no satisfactory basis for allowing for the difference in the character of the conduit or for the effect of sewage instead of clean water, or for accumulations of grease or deposits, especially as the same value of n as for a full pipe cannot be used.

The data contained in Scobey's paper are sufficient to show that Kutter's formula is applicable to computations of flow in concrete sewers, say 3 ft. in diameter and upwards, with a good degree of accuracy. Perhaps slightly larger values of n should be used for large than for small sewers, although it is probable that the effect of slime and grease on the interior surface, and of deposits of solid matter, would be proportionately less in large than in small sewers, so that it appears reasonable to adopt a single value for design of concrete sewers of any size. It appears that a value of $n = 0.012$ for clean water, and $n = 0.013$ for sewage, is probably applicable to such surfaces as would ordinarily be obtained in sewers built on metal forms.

With Pipes Substantially Full—For pipe sewers, the Yarnell and Woodward data indicate that, with clean water flowing and with the pipes substantially full, a value of $n = 0.011$ is applicable to drain tile in perfect alignment, and (probably) $n = 0.012$ to 0.013 for sewer pipe. Larger values should be used for sewage, not less than 0.014, and probably 0.015 would be safer. Mr. Silliman's observations, that actual velocities were materially less than those computed with $n = 0.013$, the difference being approximately such as to indicate that the actual velocities would correspond closely with computed velocities for $n = 0.015$, further confirm the view that the latter value should be used in design. The utilization of the full capacity of a sewer is contemplated in design, and this is the condition in which Kutter's formula has been found to apply—i.e.—a pipe substantially full but not under pressure.

Yarnell and Woodward's experiments have, however, demonstrated that Kutter's formula is not satisfactory as a basis of estimating flow in sewers running partly full. Under such conditions, other factors than the condition of the surface have an effect upon the flow, and no satisfactory basis of allowing for such influence has yet been found. Attempts to gage the flow in pipe sewers by observing the depth and slope, and computing the velocity by Kutter's formula, using assumed coefficients, must, therefore, be recognized as unsatisfactory, since the actual variations of n with pipe partly filled have been found to be such that errors of 50 per cent or more might readily result.

Conclusions as to Concrete and Pipe—The data available and reviewed above seem to indicate that in the design of sewers under usual conditions, values of $n = 0.013$ for concrete and 0.015 for pipe sewers should be used. These values have been employed in the practice of the writer's firm for some time, and are in accordance with the recommendations in "American Sewerage Practice," Vol. I, p. 94, except that it is there suggested that a value of $n = 0.012$ should be used "for concrete sewers of large section and best work laid on slopes giving velocities of 3 ft. per second or more." It now seems to be definitely shown that, for a given character of surface, somewhat larger values of n are found for large than for small channels, and it is therefore believed that a value of 0.013 should be used for all concrete sewers, if well-made with smooth interior surfaces.

It should be noted further that the use of the above values of n—0.013 for concrete and 0.015 for pipe sewers—is justified only when no other losses than those due to friction are to be included. In cases where there is appreciable curvature, allowance should be made for its effect by estimating it separately, or by arbitrarily assuming an increased value for n. Changes of direction in pipe sewers are usually made in the manholes, and it is a common practice to allow an additional drop in such manholes, which is assumed to be sufficient to overcome the resistance of the curve. Unless such an allowance is made, it is probable that a higher value for n than 0.015 should be used in the design of pipe sewers.

Because satisfactory experimental determinations of n for sewers are few in number, particularly for pipe sewers, it is much to be desired that advantage should be taken of every opportunity for making actual measurements of velocity and comparing them with slope, cross-section, character of surface, etc. Such information may perhaps make possible the future development of a more satisfactory formula for flow in sewers.

Buffalo Water Consumption Falling, but Still High

Since the campaign against excessive water waste was begun at Buffalo in 1917, the daily per capita water consumption has fallen from 339 gal. for the fiscal year 1916-1917 to 227 gal. for 1921-1922. During the same period the pumpage has declined from an average of 168 to 117 m.g.d. and the total yearly pumpage from 61.49 to 42.76 billion gallons. George C. Andrews is Water Commissioner of Buffalo.

Failure of Concrete Arch Bridge Due to Pier Washout

Undermined Shale Foundation Tips Pier Supporting 90-Ft. and 110-Ft. Spans—Arches Fall Six Weeks Later

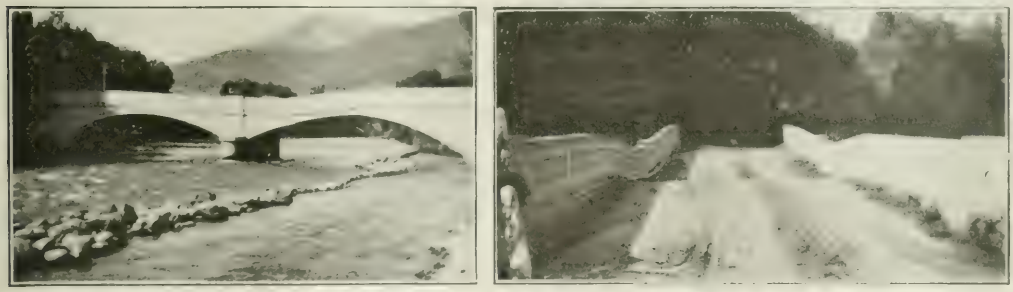
TWO spans of a concrete arch highway bridge crossing the Eel River near Brazil, Ind., known as Brunswick Bridge, collapsed on April 20, as the result of undermining of one pier several weeks before. The bridge consisted of a central 110-ft. span flanked on either side by a 90-ft. span. It was built in 1917 to replace a 190-ft. span washed out by flood. The design was made by Daniel B. Luten, and the National Bridge Co. built the structure.

The following account of the washout and failure has been prepared by Mr. Luten at the request of *Engineering News-Record:*

"In March, 1922, a flood of substantially the same height as the record high water of Easter week, 1913, undermined one of the piers, which tipped 18 in. upstream, indicating a settlement of about 4 in. under its upstream end. The arches remained standing, however, and traffic was continued across the bridge, although the bridge was posted as dangerous. Recommendations were made for saving part of the structure, but the high water continued for so long and to such an extent that the proper support could not be provided, and after five or six weeks the two spans supported by the undermined pier collapsed. The third span remains standing.

"The design called for piled foundations under the abutments 19 ft. below low water, and under the piers 23 ft. below low water and 11 ft. below the deepest part of the stream. It was found impossible to drive piling more than 4 ft. in the south abutment, and excavation continued 4 ft. deeper, when shale was encountered. The north abutment was placed on coal, without piling, at the depth required by the plans (19 ft.), and the two piers were placed on the shale strata at their required depth (23 ft.). This shale, while apparently a secure footing, must nevertheless have been attacked by the currents, causing the collapse of the two spans.

"The punishment sustained by the two arches, which remained standing for over a month [illegible] subjected to unequal settlement, is more than paralleled by the bridge across the Eagle River at Gypsum, Col., shown in the accompanying photographs. The two spans are 60 ft. each. The pier was undermined by a flood in 1916 and settled 10 in. at one end and 4 in. at the other, but the arches remained standing, in the condition shown in the view. Traffic on a transcontinental highway has continued across the structure to the present time without repairs, which were postponed by the county because of the cost."



EAGLE RIVER BRIDGE STILL STANDING SIX YEARS AFTER PIER SETTLED
A similar pier settlement at the Eel River bridge near Brazil, Ind., resulted in collapse of the arches after six weeks.

Water Company Sued for Typhoid Damages

Suits for damages totalling nearly $300,000 have been brought against the Blue Ridge Water Supply Co. of Walnutport, Pa., by some thirty residents who allege that the supplying of polluted water caused typhoid, sickness and death. *Engineering News-Record* is informed by T. McKeen Chidsey, of Easton, Pa., counsel for the plaintiffs, that owing to water shortage the flow of a spring was diverted to one of the water company's reservoirs through an open channel. It is alleged that this channel received pollution from various sources, including the overflow from a privy. It is maintained that this spring should have been protected from possible contamination and that the water should have been conveyed through closed conduits. Mr. Chidsey states that under Pennsylvania practice the plaintiffs in such cases "need to aver and do aver only the fact that they drank the water and that the water was polluted, due to neglect."

From C. A. Emerson, Jr., chief engineer, Pennsylvania Department of Health, *Engineering News-Record* learns that of 53 cases of typhoid during the outbreak, about 80 per cent had onsets from June 13 to 21, 1921. All the persons suffering from typhoid had used the public water supply and no other probable common cause was found. Laboratory findings of the State Department of Health indicated sewage contamination of the water but no active typhoid case or carriers could be located on the watershed. From circumstantial evidence it seems that the outbreak was caused by the water supply. One of the springs forming the supply, Mr. Emerson states, was [illegible] may have been polluted while being used by an itinerant typhoid carrier.

Walnutport borough has a population of about 1,000. The water supply in question, Mr. Emerson states, was never approved by the State Department of Health. In fact, its existence was only learned of by chance a few weeks before the outbreak.

Grade Reduction Increases Train Loads on Coal Road

Location of New Second Track on Louisville & Nashville R.R. Avoids Grade for Loaded Traffic—Tunnel Opened by Deep Cut

A COMBINATION of relocation, grade reduction and double tracking, together with some interesting structures and the opening up of an old single-track tunnel by a new double-track cut, is included in a 5½-mile stretch of improvement now approaching completion on the Cumberland Valley division of the Louisville & Nashville R.R. This improvement, estimated to cost $1,254,700, is designed to relieve congested traffic conditions on an overtaxed coal carrying division, to increase the train load about 60 per cent, and to reduce the high operating expenses incident to hauling heavy coal trains on a grade of 1.25 per cent for a distance of 2.7 miles.

The Cumberland Valley division, leaving the main line at Corbin, Ky., runs southeast and south to Middlesborough and then approximately east to Norton, Va. From Acosta, on this division, the Kentucky and Virginia division extends eastward to Harlan, Ky. Both of these divisions serve large coal districts, so that there is a heavy northbound coal traffic from Acosta to Corbin. Beyond the latter point the bulk of the traffic moves north to Cincinnati and Louisville, a small proportion moving south.

Physical Conditions and Traffic—At Emanuel, Ky., 183 miles from Louisville, the line leaves the valley of the Cumberland River and climbs through rough country to an interior plateau. This ascent is made mainly by a grade of 1.25 per cent 2.7 miles long to the summit at Arkle, near mile 180. Beyond this, the line has moderate grades to Corbin. The grade is opposed to the heavy northbound traffic, and although helper engines are used it is a cause of delay in handling the traffic. The standard trainload at present is 3,150 tons for a 154-ton locomotive of the 2:8:2 type, but when the present work is completed this will be increased to 5,300 tons. The improvement consists in lowering the summit elevation and building for the northbound traffic a new direct line having a ruling grade of only 0.65 per cent. Except for some minor changes in location the original line will continue to be used for southbound traffic. The general conditions are shown in the plan and profile, Fig. 1.

From Corbin to Arkle (Sta. 405) the line is now double track, but from Sta. 393 to 405 the grade has been lowered. Beyond this point the double-track roadbed has been extended to Sta. 444. Here the new second track diverges from the original line on a new location. Being on a more direct course it crosses the original line at two points: At Sta. 555, near Emanuel, and again at Sta. 600 near Bailey's. The first crossing, with an angle of 41 deg., is made by an oval underpass or tunnel 158 ft. long, through the new fill. Parallel with it is an underpass for a road diversion. The second railway underpass has a rectangular opening with girder roof and ballasted deck. The two lines come together again at Sta. 639, which is the north end of a middle passing track. When other grades of 0.65 per cent on this division have been reduced the long 0.65 per cent grade between Bailey's and Arkle will be the ruling grade. Trainloads will then be increased and pusher engines used on this grade.

Curvature between Arkle and Bailey's amounts to

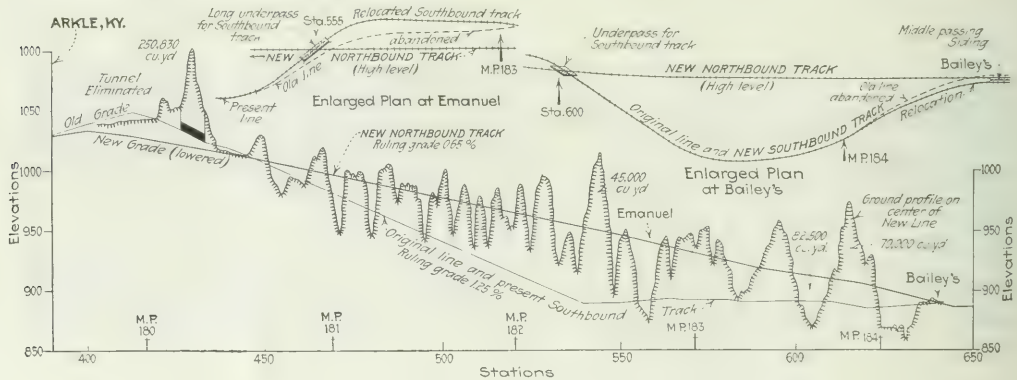


FIG. 1. PROFILE OF OLD AND NEW LINES ON GRADE REDUCTION WORK

272 deg. on the new track as compared with 623 deg. on the original line, the sharpest curves being 7½ deg. on the former and 6 deg. on the latter. Grades are compensated for curvature at the rate of 0.035 per cent per degree of curve. The distance between the two points is 29,040 for the new track, with 149 ft. rise and fall; on the old line it is 30,320 ft., with 166 ft. rise and fall. For the 5½ miles of new second track there was about 625,000 cu.yd. of excavation, most of this being solid sandstone rock. About 6,700 cu.yd. of reinforced concrete was required, nearly all of this being in line structures.

Cut Replaces Tunnel—Grade revision on the present location at the north end of the work will lower the grade to a maximum of 22 ft. below the old subgrade. This includes the elimination of the single track Brafford Gap tunnel, 725 ft. long, by an open cut with its grade about 14 ft. below that of the tunnel. This cut, which has a maximum depth of 90 ft., required the removal of more than 250,000 cu.yd. of material, mostly solid rock. A typical section through the tunnel and cut is shown in Fig. 2.

In making the new cut, the surface was first ex-

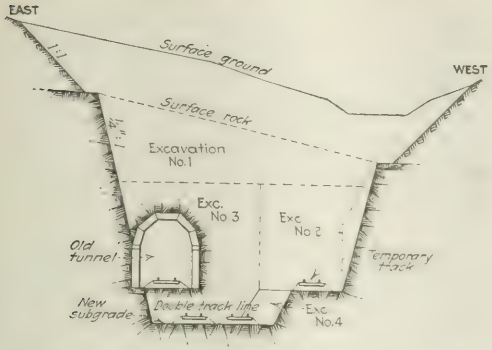


FIG. 2. SECTION OF DEEP CUT REPLACING TUNNEL

cavated for the full width down to within 10 ft. of the tunnel roof. A second cut, with practically vertical sides, was then carried parallel with the tunnel and down to the same grade, leaving nearly 20 ft. of material between the tunnel wall and the cut. In this second cut was laid a temporary track for traffic. With traffic thus diverted, a third cut opened up the tunnel, removed the material between it and cut No. 2 and carried the excavation down to the new subgrade elevation. A single track was laid on this roadbed and traffic diverted to it. A shallow fourth cut then widened the roadbed for the second track. As a final step the rough west side of cut No. 2 was dressed to a slope of ¾ on 1.

Concrete Underpasses—Owing to the flat angle of 41 deg. for the crossing of the two lines at Emanuel, an underpass or tunnel 158 ft. long is required to carry the old line through the high 55-ft. fill for the new line. This reinforced-concrete structure, Figs. 3 and 4, is of oval section, with a maximum clearance width of 18½ ft. and a height of 26 ft. above base of rail. The sides extend 2½ ft. lower and are shaped to form concrete side ditches.

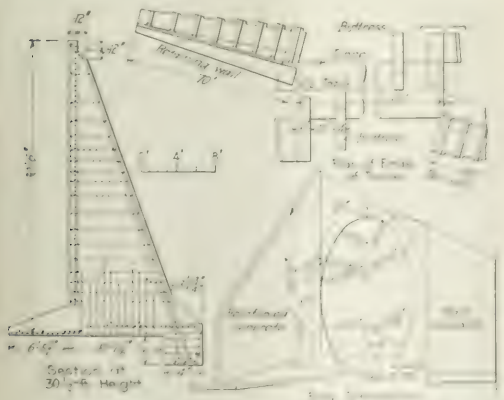


FIG. 4. CONCRETE UNDERPASS FOR OLD LINE

Lateral thrust at each portal, due to the angle of crossing and the height of fill, is resisted by an extension of the portal wall and by a buttress 11 ft. back of the portal, as shown in Fig. 4. The barrel of the tunnel, 21 in. thick at the crown and 27 in. at the haunches, was built in lengths of 15 ft., with the reinforcement extending through the construction joints. Beyond each portal a long wing wall is required on one side to keep the toe of the slope clear of the track. These walls are of the counterfort type and have a maximum height of 37½ ft.

An underpass for a country road diversion, through the same fill, is a rectangular structure with opening 20 ft. long and 14 ft. wide, beyond which are wing retaining walls of the counterfort type. The roof has two heavy girders built monolithic with a 10-in. deck slab 15 ft. wide, having curb walls to retain the ballast. A structure of similar type, but with opening 16 ft. wide and 22 ft. high, forms the second track underpass near Bailey's.

Construction Methods—Practically all excavation was handled by steam shovels loading trains of 6-yd. and

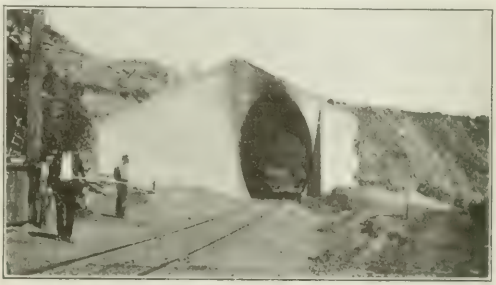


FIG. 3. UNDERPASS FOR OLD TRACK BEFORE FILLING

8-yd. dump cars, these cars being dumped on light construction trestles at the fills. Excavation for the tunnel underpass was largely in solid rock and was done with a small revolving shovel. The downhill side of the underpass was entirely in the open and the rock was excavated on the uphill side for a distance of about 2 ft. from the outside lines of the arch and wing walls.

The fill across this structure was made in two lifts. For the first lift a temporary trestle was constructed with its deck approximately 4 ft. above the top of the masonry, and the fill from this was made with a soft, friable sandstone obtained from a cut about 2,000 ft. north of the underpass. This lower section of the fill was built to full width between slope stakes and the masonry of the underpass was fully covered and protected with the soft sandstone before the second lift of the fill was made. In blasting, this rock broke up to such an extent that in making the fill it was easy to keep the pressure equalized on either side of the structure in order to avoid damage.

Engineers and Contractors—Work on this improvement was begun in September, 1920. That portion north of Emanuel was done by the Nichols Contracting Co., Atlanta, Ga. The southern portion was handled jointly by the Codell-Byers Construction Co., Winchester, Ky., and U. S. Tackett, Mount Sterling, Ky. Ballasting and tracklaying were done by railway forces.

All work was planned and carried out under the direction of W. H. Courtenay, chief engineer, Louisville & Nashville R.R., and C. E. Ramey, chief engineer of construction, with J. M. Farley as resident engineer.

An Economic Foundation for Highway Progress

By Thomas H. MacDonald
Chief, U. S. Bureau of Public Roads, Washington, D. C.

Address Delivered at the Highway Transport Session of the Annual Meeting of the Chamber of Commerce of the U.S.A., Washington, D. C., May 16, 1922.

THERE is difficulty in properly allocating the earnings of the highway among the different services which it performs. Too many studies have been made for the purpose of proving a pre-determined conclusion. All the aspects of highway improvement are so modified by the particular conditions of the locality, small or large, that many dogmatic assertions, predicated upon insufficient or circumscribed data, which we have accepted as almost axiomatic, fall down when examined in the light of real fact.

Fallacies Accepted — For example, it has been accepted as a tenet that highway bonds shall be issued for a shorter period than the life of the road. The Cumberland Pike, the first and only great national highway of the early days, was opened to traffic about 1818. Today, after a full century, that highway is still in existence, rehabilitated and carying an ever-increasing traffic. It is true that, due to changes in overland transportation, there was a long period when this highway fell into disuse and disrepair, but today, with the surfacing repaired and rebuilt, the same road-bed and most of the same waterway structures are serving traffic. The extension of this road from Baltimore to Cumberland, originally a state project, was resurfaced in recent years at a nominal cost. This light surfacing was placed for horse-drawn traffic, but with continued maintenance and necessary reconstruction from time to time, is now carrying heavy automotive traffic. Under the theory just mentioned, for how long a period would the bonds, had the road been so built, have been proper? Apparently the road is in better condition today than it has ever been in the past.

The term "permanent roads" is a fallacy which is responsible for more or less of the unsound theory which has been advanced with reference to bond issues. There are certain of the essentials of road construction, such as the road-bed and drainage structures, that can be so built that the deterioration is so slow that they may be properly termed "permanent." Road surfaces of whatever type deteriorate. Maintenance should begin as soon as the surface is thrown open to traffic, and the higher the cost of the road, the more careful in detail should be the maintenance.

There is also the fallacy of the imposition of detailed and arbitrary legal limitations upon the character and weight of the loads which shall use the roads. Proper regulation, within certain reasonable legal limits, of the use of the roads is an administrative matter. Even in a single state conditions vary to the extent that loadings which may be carried without deterioration of some road surfaces will inflict untold damage upon others. Yet under the average regulatory law the utility of the best roadways is not realized in full, nor is the safety of the lesser capacity roadways assured.

Research in the field of the weight of loads that can be carried by different road surfaces is revealing definite information. The influence of subgrade soils, tire equipment, distribution of the loads to the wheels, the speed and many other variables is too complex to be written into law. The seasonal variation alone in the carrying capacity of the road-beds, due to moisture conditions, is one of the most serious of all causes of road damage, and for this single reason the highway authorities must be given wide discretion in traffic regulation.

There are many other fallacies which must be cleared away before we can hope to reach sound conclusions as to far-reaching permanent highway policies which will justify themselves over a long term of years. Our total expenditures for all highway purposes in the United States last year were approximately $600,000,000. An examination of the progress in highway building over the past ten or twelve years indicates a very serious lag in the development of the road-bed in comparison to the increase in the rolling stock. This lag is so serious that there is an insistent demand on the part of the large body of vehicle owners that the providing of improved road-beds shall be hastened. This demand in turn is followed, and properly so, because of the very large expenditures required, by the equally insistent question of who shall pay.

Four Classes of Service — There can be no question as to the service that highways render (1) to the owner of the motor vehicle privately operated; (2) to the operator of motor-truck lines and motor-bus lines, the granting of franchises being followed by a real financial return; (3) to real property in the rural districts. There is, although more questions may be raised, a real service rendered by the rural highway (4) to the property within the urban limits, or, if more acceptable, to the people as a whole within the cities. All foodstuffs originate upon a highway, some place, and the nearer to the district that the perishable foodstuffs, such as garden truck, milk, eggs and butter, can be produced, and the more directly and quickly they can be transported from their point of origin to these people, the cheaper will be the cost and the better will be the quality.

Under these four classes may be grouped the major services which are rendered by the highway, but these do not bear a constant relation to each other, nor does the highway maintain a constant relation to each of these. The truck gardner is more dependent upon improved highways than is the farmer who raises only annual crops.

Thus the relative share of the cost of highways may not remain constant, but it is difficult to harmonize with the tenets of fairness and equity any plan of financing which does not distribute some part of the cost to each of these four services.

The 7-Per Cent System—A proper financial policy cannot be established unless there is functioning an efficient, stable highway administration. This applies regardless of the unit that is under consideration. With the exception of a very few states it is apparent that the major highway development for the next decade and probably longer will be upon the so-called 7-per cent system which is now being established under the requirements of the Federal Highway Act of November, 1921.

We have now on a national scale the inauguration of the first cardinal principle of efficient highway administration—the classification of the roads into selected systems. On the 7-per cent system federal and state funds will be concentrated until completion. This classification, recognizing with full credit the progress made by many of the states before the federal enactment, is fundamental. Through its operation the roads of greatest importance are first improved and all work done is accumulative toward the completion of a system of interconnected and correlated traffic lines as between the communities within the states and between the states themselves. As the highway systems are completed the traffic will become more and more organized and concentrated on the improved roadways. If these systems are not properly selected they will eventually have to be revised and so much of the investment jeopardized.

In sequence of importance is the proper improvement of the highways so selected. Up to a certain point the steps in the improvement of all types of roadways are the same. The selection of the best location, the building of the road-bed by excavation, filling and draining, the building of the necessary culverts and bridges, the building of guard rails, approaches and all the incidental construction will be as carefully and thoroughly done under an efficient highway administration for all types of highways.

Selection of Type—The selection of the type of roadway surface is the all-important item from the standpoint of the highway service and highway finance policies. The service to be rendered must determine the selection of the type of highway. Here again research and investigational studies are rapidly fixing within reasonably definite limits the kind and volume of traffic which can be carried by the different roadway surfaces within reasonable maintenance costs. Such a selection will determine the proper financial policy, for it will provide the basis for the establishment of an annual highway expenditure budget. The major items of the budget will include (a) maintenance, (b) reconstruction, (c) new construction. Reconstruction is included separately from maintenance for in the progress of highway improvement the replacement of old surfaces is usually by a higher-type surface and consequently the road is improved beyond its first condition.

The amounts needed for maintenance and reconstruction will be determined from the records and reports of the condition of roads in the system. The new construction requirements in the majority of the states are capable of absorbing all the funds that can be made available, so it is in the fixing of this fund that the most care should be exercised. It should be sufficient, however, to complete the first construction of the state system within the shortest period consistent with good management and the maintenance of competitive prices.

Basis of Financial Policy—It is believed that a proper financial policy will require first that all of the maintenance funds be met from the revenues derived from the road user; second, that the costs of reconstruction be met from the revenues derived from both the road user and from states taxes, the relative percentages being different for different states and for the different types of roadways built; third, after deducting the federal aid, the cost of new construction should be divided between the road users and other state taxes from both urban and road sources.

Just how the respective revenues for reconstruction and new construction shall be divided between revenues from the road users and other classes of revenues, and how these costs, once apportioned, shall be divided to the several classes of road users and the different classes contributing to the other revenues, must be determined upon the most thorough research and investigation. It has been stated that the total expenditures for rural highway purposes in the United States for the past year were approximately $600,000,000. These revenues came from the following sources:

Local Road Bonds	22
Federal Aid	11
State road bonds	1
State taxes and appropriations	1
County, township and district taxes	13
Motor vehicle revenues	12
Miscellaneous	1

Federal aid and motor vehicle revenues constituted 33 per cent; the remaining 67 per cent either comes directly or will eventually be paid from state and local taxes. It is believed that a very considerable readjustment of these sources of revenues must be made, so that a larger percentage will be paid by the road user and a lesser percentage from state or local taxes. This statement of motor vehicle revenues is not fairly representative of the total funds collected directly or indirectly from the motor vehicles, for our estimates show the following revenues paid during the fiscal year 1921:

Federal taxes paid by manufacturers	
Cars and motor trucks	$ 11[illegible] 12
State registration fees	[illegible]
Personal property taxes	[illegible]
Wheel and gear taxes	[illegible]
Gasoline tax, 17 states calendar year	11[illegible]
Total	$[illegible]

The total of $305,161,146 is equivalent to [illegible] to $30 for each car and truck registered during 1921. This total sum, it will be noted, amounts to [illegible] half of the total estimated road expenditure for 1921.

Consider also the question of gasoline consumption. It is probable that the total gas consumption for use in operating automotive vehicles is not far short of 4,000,000,000 gal. per year. An advance of 1 cent in the price of gasoline on the annual consumption would amount to approximately $40,000,000.

Costs Classified—Facts as to the type of construction which is going into the road building program must also be given consideration. For over 11,000 miles of federal-aid roads involving a total cost of over $188,000,000, the surfacing cost is 60 per cent and the remaining 40 per cent is made up of: Grading, 22 per cent; structures, 14 per cent; shoulders, 1 per cent; engineering, 3 per cent. That is, 40 per cent of the expenditures were for the permanent features of the road. The greater part of the expenditures for surfacing can be rightfully considered in the same class, for it is being successfully demonstrated that by supplementary construction, such as the placing of new surfaces and widening by addition of shoulders, the greater part of the investment can be continually maintained and thus preserved indefinitely. Expenditures of this class fall into the category of maintenance and reconstruction, and if continuance of these two can be relied upon the original investment is preserved indefinitely. Therefore, little fault can be found with the soundness of the financing if bonds are issued for new construction provided that the original investment is thus continually preserved.

Of all these requirements it appears that the funds for the new construction in the amounts that will be needed will be the most difficult to secure. The public should not be called upon to bear this entire cost as an annual expense. Rather is it fair to distribute these costs over a period of years extending beyond the time of the maximum expenditures for new construction. It is not doubtful that succeeding generations will enjoy the use of the highways which are being built now, and there is nothing unfair in pursuing a financial policy which distributes a portion of the cost beyond the immediate period. No enterprise requiring funds in the large amounts that they will be required for the new construction of highways can go forward without anticipation of revenues.

Six Principles—Experience in the administration of highway work has already established certain definite principles without the observance of which it would be highly unsafe to resort to bond issues. The major principles may be outlined as follows:

1. As a general proposition state, not local, bonds should be issued for the building of the state highway system. In any case the total amount of bonds to be issued for any one year or over a period of years in any state should be subject to the control of one central body.

2. Sufficient revenues must be derived from the users of the highways to pay all of the maintenance and a percentage of any reconstruction charges.

3. All bond-built highways ought to be maintained under the direct supervision of the state highway department, which also must have jurisdiction of the revenues from the road users. The proper maintenance of all bond-built roads must be considered a first lien upon such revenues.

4. The proceeds of bonds must be devoted to a system of roads so devised that as the system is completed these roads will in fact continually serve the major traffic in the vicinity. This means that the only safe sequence of improvement is in the order that the different sections of the system serve the traffic.

5. Bonds should not be issued in an amount beyond the ability of the traffic of the present and immediate future to pay revenues sufficient for the proper maintenance of the roads built from the proceeds.

6. The type of roads built with bonds should be adjusted to the traffic which they will be called upon to bear within the reasonable future.

It will be noted that little has been said as to the uses which are to be made of the highways, but it must be remembered that the whole question of highway transportation is in its infant stages. Careful investigations and studies are now going forward to determine both the

economic limitations of highway transport and of the necessarily adjusted highway construction. We have made rapid progress during the past two years toward such determination, and the suggestions which have been made are based upon an administration of a highway program predicated upon the results and determinations of these scientific researches and investigations.

If permanent policies can be adopted and carried forward without change over a period of years the necessary roads can be built without undue burdens upon the public. The result will depend upon foresight and adherence done by foreseeing now and adhering to safe and sound financial policies.

Large Hollow Concrete Blocks Form Dock Wall

Blocks 16 x 15 x 3½ Ft. Built in Wharf and Retain Solid Fill—Concrete and Broken Stone Placed in Cells of Wall

A DOCK-WALL or wharf of 18-ton cellular concrete blocks built up like ashlar masonry is a novel type of structure constructed in the enlargement of shipping facilities for the Petoskey Portland Cement Co., at Petoskey, Mich. This wharf, which is for shipping cement and rock and for receiving coal and supplies, is on the south side of Little Traverse Bay and is exposed to the action of waves and heavy ice. As shown in Fig. 1 the construction consists of about 400 ft. of concrete dock wall with filled ground behind it for a width of 400 ft. from the present shore line for



FIG. 2. CONCRETE BLOCKS IN CASTING YARD

capping has expansion joints at intervals of 64 ft. Its face is protected by two lines of fender timbers bolted to the face and by 3-in. hemlock planking which extends 5 ft. below the water line.

Blocks 16 x 15 ft. in plan and 3½ ft. high are used in this wall, each block having four large cells, as shown. The walls and partition are 8 in. thick and the front and back walls extend beyond the side walls so as to form pockets between adjacent blocks. These pockets are filled with broken stone. There is no dovetailing or interlocking of the blocks, nor do they break joint, the wall being built up in 16-ft. lengths with vertical joints.

In construction, the courses of blocks are lined up

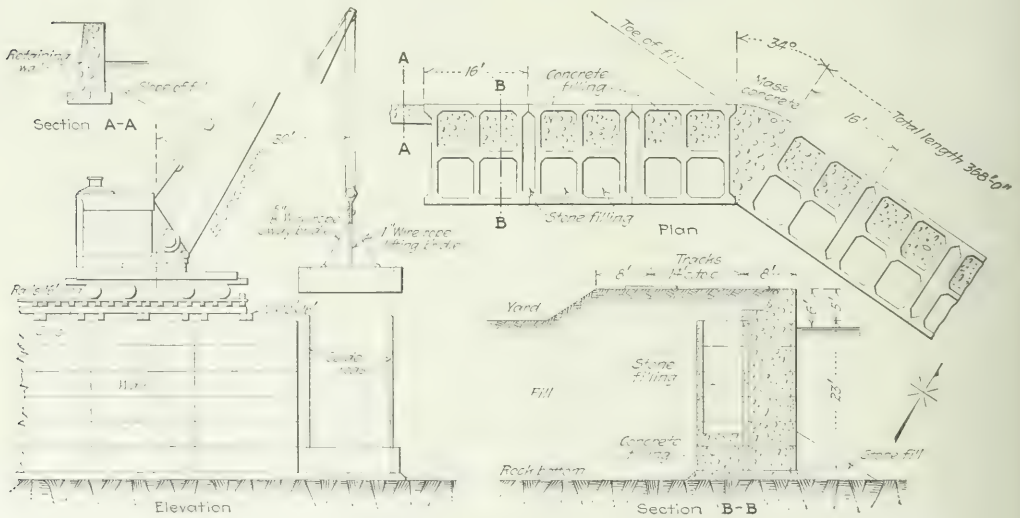


FIG. 1. DOCK WALL BUILT UP OF HOLLOW CONCRETE BLOCKS

a yard and railway trackage. At the west or inner end the upper part of the fill has a mass concrete retaining wall with a maximum depth of 12 ft. 9 in., but beyond this the concrete wall provides 23 ft. of water for vessels.

From the rock bed of the bay the wall is built up of concrete blocks to about a foot above the water line and is capped with 5 ft. of mass concrete, making a total height of 28 ft. to wharf level. This concrete and secured temporarily by four 2½-in. vertical tie-rods which are grouted into holes drilled in the rock, these rods engaging cored holes in the corners of the blocks. At one point the wall makes a change in direction and the triangular space thus formed is filled with mass 1:2:4 concrete which is bonded to the wall by the flanges or projections on the face of the blocks. About 200 blocks were required and were made by the cement company at its yards, using a 1:2:4 mix with 1¾-in.

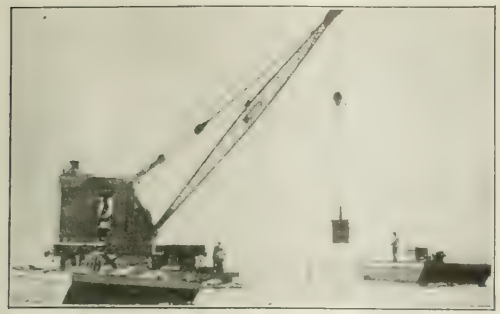


FIG. 4. DEPOSITING CONCRETE UNDER WATER BY DROP-BOTTOM BUCKET

stone for coarse aggregate. The concrete was poured in wood molds and left for three days, after which the blocks were removed and stacked for thirty days to cure before being used. Each contains about 9 cu.yd. of concrete and has a weight of 36,000 lb. in air or 21,000 lb. in water. Blocks stored in the casting yard are shown in Fig. 2.

A 25-ton locomotive crane placed the blocks, which were delivered in rear of the crane on flat cars. A short length of frame trestle was built to carry the crane while building the first section of the wall. Beyond that, the crane track was laid on the completed part of the work. Sills 12 x 12-in. and 15 ft. long, were laid across the wall to carry packed stringers of the same size, upon which the track ties were placed. This track was built in 16-ft. sections as the wall progressed.

Before a section of the block wall was commenced the bottom was cleaned by a small sand-sucker or hydraulic dredge, the nozzle of the suction pipe being handled by a diver. The diver also removed loose rocks, attaching a sling or grapple of the crane to rocks and boulders too large for him to move. The crane then picked up a concrete block from a car in the rear and lowered it into place, guided by the four rods. Stones were placed by the diver to level up the block on the sloping rock bed. The concreting train was then pushed out by a yard locomotive and the mixer, of 13 cu.ft. capacity, delivered concrete to a 27-cu.ft. closed drop-bottom bucket which the crane lowered into the water, so that the concrete was deposited quietly and directly in place to fill the pockets of the block. This concrete flowed under the block, filling all irregularities of the rock surface and the spaces between the stones used in leveling up the block. A 1:3:6 mix of stiff consistency was used for this filling. Fig. 3 shows the concreting train and the dredge scow. Fig. 4 shows the floating crane handling the drop-bottom bucket. On the scow at the right is the compressor supplying air to the diver who guides the bucket into position.



FIG. 3. CONCRETING TRAIN ON [illegible]

This sealing or anchoring concrete was allowed to set for 48 hours, after which additional blocks were placed to the full height of the wall. Concrete filling was then completed in the front pockets and 2½-in. stone was placed in the rear pockets by a grab bucket, the stone being run out on flat cars. Following the construction of the wall, the fill behind it was made with earth and loose rock obtained in stripping a quarry of the cement company, this fill being deposited by 16-yd. side-dump cars.

In building the 400-ft. length only one section of wall was damaged owing to a storm, and in that case the storm came up so suddenly as to prevent concreting the blocks in place. Since the bottom block was not disturbed, only the displaced upper blocks were removed and the section of wall was then reconstructed. Part of the concrete wharf has been in service for three years and during two winters heavy ice and high waves were experienced, but it is reported that no damage was done although timber piers in the same district suffered severely. It is expected to complete the work this season. This structure was designed and constructed under the direction of the J. C. Buckbee Co., Chicago, as engineers for the Petoskey Portland Cement Co.

Highway Problems in Britain

(London Correspondence)

British authorities on raising revenue for road maintenance are divided into two camps. There are those who assert that road charges should be raised from the land, since it is in the interests of local authorities to provide and maintain good roads so as to encourage road transport; and there are those who maintain that the tax now imposed on mechanical vehicles using the roads should contribute to their maintenance.

The total cost of maintaining British highways is £52,000,000 per annum, of which £9,000,000 have been raised in tax from 871,000 vehicles (motor driven). Under present legislation every motor omnibus contributes 6/10d. in direct taxation for every mile run, while automobiles contribute 3/4d.

According to Sir Henry Maybury, of the Ministry of Transport, 79 per cent of the population of the British Isles lives in urban districts, compared with 72 per cent 30 years ago. Nearly half the total population has gravitated to the large and relatively dense areas where traffic problems already present the acutest difficulties. This movement has led to the formation of joint town-planning committees in the north of England regions. The aim of these committees is to urge upon local authorities the necessity for preserving such building lines as will create a dignified and roomy setting for the highways under the new road program; in these highways the width between fences varies from 100 to 120 ft. These committees will endeavor to secure road width, leaving for future determination the exact apportionment of that width between carriageways, footways and tracks reserved for special forms of traffic.

Traffic on Maryland's Roads Shown on Map

Graphic Explanation Afforded by Plotting Figures of Four-Year Count—Intensity and Seasonal Variation Given

By A. N. Johnson
Dean, Engineering College, University of Maryland

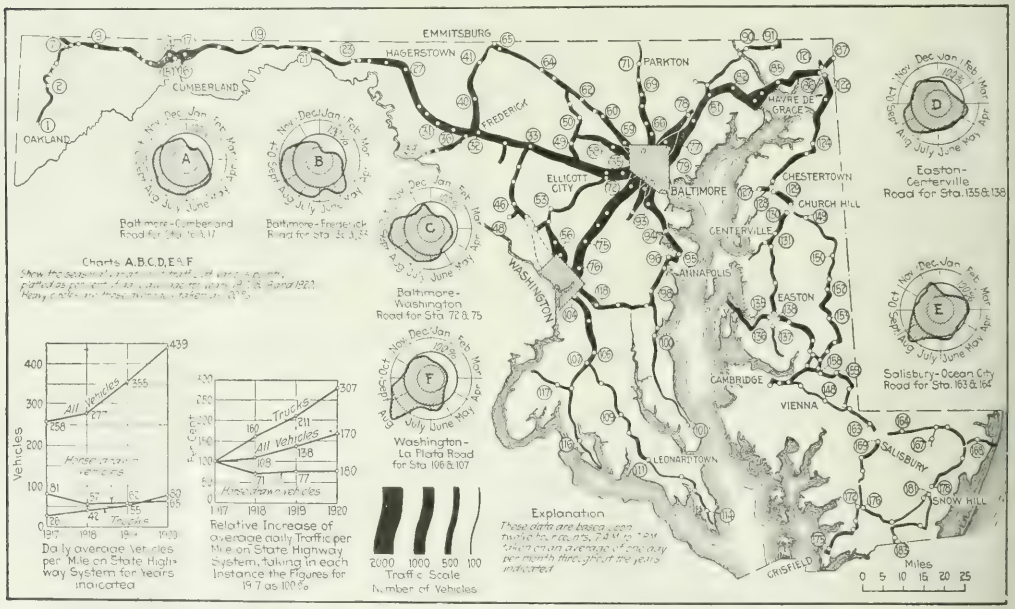
A TRAFFIC map visualizes, as can be done in no other way, the relative amounts of traffic that flow over different portions of a highway. There is here presented a traffic map for nearly the entire state highway system of Maryland, based upon traffic counts extending over several years.

This map was prepared at the Engineering Experiment Station of the University of Maryland, in cooperation with the U. S. Bureau of Public Roads and the State Roads Commission. The traffic counts were taken by the State Roads Commission of Maryland, under the direction of J. N. Mackall, chairman and chief engineer. These counts, which were made one day per month from 7 a.m. to 7 p.m., extended over the years 1917 to 1920, inclusive. The location of the counting stations is shown by small circles upon the map.

The basis upon which all the data are compared is the average daily traffic for a year. This quantity was obtained for a given station by platting the daily counts, with days for abscissas and the number of vehicles as ordinates. The area under these curves, as found by a planimeter, divided by the number of days (365) gave the average daily traffic for a year for a particular station. The values of the average daily traffic so found for each station were platted to an arbitrary scale upon a road map. These values were laid off with equal lengths either side of the center line of the road and perpendicular to it; thus the width of the space so drawn from station to station becomes a measure of the amount of density of traffic.

The map shows the traffic recorded during 1920. In addition, there has been recorded for each station the actual daily average number of all vehicles during each of the years—1917 to 1920, inclusive, as well as the average daily truck traffic for like periods. [Results for a few stations are given in the accompanying table.]

There are also shown diagrams of the seasonal variation in traffic for a number of stations and others that show the yearly increase in the average daily traffic per mile over the entire state road system. These latter diagrams were computed by platting the average daily traffic at the various stations as ordinates and



DISTRIBUTION OF TRAFFIC ON MARYLAND'S STATE HIGHWAY SYSTEM, BASED ON DAILY AVERAGES

The area between this curve and the horizontal axis, as determined by a planimeter, divided by the distance in miles, gave the average daily traffic per mile throughout the entire highway system for a given year. The actual increase in the daily average number of vehicles per mile, as well as the percentage of increase, for all vehicles, for trucks, and for horse-drawn vehicles is shown.

It is noted that the amount of horse-drawn traffic is about constant, the increase during 1917 undoubtedly being due to emergency war work. The increase in truck traffic is greater proportionately than that for all traffic.

The feature of the map that first strikes the eye is the great increase in density of traffic as we approach the larger cities, although the uniformity of the traffic density throughout the entire distance between Baltimore and Washington is in marked contrast to that noted on most other roads, with the exception of the one running west from Baltimore to Frederick.

As our highway expenditures become heavier and the operation of a state highway system a more and more complex problem, the traffic census becomes a necessity for any intelligent study and guide in handling the situation.

How much use do we make of our roads? What do we pay per unit of road service? Given the number of

TRAFFIC RECORDED AT CERTAIN STATIONS ON MARYLAND HIGHWAY SYSTEM

Station	1917		1918		1919		1920	
No.	Total	Trucks	Total	Trucks	Total	Trucks	Total	Trucks
1	226	25	290	36	166	24	206	51
2	170	7	145	10	146	15	217	61
7	145	[illegible]	222	27	181	11	334	27
	454	35	478	78	477	59	640	69
1[illegible]	425	62	....	....	....	....	763	165
15	790	102	....	....	....	....	1,041	305
16	381	44	433	61	469	78	516	95
17	234	21	333	51	430	51	480	75
19	84	[illegible]	134	17	154	15	279	21
26	555	33	575	113	762	178	830	178
27	798	109	550	94	633	87	692	108
31	833	26	547	49	629	39	758	61
32	716	68	621	71	858	99	709	100
33	413	45	453	58	397	65	619	124
35	1,245	265	910	241	871	279	1,188	418
36	331	36	400	40	471	53	285	83
39	246	11			328	36	114	48
41	256	21	251	14	253	29	348	42
46	257	22	228	35	368	48	470	63
49	151	24	160	20	309	37	413	56
50	..	..	163	29	321	53	282	56
56	....	..	766	158	910	173	1,508	306
58	..	..	456	113	470	125	812	177
59	..	..	638	157	582	104		
60	..	..	444	94	361	77	514	123
64	168	17	197	23	278	32	197	41
65					261	17	539	55
66	....				....	....	783	286
71			181	21	303	58	262	57
72	824	149	985	286	952	263	1,106	298
75	721	50			730	116	766	136
76							1,173	238
77	1,465	319	1,766	606				
78					309	79	307	73
79	1,389	403	1,749	600	1,252	417	2,207	804
81	410	57	589	148	661	121	782	181
82	562	46	843	177	760	135	884	204
85			347	80	388	63	436	90
86	436	26	365	84			541	130
87		..	226	43	363	91	462	89
90	201	9	242	16	420	36	344	55
93	394	72	396	108	569	174	816	321
94	557	107	384	71	550	90	645	236
96			688	81	421	58	517	117
98	221	13	225	22	242	32	325	62
100	..		289	24	223	20	327	34
101	..	..			87	50	105	16
102	..	..	642	143	480	95	772	338
103	..	..			727	259	715	281
104	333	70			568	166	563	159
107	517	32	318	55	460	96	431	74
109	154	13	163	16	203	47	250	46
111	345	17			463	95	333	36
114	190	21	158	13	201	20	243	29
116	157	[illegible]	230	27	293	43	236	26
118	160	20	177	9	203	27	221	60
121	..	....			185	28	259	43
122	..	....			389	53	447	64
123	..	..			915	127	680	106
126	..	..	258	12	276	18	298	25
127	..	..	205	11	262	36	287	59
128	425	21	488	17	467	34	505	30
134			171	28	229	60	200	32
135			551	43	510	55	414	45
136					439	48	313	46
137	423	21	291	41	371	46	387	55
138			294	17	415	40	360	28
146	377	26	432	47	419	47	384	52
148	102	6	108	5	155	18	135	14
149			138	9	204	21	191	17
158	183	11	219	18	253	26	230	33
163	233	23	218	23	293	41	303	48
167			57	2	56	5	68	4
168	203	15	257	24	287	31	197	17
169	290	22	323	30	395	39	495	57
172					247	36	325	54
175	240	8	237	8	297	28	450	12
176	173	9	217	21			186	36
177	175	19	179	12	197	11	83	10
183			148	6	209	12	137	12

service units, on what character of road is the service most economically rendered? These are but illustrations of a few of the important questions that can only be answered by the aid of a comprehensive traffic census. And a traffic map is a visualized traffic census.

Estimating Brickwork-Labor Cost

Every Reasonable Labor Detail Included in Compilation—Cost of Executing Individual Operations Given

By Chas. F. Dingman
Palmer, Massachusetts
(*Copyright 1922 by Chas. F. Dingman*)

THE method of figuring the cost of brickwork-labor herein described is one that I have been using with highly-satisfactory results. I realize that the ideal method would be similar to that for concrete costs presented by Taylor and Thompson in their book "Concrete Costs." Such a method, however, would involve the tabulation of such unit operations as picking the bricks from the pile, loading hods or wheelbarrows, delivering to scaffold, picking up, turning, placing, spreading mortar, cutting the joint, pointing, raising the line, plumbing corners and jambs, etc.

However, existing competitive business methods, as well as labor conditions, make the use of such details impracticable, although good business demands that the estimate closely approximate the actual cost.

If the estimator could determine the exact conditions under which the work is to be done he might be justified in using detailed methods of estimating. The best he can do, however, is to exercise good judgment in handling the work, and estimate accordingly.

Basis of Data—The quantities which are set down herein as a normal hourly production for different classes of work were determined after a careful study of all the published literature that I could find plus data secured from personal experience. Incidentally, these figures show how much weight should be given such press statements as: "Bricklayers in Chicago are now laying 2,000 bricks a day, and that is really only half a day's work."

While the bricklayer's wages may not always be the largest single item in the cost of laying bricks, the number of bricks each man lays per hour is usually the determining cost factor.

The following table gives the hourly production that may be expected from competent bricklayers working under average conditions:

TABLE I—AVERAGE PRODUCTION—COMMON BRICKWORK
Laid across ends of walls

Thickness of Wall	Type of Mortar	Cement Mortar
3 [illegible]	[illegible]	300
2 [illegible]	[illegible]	225
1 [illegible]	[illegible]	200
1 [illegible]	[illegible]	175
1 [illegible]	[illegible]	150
0 [illegible]	[illegible]	125

If joints on both sides of the wall are struck the production will be about 10 per cent less than the figures given above.

TABLE II—AVERAGE PRODUCTION—[illegible] BRICKWORK

	Number per Hour
[illegible]	70
[illegible]	70
[illegible] ut joints	70
[illegible]	65
[illegible]	65
[illegible]	60
[illegible]	50
Flemish Bond, rodded joints	45

Other special bonds will decrease the production, as will the introduction of pilasters, openings, paneling, etc.

Hints on Labor—The number of laborers or tenders required is determined by the number of bricks being laid, the distance the bricks must be moved, necessity of culling bricks, etc. The ratio may be anywhere from

four laborers to each five bricklayers to three laborers to one bricklayer. The following information will be helpful in determining the number of laborers necessary:

1—One mortar mixer, working nine hours, can produce about 4 cu.yd. of sand-cement or sand-lime-cement mortar.

2—One laborer in an hour can load about 1,120 bricks, wheel them 40 ft. using a barrow, and dump them on the scaffold. Using a hod, he can make more trips but will probably transport only half as many bricks.

3—One laborer can handle about 500 bricks per hour from car to wagon or from wagon to pile.

4—Two good laborers working together can handle about 16 lin.ft. of pole-staging per hour.

5—On thick walls one laborer can build, take down and move horse-scaffolding for twelve bricklayers. Thinner walls go up more quickly so more men are needed to build scaffolds. A fair ratio would be to decrease the number of bricklayers to each scaffold-man by two for each decrease of 8 in. in wall thickness below 3 ft. It is, of course, assumed that horse-scaffolding will not be used for any walls above normal story height. No figures are included here for patented scaffolds.

6—One laborer can cull from 200 to 300 bricks per hour, depending upon the quality of the bricks and the stringency of the inspection.

7—One laborer, using a barrow, can wheel about 33 cu.ft. of mortar 40 ft. an hour.

8—Two laborers, with a chain hod-elevator, can elevate 2,500 bricks 30 ft. an hour.

9—A two-barrow elevator, operated by a motor or steam engine, can elevate 10,000 bricks 30 ft. per hour.

10—A two-horse team will travel with an empty wagon about three miles per hour or about two miles per hour with the following loads:

On poor earth roads, 2,000 lb., equal to 370 average bricks	
On fair earth roads, 2,500 lb., equal to 465 average bricks	
On good earth roads, 4,000 lb., equal to 750 average bricks	
On hard surface roads, 6,000 lb., equal to 1110 average bricks	

Steep grades will reduce both the load and the speed of travel.

Other Information—Motor trucks can be figured to carry rated loadings at an average safe speed of 8 to 12 miles per hour. The same proportionate time must be allowed for loading and unloading as for horse-drawn wagons.

Actual production will vary very widely in different parts of the country with the figures set forth here. Every estimator will undoubtedly have his own data-book, covering the experience of his own organization. Those data will reflect the skill of the workmen as well as the organizing and executive ability of the foremen, superintendent, and higher officials. However, by substituting the proper quantities and taking due account of all local conditions, this method of estimating may be used for practically every job.

As a typical example, we may take the case of an ordinary brick mill building, four stories high, with interior brick walls enclosing the stairways. We will assume the building to be 80 ft. x 200 ft. and the thickness of the walls in inches as follows:

	Exterior	Interior
First story	20	16
Second story	16	12
Third story	16	12
Fourth story	12	12

Figuring the quantity of bricks by the usual method and deducting all openings we find that the job will require about 641,000 bricks distributed as follows:

164,000	in 20-in. walls on first story
29,000	in 16-in. walls on first story
139,000	in 16-in. walls on second story
139,000	in 16-in. walls on third story
22,000	in 12-in. walls on second story
22,000	in 12-in. walls on third story
126,000	in 12-in. walls on fourth story

It is assumed that sand, cement and lime have been purchased for delivery at the site, that the bricks must be hauled from the siding two miles away over good earth roads, and that teams are more readily available than motor trucks. It will also be assumed that the lime, cement, sand and bricks will be stocked about 25 ft. from the building and that a steam elevator will be used.

Hourly rates of pay are assumed as follows:

Bricklayers	90c.
Laborers	50c.
Teams	100c.
Elevator—Flat rate of $20 per day, including engineman, fuel, raising for additional stories, etc.	

Horse-scaffolding will be used throughout, working from the floor construction and the outside bricks will be laid over-hand.

Evidently the first thing to do is to get the bricks from the siding to the site. Since the team can haul 750 bricks to a load, and since a laborer can handle 500 bricks per hour from car to wagon, it will take two men about 45 minutes to load a wagon. If the driver helps to load, it will require only thirty minutes. The cost per trip is therefore:

Team—		
Loading time	30 min.	
Traveling loaded at 2 m.p.h.	60 min.	
Dumping	5 min.	
Returning at 3 m.p.h.	40 min.	
	135 min.	
135 minutes @ $1 per hour		$2.25
Men—		
2 men, each 30 min., 60 min.		.50
Cost of 750 bricks		$2.75

This equals $3.67 per thousand net, so we will use a figure of $3.70 to allow for a few minor contingencies.

It is assumed that a sufficient number of teams will be employed to keep the men at the car busy; otherwise their waiting time must be included in the cost. In most places it will be found practicable to employ lower-priced men for unloading cars, and the figure above may be varied accordingly.

From the method given in *Engineering News-Record*, Feb. 23, p. 315, we find that about 266 cu.yd. of mortar will be required, to be used as follows:

86	cu.yd. on the first story
65	cu.yd. on the second story
65	cu.yd. on the third story
50	cu.yd. on the fourth story

Because a job of this size will hardly tax the full capacity of the elevator, the cost of hoisting need not be figured separately for each floor but can be covered by a single item. Where a building is very high or the number of bricklayers great enough to use the full capacity of the elevator, it is well to estimate the materials to be hoisted to the various heights and to figure accordingly.

From the dimensions of the building and the locations of the piles, it will be seen that the greatest horizontal distance that materials will be transported is about 305 ft. and the average about 165 ft.

Therefore, the total cost of making and delivering the mortar will be as follows:

Making 266 cu.yd. at 4 cu.yd. per 9 hr., 598.5 hr. @ 50c.		299.25
Transporting 266 cu.yd. (using barrows) average distance 165 ft. at 33 cu.ft. per hour for 40 ft.		
897.7 hr. @ 50c		448.85
Labor cost of mortar		$748.10

Figuring three scaffolds per floor (if we can work from the floor plank we shall only need two scaffolds per floor) above the first and two on the first floor, we find that we need 6,160 ft. of scaffolding which must be built, taken down and rebuilt rapidly enough to provide for the number of bricklayers employed. This job appears to require about 512 hours of scaffold builders' time, which at 50c. per hour equals $256.00

The cost of taking the bricks from the pile and transporting them, by barrows, to the scaffold, an average horizontal distance of 165 ft. at the rate of 10,120 bricks 40 ft. per hour, will be 2,361 hr., which at 50c. per hour equals $1,180.50

Laying the bricks will take, for 20 in. walls, $\frac{164,000}{200}$ = 820 hr.; for 16-in. walls, 307,000 + 1,754 hr.; and for 12-in. walls $\frac{170,000}{150}$ = 1,133 hr.; a total of 3,707 hr. which at 90c. an hour is $3,336.30

Since the walls on this kind of a job must be pointed on both sides, the production will be decreased 10 per cent, which means that the number of hours must be increased by one-ninth, thus: pointing, $\frac{412}{175}$ hr. at 90c. is 370 80

If the average force is to be fifteen bricklayers, the job will run for at least 36 working days, but, since allowance must be made for rainy days and other delays, a mason foreman will have to be on the job for at least 40 days, and his rate will be about $48 for a 5½-day week, or 7.3 weeks, which equals 350 40

Since all of the bricks above the first floor must be elevated, an elevator will be needed for 22 of the 31 working days, and this will cost, at $20 per day 440.00

We now have a total of $6,682.10

for the labor cost on the job (which is an average cost of $10.42 per thousand). To this must be added the cost of unloading and carting which, at $3.70 per thousand equals 2,371.70

(Of this amount approximately $448.70 is payroll and $1,923. is team hire).

To wash down the building, two bricklayers and two laborers will be required, each working 7 days of 8 hr. each, or a cost of 156 80

Labor Total $9,210.60

Compensation insurance, figured as 5% on payroll and 3% on team hire will be 422 07

$9,632 67

I have not attempted to discuss such items as cutting and grinding brick for arches, building quoins or ornamental cornices, though proper allowance must be made for each such item. However, it is almost impossible to set down figures that will be of any value without examining the design in each case. I usually allow at least ten minutes of bricklayer's time for each brick that must be cut and ground and ten minutes per running foot of each projecting course. These amounts I add to the total cost of doing the work.

Tri-City Activated-Sludge Plant at Pasadena

The proposed activated-sludge plant to be built jointly by Pasadena, South Pasadena and Alhambra, Cal., noted in *Engineering News-Record*, April 27, p. 709, is designed to have a capacity of 36 m.g.d. It will be located on the sewage farm which the City of Pasadena has operated for many years. The effluent from the new works will be used for irrigation, but it will be beyond the capacity of the present farm. It is proposed to sell the surplus to ranchers, thus conserving for domestic purposes the water that these ranchers are now using for irrigation. The plan is to dewater the sludge to about 70 to 80 per cent moisture and then to use it without further treatment for local fertilizing purposes. Experience at the existing sewage farm, states R. V. Orbison, city manager and city engineer of South Pasadena, and formerly city engineer of Pasadena, in a letter to *Engineering News-Record*, shows that a large quantity of sludge can be successfully handled by spreading it on the ground and plowing it under. The cost of the tri-city works will be proportioned between the several municipalities, probably on the basis of the number of acres served in each city, Mr. Orbison states. Pasadena has already voted bonds for its share in the cost of building the activated-sludge plant. In June it is expected that Alhambra will vote on bonds for its share of the sewage-works and for a construction of sewers. South Pasadena expects to vote on bonds for its share in the activated-sludge plant before long.

Los Angeles Mapped from Air to Aid Traffic Studies

Area of 6½ Square Miles in Business District Covered by 450 Exposures at Total Cost of $1,625

By C. H. Richards
Associate, Engineering Offices, J. B. Lippincott, Consulting Engineers, Los Angeles, Cal.

LOS ANGELES is the hub of a large mileage of paved roads that radiate in many directions. These roads and the all-year-around motoring climate that California enjoys, together with the rapid increase in population of Southern California towns and cities, have resulted in an acute congestion of traffic in the streets in Los Angeles.

The Automobile Club of Southern California, which has 65,000 members, is helping to solve these problems. The club has had a survey made to ascertain whether substantial portions of the traffic congesting the business section of the city could be diverted therefrom by improving broad streets around its perimeter. An extended count showed that a small percentage only could be so by-passed and that relief could be had by remedying conditions in the business area itself.

Topographical features have compelled the city to grow mostly to the southwest, with the result that the business area is long and narrow with few cross outlets, thus forcing traffic to a few streets. Several months ago the Automobile Club instructed this office to make an intensive study of traffic conditions, report its findings and recommend steps to be taken for relief of the congestion.

It was decided that an aerial map, if made in conjunction with a traffic census, would furnish the best basis for this study. Co-operation by several of the city departments in preliminary studies lead to the adoption of this aerial survey for a strip of the city 4.5 miles long and 1.33 miles wide, or approximately 6.5 square miles. At the time the picture was taken, a "flow check" was made. This was to determine the speed of vehicles and street cars traversing the area.

There was also a count made at numerous corners to ascertain the quantity and direction of all automobile and street car movement. On the aerial map itself the total number of vehicles within a given area could be counted. The number of machines parked on streets could also be ascertained from this count. With all of this information a definite relation, synchronous in character, was established between the total number of vehicles within an area and their rate of flow and number passing certain corner in a given time.

Detail Shown—The map is of sufficient detail so that a count could be made of automobiles parked in open-air parking places, such as vacant lots, roofs of buildings, etc. From a count of these machines and adding the automobiles stored for the day in garages, an estimate of the addition to the normal street traffic can be made which will approximate the number of vehicles that the outlets of the congested district will be called upon to pass during the peak hours of traffic flow.

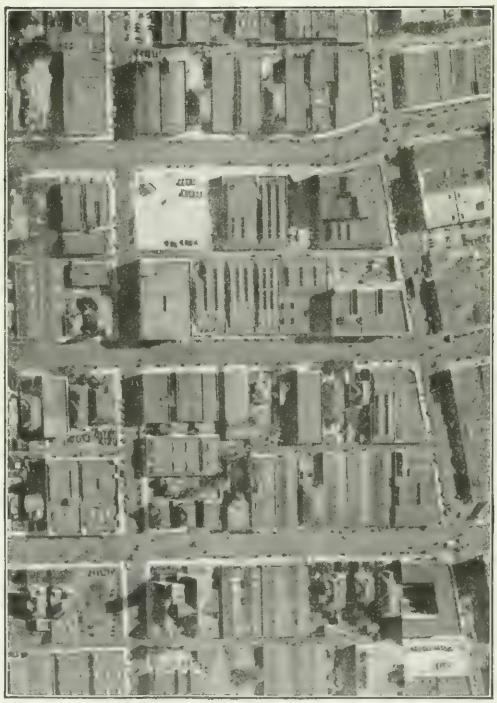
The airplane used in making the survey was equipped with an Eastman, 20-in. lens camera, and flew at a height of 4,000 ft. The mosaic is at a scale of 186 ft to the inch. This scale will allow for contraction in the finished prints or reproductions, which are to be 200 ft.

to the inch. This scale will permit using tracings of city maps to copy improvement features, if so desired.

Pedestrians on the pavements could be counted where not in shaded portions of the picture. Street car and railroad tracks show plainly.

Results Secured—The most important results gained from the picture were suggestions for elimination of awkward angles and turns at various street intersections and the possibilities afforded for cutting through new connecting streets along the least improved routes. Study of the map brought out ideas and facts that ordinary tables, diagrams and line maps would not readily do.

The aerial map presents the features so realistically



AERIAL MAP SHOWS TRAFFIC ON CITY STREETS

that explanations are not needed when suggesting a project of improvement for consideration. Projected improvements can be delineated in water colors upon the picture and if changes are to be made, these colors can be eradicated readily. Lantern slides can be made of any area under discussion and these slides used at conferences where the improvement is the subject of debate. In this way the projects can be presented in a popular way.

It is found that estimates can be made readily from this aerial map, as all improvements can be scaled from it. The only field information needed is the height, class of building, etc.

Specifications—Following are the specifications for the aerial map submitted for bids to the firms doing this class of work:

(1) Area to be surveyed: The area to be surveyed shall be that portion of the City of Los Angeles, Cal., bounded as follows: ————

(2) Day of making survey: The survey shall be made on either the first Saturday or the first Monday following the signing of this contract, weather permitting. It shall not be made upon any other day unless authorization therefor is given by the Automobile Club.

(3) Time of making survey: The survey shall be made at the time of day when the rays of the sun's light are as nearly vertical as possible and the shadows are shortest in both the major and minor axis of the picture.

(4) Scale: The original mosaic or master map shall be on a scale of 200 ft. to 1 in. (The original negative made in the air shall be exposed at said scale of 200 ft. to 1 in. and no enlargement of said negative shall be made in constructing the mosaic or master map, except as ordinarily required in the general rectification processes, which it is understood and agreed between the parties hereto shall in no case exceed a 2 per cent change of scale of said original negative.)

(5) Accuracy: The original mosaic or master map shall be as accurate as possible and there shall be no variation or error therein greater than 5/10 of 1 per cent in any area where there are street intersections, or greater than 1 per cent in any other area.

(6) Clearness of picture: Vehicular traffic on unshaded portions must stand out clearly enough so that individual vehicles can be counted without the use of a magnifying glass. Shadows shown in the picture must be sufficiently transparent so that vehicles can be counted with the aid of a magnifying glass with a power of not over four diameters.

(7) Quality of work: The mosaic or master map shall be built up from the individual pictures taken in the survey with such workmanship as will insure a reproduction that will not show lines of joining and will be free from other imperfections.

(8) Disposal of mosaic or master map: The company shall retain the ownership of all negatives secured or used in the making of the survey and also the original mosaic or master map. The company shall immediately after the delivery of the prints hereinafter provided for, deliver to the Automobile Club the original mosaic or master map for its use for a period of one year from the date of such delivery. Such mosaic shall be mounted on composition board.

(9) Prints: The company shall furnish to the Automobile Club one print of the original mosaic or master map on velvet surface paper and one on glossy surface paper, each print to be mounted on linen or on composition board at the option of the Automobile Club.

The Automobile Club shall be entitled to additional copies of the picture at a cost of the labor and material used in making such prints, plus 25 per cent thereof. With such mosaic the company shall furnish a schedule of the time of each photographic exposure used in the preparation thereof.

(10) Copyright and reproductions: The company shall copyright the completed picture secured by this survey and shall retain the copyright and shall not sell, give away or produce reproductions of said picture for one year except on written authorization of the Automobile Club.

(11) The work called for herein: The original mosaic or master map and the prints will be made subject to acceptance thereof by the Automobile Club, which acceptance will be given in writing only upon the receipt by the said Automobile Club of a written statement signed by its consulting engineer and the chief engineer of the Board of Public Utilities of the City of Los Angeles, that the said original mosaic or master map has been by them compared with the actual measurements of the distance existing between street intersections in the area to be surveyed and has been found to conform to the limits of accuracy hereinbefore set forth and with the requirements hereof as to the clearness thereof. Such verification shall be promptly secured by Automobile Club without expense to company.

(12) Liability for accident or damage: The company hereby waives any claim against the Automobile Club for damages arising out of the performance by the company of any of the terms of this contract and hereby expressly agrees with the said Automobile Club that it will protect, save and keep harmless the said Automobile Club from any claim for damage or injuries sustained or alleged to have been sustained by anyone on account of the performance of the terms of this contract by the company, its agents, employees or sub-contractors.

Cost—The pictures were taken Feb. 3, 1922, between the hours of 11:30 a.m. and 1:30 p.m. There were 450

exposures on 7- x 9-in. film. Approximately 47 per cent of each print was used in building up the mosaic map. The Automobile Club secured insurance against property damage of $1,500 and $10,000 to $20,000 for personal liability, the premium being $222 per year. The cost of the maps to the Automobile Club was $1,625 for the 6½ sq. miles, or $250 per square mile, not including insurance.

The contract for this map was let to the Pioneer Aerial Engineering Co. of Beverly Hills, Cal; this company specializes in aerial map work.

Results obtained in this work lead to the conclusion that aerial maps, if made upon a sufficiently large scale, will show sufficient data to aid materially in the solution of traffic problems at a lesser cost than other mediums.

Buckle-Plate Longitudinal Joint For Concrete Roads

New Jersey Adopts Twenty-Foot Slab Separated at the Center and Having Dowels at All Transverse Joints

A 20-FOOT slab uniformly 8 in. thick, heavily reinforced and having a keyed longitudinal joint and doweled transverse joints has been adopted as standard for concrete roads in New Jersey. This design is a development of a similar construction which was employed last year and which proved reasonably easy to obtain with ordinary contracting skill and workmanship. Incidentally very few cracks have developed in the jointed pavements built in 1921. The design shown

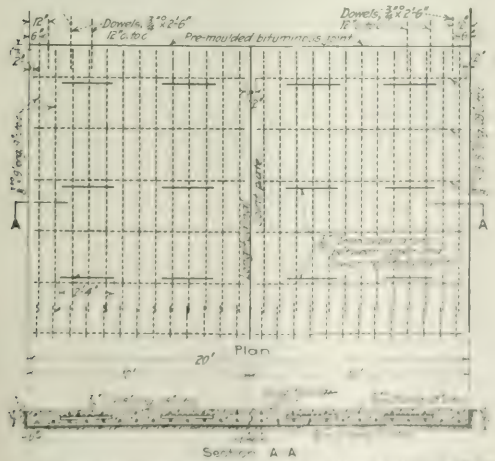


FIG. 1. REINFORCED-CONCRETE PAVEMENT WITH KEYED CENTER JOINT

is for heavy traffic roads. Other sections have a single layer of reinforcement or are plain concrete.

A slab, Fig. 1, of uniform thickness on a crowned subgrade is employed. To insure the cross-section curve of the subgrade, surfacing with a subgrader is specified. Forms are required to be set ahead for the subgrader and the soil is required to be consolidated with a 10-ton roller before it is planed to profile. Similarly exact construction is called for throughout the fabrication of the pavement.

Two layers of reinforcement are required for the heavy traffic pavement shown by Fig. 1. Where single reinforcement is required, the top layer of rods shown by Fig. 1 is omitted. Two things are to be noted in the reinforcing; it is a separate structure between transverse joints for each half of the slab and where two layers are employed they are held apart vertically by stiff iron separators or spreaders. The distinguishing structural detail is, however, the longitudinal joint, Fig. 2.

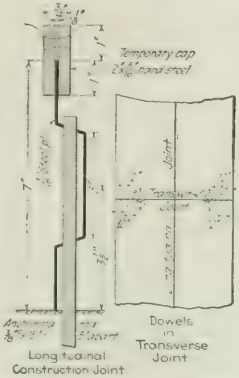


FIG. 2. LONGITUDINAL JOINT DETAIL AND DOWEL ARRANGEMENT

A sheet-steel buckle-plate, with its top 1 in. below the slab surface forms the joint. It is lined up vertically and pinned to the sub-grade. Also it has a removable cap set onto its top edge to form the ¾-in. groove which is tooled and, after the cap is pulled out, is filled with bitumen. The buckle-section of the joint sheet, it will be noted, forms a keyed joint. This is a development from the flat-plate joint used in 1921. It locks the inside corners wherever a transverse joint crosses the longitudinal joint and the dowels can, as shown, be confined to the outside corners. In 1921 construction the dowels were placed 2 ft. apart across the pavement. On one side of the joint the dowel rods are wrapped in two layers of tar paper or are encased in a paper tube so that the rods will slide as the joint opens and closes.

Concrete proportions for pavement are usually 1:1½:3 or 1:2:4 but are changed, when the aggregates are unusual, to the figures required to ensure use of the specified volume of cement per cubic yard. Similarly the slump limit specified for consistency of mixture, is determined for each aggregate. Concrete is required to be mixed 1½ minutes.

T. J. Wasser is state highway engineer of New Jersey with E. A. Reed as assistant in charge of design and C. F. Bedwell as construction engineer.

Mileage and Costs of California Highways

By the end of the present fiscal year California will have completed about 3,007 miles of its state highway program, according to a recent announcement of the California highway commission. The total mileage in the road system on which the state highway commission has charge of both construction and maintenance is about 6,300 miles. There are in the state about 70,000 miles of dedicated public roads outside the boundaries of incorporated cities. Of this total more than 6,000 miles have been paved by state and county agencies. The mileage of paved surface is being rapidly increased by the extensive road construction and improvement projects now under way. The California state highway commission alone will this year expend about $15,000,000 in new highway construction. During 1921 the average cost per mile for the different types of road were roughly as follows: Graded roads, $12,000; bituminized macadam, $21,000; concrete base, $30,000 and bituminous pavement, $24,000.

Preventing Loss of Power Due To High Backwater

Notes on Design and Tests of the Thurlow Backwater Suppressor To Offset Head Reduction

Abstract of a paper read before the annual convention of the American Society of Mechanical Engineers, Atlanta, Ga.

By J. A. Sirnit

Designing and Electrical Engineer, Alabama Power Co., Birmingham, Ala.

IN MANY hydraulic power plants, there is a great loss of power due to the fact that during flood conditions, when water is being wasted over the spillway, the level of the water in the tailrace at the outlets of the draft tubes leading from the turbine is raised, thus reducing the head on the turbines and in turn their capacity and the output of the power plant. In many cases of proposed developments, engineers have hesitated in recommending the carrying out of the development on account of backwater conditions in the tailrace, which can be foreseen and predicted very closely.

Engineers for many years have wrestled with this problem and have tried to overcome this difficulty by installing a greater number of generating units where it is possible to do so, to compensate for the loss in capacity of each unit; of course, such a procedure necessarily makes the installation more expensive with the resulting increase of

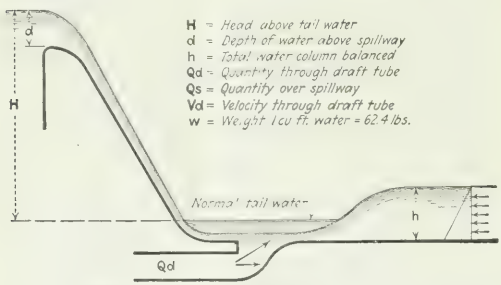


FIG. 1. ACTION OF THE STANDING WAVE IN REDUCING TAILWATER

production costs. Attempts have also been made to counteract this loss in head by admitting into the draft tube water through jets at a relatively high velocity which, by accelerating the velocity of the combined turbine discharge and jet water through the draft tube, produce a negative head which is added to the head on the turbine. A number of variations in the place and manner of introducing this jet into the draft tube have been tried and results published but the results have not been entirely satisfactory.

The most logical and simplest way to maintain the normal head on the waterwheel and thereby the full capacity of the plant during flood periods is to remove the high tailwater from the discharge opening, and credit is due to O. G. Thurlow, chief engineer, Alabama Power Co., who conceived the idea of utilizing the waste water to accomplish this fact, thereby successfully solving the problem. The development of this conception resulted in what is now known as the "Thurlow Backwater Suppressor."

It is a well known phenomenon of nature that water flowing over a masonry dam, having a downstream face of ogee section, leaves the apron in a thin sheet at high velocity. At a point below the dam, the water rises turbulently, forming a so-called "standing wave," "hydraulic jump," or "back roll." The thickness of this sheet and the velocity of the water depends upon the height and shape of the downstream face of the dam, upon the depth of water at the crest of the dam, and upon the quantity of water flowing over the dam. The energy developed in this thin sheet of water has generally been regarded heretofore as solely of destructive nature, but in the backwater supressor the energy of the spillway water is directed so as to remove the backwater from over the draft-tube orifice, sweeping it downstream, thus freeing the draft tube from this pressure of water over it and maintaining a practically uniform head on the turbine as long as the spillway water is able to sweep the backwater away from the draft-tube orifices. In Fig. 1 is shown diagrammatically the action of the overflow spillway water

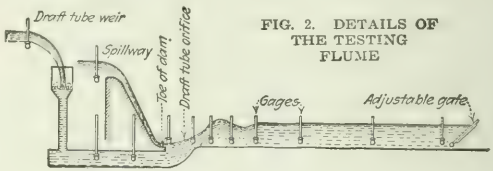


FIG. 2. DETAILS OF THE TESTING FLUME

on the tailwater. It is indicated there, that the energy of the spillway water not only removes the height of tailwater from the draft-tube orifice but even lowers the normal tailwater level to a level that can be predetermined.

Testing Models — In order to substantiate the idea and evolve a definite theory on which to base the calculations, a model was constructed on $\frac{1}{24}$ scale, where a small flow at 8 ft. head was available. The results obtained here were so interesting that, to check the data obtained and to increase the accuracy of measurements, a second and larger model was constructed to $\frac{1}{16}$ scale, where a greater flow and head were available. The results obtained with the two models, when reduced to the same scale, were in close agreement and the observed results followed those calculated for similar conditions.

Fig. 2 shows diagrammatically the essential elements of those models. Each consists of a forebay for stilling the water, a spillway having the usual ogee section, a draft tube with its orifice located directly under the spillway and a tailwater wasteway. The height of the water in the forebay wasteway and draft tube were measured in glass gages conveniently located on central platforms. By means of these, measurements corresponding to the pond level head above the river bed, the effective turbine head, the depth of water over the spillway and the backwater head could be conveniently determined. Weirs were used in admitting water to the draft tube so that the amount could be accurately measured. This amount was ordinarily maintained to correspond to a normal turbine discharge. Bear trap stop logs were provided at the end of the wasteway by which the height of the water in the wasteway could be varied to simulate backwater.

The height of the standing wave taking a section of unit (1 ft.) width and neglecting losses due to the friction of the moving water over the spillway, can be approximated by the empirical formula $h = \sqrt{d^3 \times H^3}$ in which d is depth of water in feet over the spillway and H, head in feet above spillway apron. This does not take into account the effect of the turbine water. This factor will increase the height of standing wave, so that the actual results will be somewhat better than as shown by this formula. A comparison of the calculated and observed heads of backwater which different amounts over the spillway are capable of removing from the draft tube orifice, are shown in the accompanying table. These figures are for a section of backwater 20 per cent greater in width than the spillway $h = \sqrt{0.83\, d^3 \times H^3}$.

CALCULATED AND OBSERVED HEADS OF BACKWATER

	MODEL 1		d	MODEL 2	
d	h Observed	h Calculated	(Ft.)	h Observed	h Calculated
(In.)	(In.)	(In.)	0.25	(Ft.)	(Ft.)
4	6.00	6.5	0.50	0.40	0.59
5	7.75	8.05	0.75	0.84	0.88
6	8.75	8.9	1.00	1.30	1.20
7	9.75	10.0	1.25	1.51	1.56
7.5	11.00	10.6	1.50	1.72	1.78
			1.75	2.10	2.08
				2.48	2.35

These readings are illustrated in Fig. 3 which shows curves of the turbine head with and without the suppressor

and is typical of the performance of the backwater suppressor with a normal thickness of water over the spillway and varying heads of backwater.

The effect of the turbine head of different amounts of water over the spillway is shown by the curve in Fig. 4. It is noted that very small amounts cause a decrease in head because sufficient velocity has not been given to the draft-tube water to cause a thinning of the sheet over the draft-tube orifice, but when the ratio of spillway to draft-tube water increases to about one to one the curves take a decided course upward and reaches its peak and starts falling off again due to a greater quantity of water passing over the orifice with practically no increase in velocity above that of the point of maximum head. This curve does not represent the best performance possible but it is typical of the ideal theoretical curve which is shown in the figure.

The curve in Fig. 5 shows the over-all performances of the test as compared to that without the suppressor. It will be noticed that the head drops off slightly as the backwater increases, due to a greater quantity of water necessary to hold the standing wave, until a point is reached where the standing wave is 13.26 in. high, and the curve takes a sharp curve down. This point represents the critical stage or the maximum height of backwater capable of being suppressed by given amount of spillway water, this could be increased by having a design of spillway permitting a greater discharge.

Following the curve on down it will be seen that a substantial increase in head is obtained even after this point is reached. The last point plotted is with backwater 50% of the total head and an increase of 5 in. is recorded.

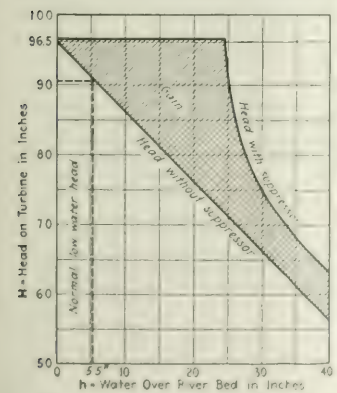


FIG 3. PERFORMANCE CURVE FOR MODEL 2

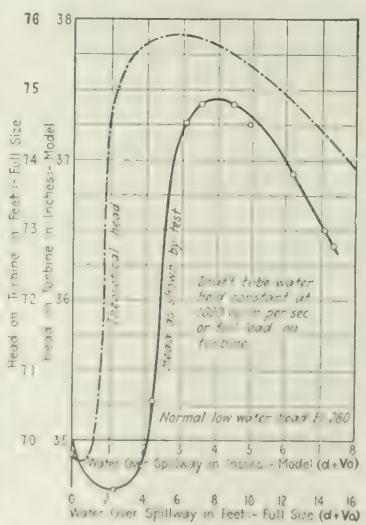


FIG 4. HEAD CURVE FOR MODEL 1

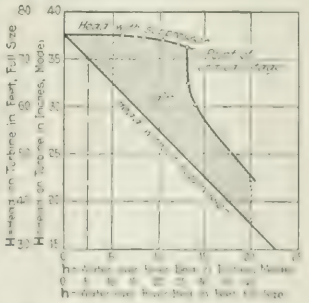


FIG 5. PERFORMANCE CURVE FOR MODEL 1

heads varying from 30 to 100 ft. The amount of water flowing over the spillway will cause this length to change but for depths up to 15 ft. this range will hold good.

The distance out of point x is determined by the amount of water passing through the draft tube. The area of the draft-tube orifice subject to the action of the sheet of spillway water must be proportioned so that a back pressure in the draft tube is not necessary to force the two waters to mix. The curve R_3 is great enough so that the centrifugal force of the fast moving sheet of water will not cause it to leap clear of the concrete surface. R_2 makes a smooth transition connecting point x and R_3 and is about $\frac{1}{2}$ R_3.

The standing wave is held out just beyond tangent R_3. The total distance from the lip of spillway apron to the point of wave must not be greater than good design of the other features will permit as the friction of the high velocity water diminishes the height of the standing wave thereby causing a greater amount of waste water necessary to operate.

The river channel below tangent R_3 must be finished with neat concrete for a distance of 4 heights of the standing wave, in the case of heads up to 25 ft., and 5 to 6 heights for heads varying from 30 to 100 ft. This is necessary for good performance although a rough bed of water pocket can be used but a great waste of water is required and heavy undercurrents, due to an imperfect standing wave, might scour the river bed badly or undermine the protecting apron.

This is of great importance if the rock strata is poor as open seams will allow the high static pressure beyond the wave to be transmitted back under the protecting apron causing an uplift. This uplift must be given attention even when the apron is carried out to the desired point and provision made for its secure anchor.

Dividing Walls—Each unit must be provided with dividing walls to permit the water from coming in on the side and to allow any one unit to operate independently.

The correct height and length of these walls is determined by the backwater and discharge curves of the river at the location of the power house. Section A A, Fig. 6, shows the condition for the installation of four units. The three intermediate walls are at an elevation shown by the backwater curve when the required amount of water to operate four turbines and three suppressors is passing that point. When the fourth suppressor is brought into action the condition is as shown by the dotted line in [illegible] and these walls [illegible] to hold better conditions at the point of wave and prevent surging.

The two outer walls are designed for extreme flood conditions, as any water passing over the walls into the suppressor sheet will cause a loss in head on the turbine and in height of standing wave; however, if there should

Design of Draft-Tube Orifice—Several shapes of draft tube orifices were tested, the one shown in Fig. 6 leaves very little to be improved upon for getting a maximum height of standing wave and a maximum head on turbine. This design can be modified to give a greater head on turbine but does so at a sacrifice in height of standing wave.

The location of point X is of great importance as it controls the increase in head on turbine and its relation to the elevation and angle of discharge of the spillway apron must be very exact or a poor performance will result, also consideration for the turbine "runoff" during the period when the suppressor is not in action must be kept in mind.

The length of tangent t must be [illegible] to hold down the spillway water well along the line AX and should be at least 5 ft. for heads up to 25 ft. and 7 to 10 ft. for

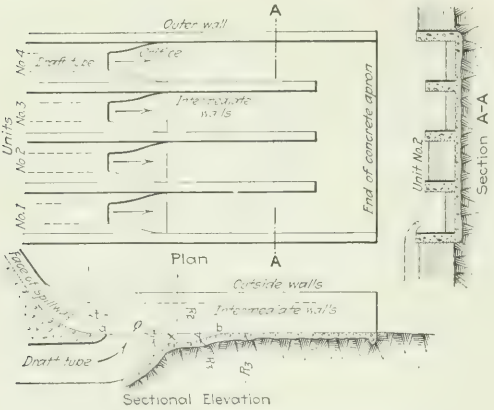


FIG. 6. TYPICAL LAYOUT OF DRAFT-TUBE ORIFICE

be spillway gates on both sides of the power house section equal to the width of two units it need not be at the maximum high water elevation but at the stage shown by the combined discharge passing the power house and side spillway. This is due to the fact that although a perfect standing wave is not formed at the toe of the side spillways a lower elevation is created than will be farther downstream where the true backwater elevation is measured.

Application of Backwater Suppressor to the Coosa River Plant

Further extracts from the preceding paper by John A. Sirnit, outlining the design of the Mitchell plant of the Alabama Power Co., in which the Thurlow backwater suppressor is used.

BEING satisfied that the backwater suppressor will perform as indicated by the tests, the next logical question would be: will the suppressor type power plant cost more to build than the conventional type of equal capabilities, and if so, how much more. If the cost is higher than a plant of conventional design with an equal output, or even if the cost were the same in both cases, the conventional type of power plant would be preferred, because in a new and untried design there always will be found things that may not work out as predicted, while the conventional type plant has proved its worth.

The estimates for the Mitchell plant, however, showed that not only the cost of the suppressor type plant was not higher than a conventional type plant of equal output but it showed even lower cost for the same number of units in each case, which of course meant that for given output the suppressor type plant was considerably lower in cost.

The design finally evolved shows several radical changes and represents an entire departure from the established conventional design of hydro-electric power plants. Fig. 1 shows the general plan of this particular development and Fig. 2 the cross section through the power house section. The salient points of interest, especially those departing from time honored practice, are many, but only the more important ones shall be outlined.

The principal and most outstanding feature in this plant is the location of the power units on separate foundations in river on the upstream side of the dam. Although this is not necessarily the only possible way to build the power house, in this particular instance it was the most economical. The river at this point being comparatively narrow, the entire length of the dam was required for spillway, and since the prime requisite of this type of plant is that the draft tube discharge directly under the spillway section, the units were so located that they would not obstruct any part of the spillway section.

The individual and separate power house units offer the added advantage that trash racks do not present a solid front, which helps materially in cleaning them and affords an easy and convenient way of diverting the trash past the power house and over the spillway.

The usual power house building is entirely eliminated; the generator room is covered with a low roof, which is designed in two sections, joined on the tranverse line, mounted on rollers; each section moving in opposite direction. In normal operation the generator room is completely protected from weather, but if access is required for handling only part of the machinery, this roof can be opened and all parts are handled through that opening with the crane.

A single gantry crane with full travel over the entire length of power house section is so designed that everything, with exception of spillway gates, can be handled with this crane, and is equipped with one 125-ton and one 20-ton hook, the former for handling heavy machinery and the latter for raising and lowering penstock gates, handling racks, stop logs and all other lighter parts.

The entire operating floor is on one floor level: generators, governors, switchboard, low tension switches, bus galleries and offices, and are easily reached without climbing of stairs or bidders. This materially adds to the convenience of operators and makes the supervision and inspection of the plant more effective. It should be mentioned that this feature of providing easy accessibility to all important parts of the station is very frequently lost sight of by the designer and the lack of these conveniences have been the cause of inefficient operation or even breakdowns due to the fact that operators have neglected the equipment in lesser or greater degree.

The generators are so installed that the hot air from the generator is discharged into a separate compartment under the main floor and is expelled into the atmosphere through side openings of that room in summer time, thereby keeping the generator room reasonably cool. In winter, however, when heat in the rooms is desired the outside openings can be closed and registers in the floor of generator room opened letting the warm air into the room.

The penstock does not represent a true scroll casing but rather a combination of scroll effect and open flume. The water velocities in the penstock being low, approximately 4 ft. per second, this combination afforded a better design.

The location of power house units on the upstream face of the dam lengthened the discharge tunnel to about 120 ft. in length from the center line of the unit. Although the velocity of the discharge is only 4 ft. per sec., the effect of this long column of moving water had to be carefully investigated and offered a problem for study. This problem was solved satisfactorily by increasing the governor action to 3½ sec. and setting the turbine to the lowest practical level. At this point it shall be emphasized that turbine

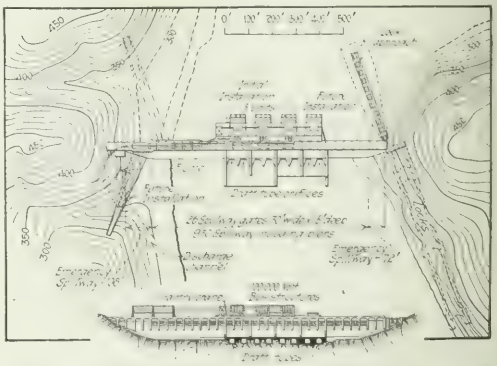


FIG. 1. GENERAL LAYOUT OF MITCHELL POWER PLANT ON THE COOSA RIVER

settings always shall be as low as possible, especially where improved draft tubes are employed. Many of the troubles in existing power plants, such as pitting of runners, excessive vibration, etc., can be directly traced to high wheel settings particularly with high specific speed runners.

Twenty-six spillway gates of the Tainter type are provided, each 15 ft. high and 30 ft. wide; these gates are capable of passing the maximum flood water known to

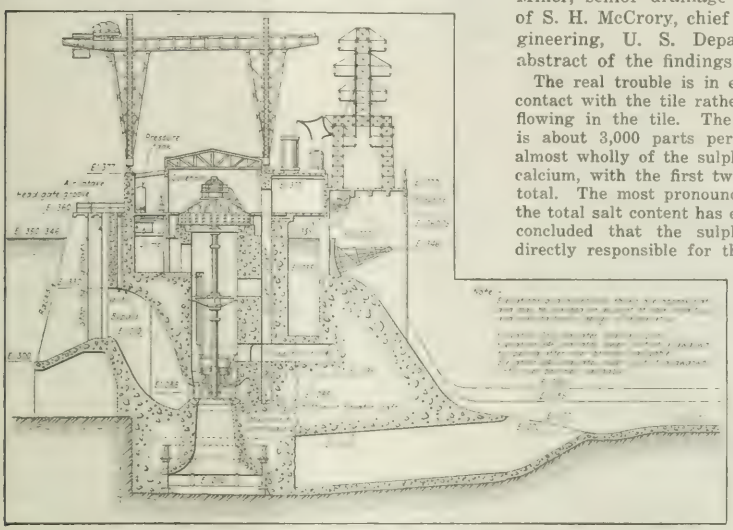


FIG. 2. SECTION THROUGH POWER HOUSE

Outstanding Features of Plant

- Power units on separate foundations upstream of dam.
- Power house building eliminated; roof over units instead.
- Outdoor gantry cranes control entire plant.
- Backwater suppressor takes care of flood conditions.

have existed in the past. There are also 6 bays, 20 on the east and 4 on the west end of the dam, which are designated as emergency spillway openings. The crest of these openings is level with the top of the spillway gates and their function is to provide additional spillway capacity in case of unprecedented floods when water would rise above normal pool level.

Federal Land Purchases To Protect Navigation

Purchases of land by the National Forest Reservation Commission for the protection of navigable streams totaled 1,602,906 acres to June 30, 1921, at an average cost of $5.31 per acre and at a total cost of $8,505,755, according to the latest annual report of the commission to the secretary of war (Senate Document 90). The distribution of this land by states and other related figures are given in the accompanying table.

PURCHASE AREAS, AREAS APPROVED AND AREAS ACQUIRED FOR BY NATIONAL FOREST CONSERVATION COMMISSION TO JUNE 30, 1921

	Total Purchase Area	Approved For Purchase			Acquired		
	Acres	Acres	Price	Value	Acres	Price	Value
Me.	121,503	32,320	$5 52	$178,566	[illegible]	$4 31	$177,608
N. H.	828,611	413,678	6 56	2,712,159	[illegible]	[illegible]	2,661,466
Md.	80,259	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Va.	1,032,134	445,208	3 69	1,641,[illegible]	[illegible]	[illegible]	1,142,682
W. Va.	845,165	128,253	3 17	40[illegible]7	[illegible]	[illegible]	102,681
N. C.	2,143,235	334,400	6 17	2,064,269	[illegible]	[illegible]	1,652,991
S. C.	151,866	18,454	5 43	100,[illegible]	[illegible]	[illegible]	[illegible]
Ga.	558,247	152,763	6 66	1,018,087	134,094	6 66	890,799
Ala.	196,520	68,995	4 60	317,600	47,127	4 59	216,256
Tenn.	1,134,991	265,146	4 86	1,288,[illegible]	811,[illegible]	4 [illegible]	3,941,582
Ark.	1,469,406	48,295	3 55	171,[illegible]	[illegible]	44	[illegible]
Grand Total	8,562,657	1,907,512	$5 19	$9,[illegible]	[illegible]	$5 11	$8,981,215

* Averages and aggregates may value have been [illegible] which may cause [illegible] compared with [illegible]

Concrete Drain Tile in Alkaline Soil

Limits to the use of concrete tile in alkaline soil are indicated by a report of investigations made in southwestern Minnesota by the State Department of Drainage and Waters in co-operation with the U. S. Department of Agriculture. This report was made by Dalton G. Miller, senior drainage engineer, under the direction of S. H. McCrory, chief of division of agricultural engineering, U. S. Department of Agriculture. An abstract of the findings of the report is given below.

The real trouble is in extreme conditions of the soil in contact with the tile rather than the salt content of water flowing in the tile. The danger limit of the soil water is about 3,000 parts per million when the salts consist almost wholly of the sulphates of magnesium, sodium and calcium, with the first two near 66 to 75 per cent of the total. The most pronounced failures have occurred where the total salt content has exceeded 4,500 parts. It has been concluded that the sulphates are in a large measure directly responsible for the failure.

Characteristic failures are by disintegration beginning with a checking and cracking of the exterior surface of the tile wall, followed by an increase in volume. Finally all binding principles of the cement disappear and the mass resembles a freshly-mixed batch of lime-mortar concrete. Of the exact chemical processes much remains to be learned, but the final result in extreme cases is a loss of most of the cement. There is no known solution for the problem but betterment in quality of the tile will minimize the difficulty in that the danger limit of the sulphate waters can be raised considerably. Until it is possible to make concrete that will definitely resist all action of sulphate waters, concrete tile should not be considered where soil analyses indicate sulphates in more than nominal quantities.

Except where disintegration has resulted from the action of sulphates, concrete tile are giving satisfactory service throughout the area covered by the investigation. Physical tests indicate that the general quality of concrete tile manufactured in southwestern Minnesota during 1919 and 1920 was high enough to meet the requirements of the drain-tile specifications of the American Society for Testing Materials. Tile manufactured previous to 1919 was somewhat inferior in quality to that now being made.

To secure better concrete tile the following suggestions are made: (1) Use only properly graded clean sand that is free from organic matter; (2) more coarse aggregate; (3) more attention to the consistency of the mix, which means a wetter mix at most of the plants; (4) more care to regulate the time of mixing so that there is more uniformity with respect to different batches and also to insure that each batch is thoroughly mixed; (5) curing the product before it leaves the tile plant. Attention is directed to the almost negligible quantity of aggregate retained on the ¼-in. screen. As this material represents the only coarse aggregate it is evident that these tile should properly be called "mortar tile" rather than "concrete tile." There is no indication that any of the mixes used are objectionable.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Slabs for Column Bases Hard to Get

Sir—Referring to your April 27 issue, page 684, the article by Eugene W. Stern on "Multiple Steel Slabs for Large Column Bases": If our experience in the last few years is any criterion, the idea proposed, while theoretically ideal, does not work out to good advantage in practice.

For a few years we have used steel plates in this manner but invariably receive a protest from the fabricator because of the difficulty he experiences in securing thick steel plates. These steel base plates are the first pieces to be shipped and put in place, and it takes the longest to secure them from the mill. A great many engineers, on the strength of such a recommendation as shown in this article, would go ahead and design their bases using heavy steel plates, and after the plans were all drawn up, contracts let, and details made, would run up against the difficulty of getting these heavy steel plates in time to avoid delay in erection. We had just this difficulty on a building we put up last year at one of our plants. The order for the steel slabs was the first to be placed, the mill order for the first-tier columns being placed a week or so later. The columns were received from the mill, fabricated and shipped before the steel slabs were received by the fabricator. We were delayed at least three weeks in starting to erect our steelwork, waiting for the steel slabs.

Hereafter we are going to use either cast-steel slabs or the usual cast-iron bases.

N. H. McKENZIE,
Engineering Department,
Chicago, May 11. Corn Products Refining Company.

In Favor of 1: 50,000 Scale for Maps

Sir—The letter of F. A. Noetzli in your issue of May 11, p. 801, expresses a point of view which should receive greater publicity at a time when there appears to be a popular feeling that the scale of the topographic maps of the U. S. Geological Survey should be changed from 1: 62,500 to 1: 63,360. One has but to compare the present use of the metric system in America with that of ten years ago to realize that we are gradually adopting that system, and that it is hardly reasonable now to go to large expense and the inconvenience of being afflicted with two scales for the same type of map, only to go through the same inconvenience and expense a few years later when the disadvantage of the 63,360 scale becomes more apparent.

Mr. Noetzli suggests a scale of either 1: 50,000 or 1: 100,000. The latter is too small a scale for this type of map, but there appears to be every reason for the adoption of 1: 50,000 and every reason for caution in the use of any scale with a more intricate relationship between distance on the map and distance on the ground.

The scale of 1: 62,500 has few reasons for existence outside of the fact that the majority of our maps are already drawn to that scale. The scale of 1: 63,360 has the apparent advantage at the present time of giving us an exact relationship of 1 in. = 1 mile. The increased accuracy of the inch-to-the-mile scale over that now in use is too small to warrant the expense and inconvenience of the change, the difference between the two scales being only 0.014 in. in 1 mile or about 0.1 in. in 10 miles. For general use this difference is immaterial.

The scale of 1: 50,000, which is uniformly in use in continental Europe, has much to commend it. It is admirably adapted to the metric system and will be continually increasing in value as the metric system becomes more generally used. It will give us a slightly larger scale for our maps, which is desirable. It fits admirably with the scale of 1: 500,000 now being used for the state maps and the 1: 1,000,000 scale of the map of the world. Its relationship with the scales 1: 125,000 and 1: 250,000 already used for mapping a very considerable part of the country is simple and these scales would not require changing.

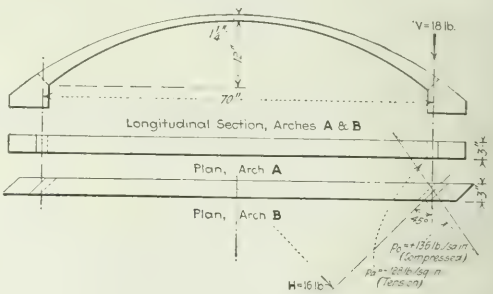
A final reason for the 50,000 scale, and an important one in view of the fact that the inch will continue to be used as a unit of measurement for some time to come, is the relationship of 1 mile = 1.267 in., or for all practical purposes 1¼ in. In addition to being the ideal metric scale, it is nearly as convenient to use with our present system of measurements as the scale proposed.

GEO. C. DANFORTH,
Chief Engineer, Maine Water Power Commission.
Augusta, May 23.

Skew Arch Thrust

Sir: Referring to the article by Prof. C. T. Morris entitled "Thrust of Skew Barrel Arch Measured on Laboratory Model" in your issue of April 20, 1922: The Fischer method of analysis, which is adopted by Professor Morris, gives absurd results when applied to a structure which is narrow compared with the length.

For example, assume a right arch of 70 in. span, 12 in. rise, 3 in. width of roadway, 1¼-in. crown thickness, and otherwise similar to the Morris experimental arch. This arch, or arch *A*, will have a weight of 36 lb. above the skewbacks, and analyzed by the usual methods the horizontal thrust due to the dead load of the rib would be 22.5 lb., and the thrust tangential to the axis of the arch rib would be 27.5 lb. Assume a second arch, *B*, with the same rise, the same width of roadway and the same distance between centers of skewbacks as for arch *A*, but with the abutments skewed to an angle of 45 degrees. This second arch is about equivalent to a vertical slice 3 in. wide cut off of one face of the Morris arch; it will have abutments 4.24 in. long and the span on the square will be 49.5 in., measured from center to center of skewbacks. Arch *B* will be stable; hence the vertical component of the total thrust tangential to the axis of the arch rib falls within the abutment.



SKEW AND SQUARE ARCHES COMPARED

Now apply the Fischer theory to find the magnitude and point of application of the resultant of the total horizontal thrust, which Fischer assumes must be normal to the abutment, and which Prof. Morris says will be equal to the thrust of a right arch of equal (projected) area. On this theory the total horizontal thrust normal to the abutment would be 16 lb. for arch *B*, and by the formula $e = (s/2)\cot\phi$ the distance of the resultant from the center of the abutment is 24.75 in. The unit stresses at the skewbacks by the formula $p = (H/b)\ (1 \pm 6e/b)$ are $p = 3.774\ (1 \pm 35) = 136$ or -128, that is, 136 lb. per square inch compression at the obtuse corner of the arch and 128 lb. per square inch tension at the acute corner of the arch.

Stated a little differently, the Fischer formula gives a horizontal resultant of 16 lb. located six abutment lengths away from the center of the abutment, and this 16 lb. causes compression stresses on one portion of the abutment

ranging from zero to 136 lb. per square inch and aggregating a total of 148 lb.; and on the other portion of the abutment tension stresses ranging from zero to 128 lb. per square inch and aggregating a total of 132 lb.

In general the stresses transmitted to the abutments of an arch all result from the application of vertical forces within the space bounded by vertical planes through the arch faces and the skewbacks. While one may conceive forces as called for by the Fischer formula being applied at the ends of arch *B*, it is difficult to believe that vertical forces aggregating 36 lb. (the weight of the arch), and of necessity transmitting their effect through the arch rib, can produce any such effect.

The resultant thrust of an arch is that force which applied to the abutment would in effect replace the arch. At its point of application any force may be resolved into components. With the vertical component of the resultant known to fall within the abutment, how can the horizontal component lie six abutment lengths away? There must be a horizontal component along the abutment, as well as the one normal to it, which latter is the only one considered by Dr. Fischer.

In the *Beton und Eisen* article Dr. Fischer states that the triangles which lie between the skew arch and its circumscribing right arch are to be taken as "gewichts- und widerstandslos"; that is as without weight or resistance. In an arch such as the Morris arch the Fischer resultant thrust would have to be transmitted by a medium incapable of resistance, which is a manifest absurdity.

In his article Professor Morris does not give complete dimensions of the experimental arch, nor dimensions showing the locations of the six springs supporting the movable abutment. Also, he does not give the stresses registered by the springs; it is only the *changes* in the spring stresses caused by adding load which are plotted on the small-scale diagrams. The author states that after the level sand fill 3 in. deep over the crown was placed "the abutments were leveled and brought into proper position" and that this was called "zero-load" condition. It is hoped that Professor Morris will supplement his article by giving the spring stresses which were developed under zero-load condition, and further information as to how the proper position of the movable abutment for zero load was determined.

New York, May 18, 1922. DANIEL ROYSE.

The High Cost of Tardy Engineering

Sir—As a sequel to the article by Chas. P. Dunn, in *Engineering News-Record*, April 27, p. 699, entitled "Graphics Applied to Economic Location of Building," the writer considers the following discussion timely.

Sites for industrial development are frequently purchased without more than a superficial examination. Large sums of money are invested in these sites without regard to their adaptability to the construction requirements of the project and not until after the purchase has been consummated are engineers employed to determine the topographical, geological, or hydrographical fitness of the site.

In many instances, this procedure is dictated by a misconceived policy of secrecy. Such a policy is a natural but mistaken expression of the true principles of economy, being adopted to prevent the raising of prices and other steps that would increase cost to the purchaser. But this often results in unreasonably excessive construction cost. Options may be obtained to secure the purchase price against increase pending proper investigation by an engineer. Should the site, as a result of such investigation prove unsuitable, the option may be surrendered and the loss entailed thereby, together with the cost of the engineer's investigation, will be insignificant as compared with the additional expense frequently incurred because of lack of proper and timely information.

In one case, which has come to the personal attention of the writer, a site was purchased and construction of the project practically completed when conditions developed which necessitated the expenditure of several times the amount of money originally estimated. These conditions could, and should, have been predetermined. They could then have been easily foreseen and, other requirements being on a par, a more suitable site selected.

In this instance, the site lay on the bank of a river that is widely respected for its vagaries of current and other peculiarities. Construction plans for the project included a railroad embankment located within about 100 ft. of the river edge. The site had been immune from erosion, according to the best authorities, for a period of more than twenty years and no consideration was given to the possibility of its recurrence. Construction had hardly been completed, however, when erosion set in necessitating the expenditure of more than twice the cost of the plant itself.

While immediate steps were taken to check this erosion, it was not until two years after the plant had been placed in operation that borings were made to determine geological conditions underlying the site. These borings indicated a surface stratum, 20 to 25 ft. thick, of alluvial clay. Beneath this, extending from mean low water level to below the bottom of the river bed, lay a stratum of sand varying in thickness between 60 and 80 feet. A conclusion is that the superimposed weight of the railroad embankment together with erosion, due to sub-surface currents in the river, caused the sand stratum to disintegrate with consequent sloughing of the surface stratum of clay.

To offset the erosion it was necessary to revet the entire shore line of this property with a willow mat 110 x 2,800 ft. At wartime costs of labor and material, it can easily be seen that the expenditure of many times the actual cost of a proper investigation by an engineer would have been justified in order to pre-determine the practicability of this site.

Another case within the personal knowledge of the writer involved the purchase of an extensive and costly tract fronting the same river on its southern reaches. Upon this site it was proposed to construct an industrial plant having, as its most important unit, a dock, or quay, extending along the shore line about 1,400 ft and projecting into the river far enough to provide a suitable depth of channel, at extreme low-water stage, for ocean-going vessels. This site was inspected, superficially, during a stage of water very nearly approaching flood-stage. Purchase of the property was consummated before any surveys were made to determine hydrography of the river bed or any other investigation made to determine sub-surface conditions.

Fortunately, in this instance, before definite plans were made for construction, topographic and hydrographic surveys were made. These surveys developed the fact that at a stage of about 5 ft. above mean low water, there existed a reef which projected into the river from the bluff bank a distance of about 250 yards. This reef extended along the entire river frontage of the site. Thus, proper investigation disproved an entirely favorable impression, created by a superficial examination. The estimates for the dock suffered an immediate and extensive revision—upward. The property, however, had already been purchased at great cost and, to date, is undeveloped.

These two instances, the most outstanding of the writer's experience, cost a corporation hundreds of thousands of dollars, whereas preliminary investigations, together with the cost of forfeited options, would have cost about one per cent of the actual loss sustained. Other engineers undoubtedly have knowledge of many similar instances, all of which demonstrate the need for consultation and employment of engineers at the very inception of any construction project. It is a field in which they are pre-eminently serviceable but one in which their services are given but little consideration.

Mr. Dunn, in the article above referred to, develops his "cost contours," in planning the economical location of a building, from a topographic map prepared in advance. If of proved economy in determining the location of a single building, it follows that such advance information is of proportionately greater value in planning the layout of an extensive industrial enterprise, or other project requiring the economic grouping of a number of buildings.

In marked contrast to the usefulness of a topographic map, soil borings, etc., which should constitute the engineer's activity in the preliminary phase of a project, is the low cost at which such information can be obtained.

St. Louis, Mo., May 6. T. T. CHENOWETH.

NEWS OF THE WEEK

New York, June 8, 1922

Warren Brothers Co. Loses Paving Suit

U. S. District Court in Los Angeles Holds Fresno Work Does Not Infringe

In the U. S. District Court at Los Angeles, Cal., May 29, Judge Benjamin F. Bledsoe handed down a decision in favor of Fresno County and Thompson Bros., contractors, in an action instituted by Warren Bros., Co., of Boston, charging infringement of the Warrenite-Bitulithic paving patents. The type of paving laid by the county under specifications designated as type A and drafted by Chris P. Jensen, county engineer, the court ruled, does not infringe the Warren patent. By the decision it is estimated that Fresno County, for work already completed or contemplated, is saved payment of $200,000 in royalties. The work on which infringement claims were based included half a block of roadway on Blackstone Ave.

The case involved the validity of the so-called Wallace patents, under which the Warren Co. has been operating since the expiration in 1920 of the basic Bitulithic patent No. 727,505. (The status of the Warren patents was discussed in detail in an article in *Engineering News-Record* of Dec. 15, 1921, p. 969.)

The Fresno case came to trial Nov. 8 in Los Angeles. Prior to the trial of that case the Warren company had filed suit against the California Construction Co. and the Federal Construction Co., other contractors who had used the specifications referred to. The county intervened and secured injunctions against further proceedings in the cases pending decision in the Thompson case.

THE COURT'S DECISION

This is the first time that the Wallace patents have been the subject of litigation. In its decision, the court said in part:

"I am persuaded from all of the facts involved, including an inspection of pavement produced by the defendant, that the two courses of pavement produced by them were and are not blended within the meaning of the term as used in the plaintiff's patents. In my judgment, therefore, there is no infringement of plaintiff's patents shown by the product of defendant. The specifications do not infringe the first claim of the patents.

"The real contention of plaintiff seems to be that its patent is infringed if an upper course of pavement be laid upon a lower course of same while the lower course is in a hot or plastic condition, irrespective of whether it is rolled immediately or not. In view of prior art the court cannot conclude that the plaintiff is entitled to have its patents thus construed because patent No. 727,505 issued to Warren in 1903 and which expired before the defendant's structure was produced, indicated the laying of a bituminous composition of any desired nature upon an under course and the rolling of this while yet soft. This contributes to the art, in the judgment of the court, and negatives now the broad claim which the plaintiff seeks to have injected into his patent. The usual decree of dismissal will be entered."

Highway Bill Deadlock Broken

(Washington Correspondence)

The deadlock on the highway bill finally was broken on June 3 when conferees for the Senate and for the House of Representatives compromised their differences in regard to that legislation. The Senate conferees agreed to accept an authorization for an appropriation rather than a direct appropriation of funds, while the House conferees, in turn, agreed to an increase in the limit of cost per mile.

As agreed to in conference the expenditure of $50,000,000 for federal-aid highways was authorized for the fiscal year which will end June 30, 1923; $65,000,000 for the fiscal year which will end June 30, 1924 and $75,000,000 for the fiscal year ending June 30, 1925.

Federal aid is limited to $16,250 per mile during the fiscal year to end June 30, 1923 and to $15,000 thereafter.

Under the agreement reached in conference, $6,500,000 is authorized for forest roads and trails during both the fiscal years of 1924 and of 1925, instead of 1924 only, as is provided in the House bill. The House provision relating to the re-allotment of funds in the event that approved projects are not put under contract within one year from date of approval.

Cement Case Retrial Soon

Following a conference in Washington June 6 between Attorney General Daugherty and Col. William Hayward, U. S. Attorney for the Southern District of New York, a retrial of the criminal case against the cement manufacturers of the eastern district was decided on as soon as a presiding judge can be assigned. The first trial ended in a jury disagreement (*Engineering News-Record*, June 1, p. 925). Decision was also reached to begin the trial of the Midwest group of cement makers on June 15.

Labor Board Orders Wage Cut for Railroad Shopmen

A wage cut of 7 cents per hour for railroad mechanics and 9 cents for freight carmen, effective July 1, has been ordered by the U. S. Railroad Labor Board. This cut will affect about 400,000 employees and will save approximately $60,000,000 annually. The combined savings effected by this action and that reducing maintenance-of-way employees' wages announced last week will, it is estimated, amount to about $110,000,000—nearly half of the loss of revenue expected to result from the recently-announced freight-rate reduction. The three labor members of the board dissented from the majority decision.

Public Service Is Keynote of A.A.E. Convention

(Engineering News-Record Staff Report)

Public service in politics, in education through publicity, and in the perfection of machinery, was the keynote of the eighth annual convention of the American Association of Engineers held June 5-7 in Salt Lake City, Utah. Compensation received little attention compared with the foregoing considerations. An extended employment service, however, was authorized.

The newly elected officers are: President, A. N. Johnson; vice-presidents, G. E. Taylor and A. M. Knowles; directors, District 3, B. W. Matteson; District 8, W. S. Boyle; District 9, W. M. Peyton; District 11, C. A. Poole; District 12, F. C. Shepherd. Of the 11,451 qualified voters in the Association 47.6 per cent returned ballots, the same percentage as voted last year.

Shirley Becomes Chairman of Virginia Highway Commission

Governor Trinkle of Virginia has announced the appointment, effective July 1, of Henry G. Shirley as chairman of the new state highway commission created by the last session of the general assembly. Mr. Shirley is at present county engineer of Baltimore County, Maryland, and was formerly state highway engineer of Maryland. He is a native of West Virginia and a graduate of the Virginia Military Institute. His early engineering work was in the railway field where he served with the New York Central and the Baltimore & Ohio Railroads. During the Spanish war he enlisted in the Third Volunteer Regiment of Engineers at Jefferson Barracks, Missouri, and went with that unit to Tampa, where he was detached for special service.

Mr. Shirley became state highway engineer of Maryland in 1912, succeeding Major W. W. Crosby, and during his term of office the bulk of that state's road system was constructed. In 1917 and 1918 he represented the American Association of State Highway Officials on the Highway Transport Committee of the Council of National Defense and later became secretary of the Federal Highway Council, with headquarters in Washington, D. C. When that organization suspended its activities Mr. Shirley received the appointment as engineer of Baltimore County. Last fall he was selected by George C. Diehl, president of the American Automobile Association, as chairman of that organization's Good Roads Board.

Mr. Shirley for years has been a leading figure in the highway field and was the first president of the American Association of State Highway Officials. During the hearings on the Federal highway bill in 1921 Mr. Shirley contributed from his experience a large volume of testimony to the Senate and House committees on roads. In his new post as chairman of the Virginia State Highway Commission he will receive a salary of $12,500.

Canada Appropriates $90,170,000 for Government Railways

The Canadian Parliament has appropriated $90,170,000 for the government railways, the principal items being as follows:

$42,800,000 to the Canadian Northern System to meet operating deficits; to pay for property, materials and supplies; to meet interest and sinking funds, and maturing or matured loans; for construction and betterments and co-ordination of lines and facilities.

$25,750,000 to the Grand Trunk Ry. system for like purposes.

$15,900,000 to the Grand Trunk Pacific Ry. for like purposes.

$2,800,000 to be advanced for the purchase or repair of equipment for the Canadian Northern and Grand Trunk Pacific.

$2,700,000 for construction and betterments on the Intercolonial & Prince Edward Island Ry. and the National Transcontinental Ry.

$150,000 toward the acquisition of the Buctouche & Moncton Ry. and the Caraquet & Gulf Shore Ry. as branch lines for the Intercolonial.

An appropriation of $221,635 was voted for the Board of Railway Commissioners.

Plans Complete for Engineering Education Convention

Elaborate plans are being made by those who have the entertainment in charge for the annual convention of the Society for the Promotion of Engineering Education, to be held at the University of Illinois June 20-23. Particular attention in the convention discussions will be paid the study of English in engineering courses, physics, graduate work, committee reports and the broader aspects of engineering education.

The annual dinner will be held June 21, and a smoker June 22. The College of Engineering will hold "open house." Trips to nearby engineering projects or other points of interest have also been provided.

Certificate in Public Health to Be Granted by M. I. T.

A certificate in public health, similar to that heretofore granted by the School of Public Health of Harvard University and the Massachusetts Institute of Technology jointly, will hereafter be granted by the Institute. Candidates for this M. I. T. certificate will be permitted to take courses in the School of Public Health of Harvard University, thus continuing the co-operation that has heretofore existed between Harvard and M. I. T. in this respect, although each institution will maintain an independent organization for public-health instruction.

Ground Broken at Jersey End of Hudson Vehicle Tunnel

Without formal ceremony ground was broken May 31 at the New Jersey end of the Hudson River vehicle tunnel, the 29½-ft. twin-tube project for which the contract was awarded to Booth & Flinn, L'td., New York City, at a cost of $19,331,723. The accompanying photographs were taken in the Erie R. R. yards in Jersey City at the site of the two land shafts for the tunnel. The action in starting work at the Jersey side comes after a long delay caused by controversy concerning the widening of Jersey City streets as part of the tunnel project.



Philadelphia Bridge Anchorage Contract Awarded

Bids received by the Delaware River Bridge Joint Commission for the anchorages on the Philadelphia and Camden sides on May 31 showed the following totals:

For the Philadelphia anchorage, Keystone State Construction Co. and Holbrook, Cabot & Rollins, Corp., $928,535; Frederick Snare Corp., $958,328; Arundel Corp. and Arthur McMullen Co., $964,983.60; H. P. Converse Co., $1,038,775; Underpinning & Foundation Co., and F. J. Boas, $1,183,868.60; Patrick McGovern, $1,276,917.50; Oscar Daniels Co., $1,352,625; Heyman & Goodman Co., $1,019,858.

For the Camden anchorage, Keystone State Construction Co. and Holbrook, Cabot & Rollins, Corp., $1,164,920; Frederick Snare Corp., $1,348,670; Arundel Corp. and Arthur McMullen Co., $1,327,876; H. P. Converse Co., $1,312,725.90; Underpinning & Foundation Co., and F. J. Boas, $1,644,661.70; Patrick McGovern, $1,528,885; Oscar Daniels Co., $1,766,655; Spencer, White & Prentis, $1,477,585.

Contracts were awarded on June 2 to the Keystone State Construction Co. and Holbrook, Cabot & Rollins Corp. for both anchorages. The major item in both contracts is for the caisson foundations, for which the successful bid on the Philadelphia anchorage asked $18.50 per cubic yard on a total property of 28,500 cu.yd., and the bid on the Camden anchorage, a price of $16.50 on a total of 27,000 cu.yd.

Atlanta Retains Old City Charter

At a second charter election, held May 30, the voters of Atlanta, Ga., decided to retain their present city charter, but with amendments, vesting the powers of existing water and other boards in the city council. A modified city-manager charter was defeated. The earlier charter election, with outlines of the three plans then voted upon, was noted in *Engineering News-Record*, May 25, p. 886.



BREAKING GROUND AT JERSEY END OF HUDSON RIVER VEHICLE TUNNEL

Upper picture: C. M. Holland, ... H. Flinn, of Booth & Flinn, ... engineer, Erie R. R.

Lower picture (left to right): ... Montgomery, tunnel superintendent, Booth & Flinn; superintendent, Booth & Flinn; Kilmer, resident engineer, Tunnel and Bridge Commission; A. C. M. Holland, ... Commissioners; J. Le Roy Tallman, ... & Flinn (New Jersey end); ... H. Flinn, secretary, Booth & Flinn; ... Commissioners; Erie R. R.

Industrial Advertisers to Meet

The first annual Industrial Advertising Conference is to be held in connection with the eighteenth annual convention of the Associated Advertising Clubs of the World in Milwaukee, Wis., June 11-15. Those who have the program in charge emphasize the fact that it will be focused upon inter-industrial marketing and that this conference will present the first opportunity for this phase of selling and advertising to be given proper attention.

The chairman of the conference is Keith J. Evans of the Engineering Advertisers' Association, Chicago, and among the speakers and their subjects are the following:

"Advertising as a Factor in Inter-industrial Marketing," Max W. Babb, vice-president, Allis-Chalmers Mfg. Co., Milwaukee, Wis.; "What the U. S. Department of Commerce is Doing to Aid Inter-Industrial Marketing," F. M. Feiker, formerly Assistant to the Secretary of Commerce, Washington, D. C.; "Cutting the Costs of Distribution," Hon. Sydney Anderson, Congressman from Minnesota; "Advertising in its Relation to the Four Points of Contact in Industry," Bennett Chapple, Director of Publicity, American Rolling Mills, Middletown, Ohio; "Advertising the Technical Product to the Non-Technical Buyer," Charles H. Mackintosh, President of the A. A. C. of W. and sales and advertising counselor of the La-Salle Extension University; "Selling to the Professional Man in Industry," J. C. McQuiston, manager, Dept. of Publicity, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.; "Expanding the Markets for Raw Materials," H. Colin Campbell, manager of publicity bureau, Portland Cement Association, Chicago; "Putting Ideas into Industrial Advertising," W. Lee, vice-president of Frank D. Chase, Inc., Chicago; "The Outlook for Business in the Industrial Field," Edwin F. Gay, president of the New York *Evening Post*.

U. S. Supreme Court Holds Unions Suable for Strike Damages

In its decision on the Coronado Coal case the U. S. Supreme Court has held that under Sections 7 and 8 of the Sherman anti-trust law, labor unions are suable for damages caused by their strikes and that funds collected for strike purposes can be assessed to pay such damages.

Although in the case under consideration the decision of the court was favorable to the unions, this phase of the decision is regarded as a heavy blow to union labor, which has relied upon the immunity of unions, as entities, from prosecution or legal action, and upon the freedom of their funds from any liability for the payment of damages. In the case at bar the court says that there is nothing in the circumstances to indicate that the labor organizations had in mind interference with interstate commerce or competition when they entered into their unlawful combination to stop non-union operation of the mines. The verdict in the District Court against the unions on this ground was reversed and the case set back for further proceedings in conformity with the opinion of the Supreme Court.

The Engineer in Public Life

CHARLES H. SIMPSON

Elected to the state legislature of Tennessee in November, 1920, Charles H. Simpson, of Nashville, after graduation from Vanderbilt University, began his engineering work as an instructor in mechanics in that institution in 1906, where he served for ten years. He resigned in 1916 to enter the automobile industry and organized the Hippodrome Motor Co. of which he is now vice-president and general manager. In 1918 Mr. Simpson was elected a member of the Davidson County Highway Commission on which he is still serving. His legislative work has included bills for the licensing of engineers and architects, the creation of a state department of forestry, tax levy for a permanent fund for the University of Tennessee, and anti-theft automobile legislation. Mr. Simpson is 41 years old and is a member of the Nashville Chapter of the American Association of Engineers.



Traffic on Pittsburgh Test Road Resumed June 1

Traffic was resumed on the test highway at Pittsburgh, Cal., on June 1. As in the earlier tests, one day per week is reserved for special tests and two streams of trucks carrying 5-ton loads run in opposite directions continuously 8 hours per day for six days of each week. The tests on this road, described in *Engineering News-Record* Dec. 29, 1921, p. 1048, were interrupted for some time, and meanwhile destroyed portions of the pavement amounting to almost 50 per cent of the total area have been replaced with new concrete.

The state highway commission has supplied 26 trucks for the continuation of the tests and the Bureau of Public Roads 20. Another fifteen will be put on by the Bureau of Public Roads if it is found, after traffic is under way, that this number can be handled to advantage. The speed is 14 miles per hour and loads are limited to conform to the state law, i.e., a maximum of 700 lb. per in. width of tire.

Congress Approves Port Authority Plan for New York Harbor

The House and Senate have passed bills consenting to the execution of the comprehensive plan prepared by the Port of New York Authority and adopted by the legislatures of the States of New York and New Jersey. The details of this plan, which provide for extensive tunnels, bridges, terminals, and belt lines to handle traffic into and through the port of New York, were described in *Engineering News-Record*, Jan. 5, 1922, p. 26.

Twelve of 21 Municipal Bond Sales Sales at 4½ to 4.05 Yield

Of 21 municipal bond sales reported by the New York *Times* for the week ending May 26, 8 bear 4½ per cent interest or less and 12 were sold to yield at the rate stated, 7 of the 12 yielding from 4.25 to 4.05. Three of the issues bear 6 per cent coupons but were sold to yield from 5.375 to 4.90.

Seattle Will Resist Bascule Bridge Suit

(*Special Correspondence*)

Seattle has decided to resist vigorously the suit of the Strauss Bascule Bridge Co. for $350,000 for infringement of patents in the construction of three city bridges, Fremont, Ballard and University. The suit is expected to come to trial in the Federal District Court shortly, and to prepare for it the corporation counsel has asked that $20,000 be appropriated to enable the city engineer to gather evidence.

Approval Given Federal Part in Sesquicentennial

(*Washington Correspondence*)

Full approval of federal participation in the Philadelphia sesquicentennial celebration has been voted by the committee on industrial arts and expositions. It has reported with certain amendments the Darrow bill and recommends that it receive the prompt approval of the House.

The bill as amended specifies that Fairmount Park shall be the site of the exposition and that the form of federal participation is to be determined by the President.

Move To Reform Building Inspection in Cleveland

Agitation has been started by the General Contractors' Association of Cleveland for a reform in building-law administration that will put an end to persistent violations of the law and widespread shoddy building construction which are said to be current. Skimping of various kinds, through departure from the file plans is common. Speculative house building is a particular field of the evil conditions. Sound construction and contracting conditions are suffering, it is claimed, and because of this and the value to the public of sound building construction the present agitation for reform has been begun.

Several meetings have been held at which the existing evils were fully discussed, and the need for remedial action established. Those engaged in the movement up to the present are chiefly contractors who handle large operations, but a smaller working committee now being organized is to include architects and engineers and representatives of commercial and financial interests.

What means of getting at the evil building conditions are practicable remains to be determined, but it is believed that one of the best possibilities is a co-operative inspection bureau to supplement the municipal inspection and make it possible to detect and check all violations of building code provisions or departures from permit plans.

Would Extend Mississippi River Commission's Jurisdiction

Legislation now is before Congress providing for the extension of the jurisdiction of the Mississippi River Commission to St. Paul. The recent floods have emphasized the need for the Commission's having control over the entire river. It also is probable that the Commission's jurisdiction may be widened to include limited areas around Mississippi tributaries and outlets.

Bill Proposes Federal Concern To Operate Muscle Shoals

A bill seeking congressional authority for the establishment of the Federal Chemical Corp. to extend and operate facilities at Muscle Shoals for the manufacture of fertilizer and nitrates has been introduced into the Senate by Senator Norris and referred to the Committee on Agriculture and Forestry.

The Norris bill proposes the leasing from the government of all its rights in and near Muscle Shoals or any property or rights which may come under government control in consideration of which the lessee is to carry out an extensive construction program for the development of power on the Tennessee River, the maintenance of navigation, the extension of the facilities at Muscle Shoals for the manufacturing of nitrates and refitting present facilities for the manufacture of fertilizers, etc. The projects specifically mentioned to be executed by the lessee are (1) Construction of Dam 1 or a channel for navigation from the railroad bridge below Muscle Shoals to the locks at Dam No. 2; (2) completion and equipping of Dam No. 2 ready to generate in conjunction with Dam No. 3 not less than 600,000 hp.; (3) the construction of Dam No. 3; (4) construction of locks or lifts to maintain navigation over the dams; and (5) the reconstruction and extension of the present nitrate plants. The estimated cost of these various projects is $60,000,000.

Construction work authorized by the Norris act is to commence within sixty days after the property located at Muscle Shoals is acquired. Within two years the hydro-electric plant is to be equipped and ready to generate 100,000 hp., in three years 200,000 hp. and within five years 600,000 hp. The construction is to be completed within five years.

The financial obligations of the company are to be met by receipts from the sale of power and the products of the nitrate plant. Fertilizer compounds produced by the plant are to be sold at a price and upon terms to be fixed by government directors.

The Federal Chemical Corp. is to hold its lease for 50 years. Business of the corporation is to be conducted by a board of seven directors. One each of these is to be selected by the Secretaries of War, the Treasury and Agriculture. The other four are to be elected by stockholders. The capital stock of the corporation is to be $5,000,000 divided into 50,000 shares of a par value of $100 a share. All of the stock is to be subscribed before any execution of a lease and at least $1,000,000 is to be paid in within 30 days thereafter. The board is required to make a report to Congress at the end of each calendar year upon the activities of the [illegible]

Concreting of Hetch Hetchy Dam Progresses

The pouring of concrete in the Hetch Hetchy Dam was resumed on April 21 after about a month's inactivity due to failure of the power supply. Since then work has been proceeding rapidly, about 1,500 cu.yd. per day of two eight-hour shifts being the usual run, although as much as 1,950 cu.yd. per day has been poured.

The concrete pedestal on which the derrick stands some 60 ft. above the adjoining concrete surface, as shown in the picture, was built up by a small force working with the limited power available while the main power supply was interrupted. In this way delay incidental to raising the derrick as the work advanced was avoided.

The wooden tower from which the concrete is chuted has four compartments and is 350 ft. high. Two compartments are served by each of the two 2-cu.yd. mixers. The mix is 1:3:6 and plums as large as can be handled by skips are used.

A horizontal section of the dam at its present height of 168 ft. includes an area of 450,000 sq.ft. which is greater than the area in any other horizontal section of the structure, hence the amount by which a given yardage of concrete increases the height is now the least. The overall height under the present contract will be 344 ft. An article on the foundation excavation for the Hetch Hetchy dam appeared in *Engineering News-Record* Aug. 11, 1921, p. 222.

About 150,000 cu.yd. had been placed in the dam by May 1, leaving 220,000 cu.yd. yet to be poured under the present contract.



LOOKING DOWN ON THE DAM FROM THE SOUTH BANK

[illegible] A row of [illegible] will be [illegible] Cut-off

Protest Against Law Requiring Ten Years' Liability

A committee has been formed of representatives of the Corporation of Engineers, Association of Architects and the Building Exchange, Montreal, Can., to take up the question of having repealed or amended the clause of the civil code which holds the building contractor and the architect jointly responsible for any structure built by them for a period of ten years from completion of the building.

Chicago Small Building Situation and the Landis Award

A boom in the construction of small dwellings and flats in Chicago is shown by a statement of the Citizens Committee to Enforce the Landis Award, a block-to-block survey giving 1,473 single-family houses and 769 two-flat buildings under way on May 1. It is estimated that over 7,000 structures of these two classes will be completed in 1922, representing about $70,000,000. These figures are exclusive of the larger apartment buildings (for which several thousand permits have been issued) and also of the buildings in suburban towns within easy transportation distance of the business district. Under these conditions a marked drop in rents is expected. Up to May 26 the Citizens Committee had brought into the city about 11,832 open-shop craftsmen to work in the trades whose unions have refused to accept the Landis Award. New building work brought the Landis Award jobs under construction to a total of $55,000,000.

Columbus Water-Works Dam Contract Again Awarded

The re-advertisement of the contract for the O'Shaughnessy dam for the water-works of Columbus, Ohio, which brought seven bids on May 25, resulted in the award of the contract to the Thompson-Starrett Co., New York City, for $1,165,511, the lowest bid. All but one of the new bids was below the engineers' estimate of $1,376,700. The bids other than the successful one were: Hickey Brothers, Columbus, Ohio, $1,195,846; John F. Casey Co., Pittsburgh, Pa., $1,211,136; Lake Erie Construction Co., Cleveland, Ohio, $1,243,000; E. H. Latham Co., Columbus, Ohio, $1,325,733; H. P. Converse & Co., Boston, Mass., $1,350,285; Dravo Construction Co., Pittsburgh, Pa., $1,434,955.

The engineers' estimate was originally $1,375,300 and the three corresponding lowest bids on April 20 were: Columbus Construction Co., $1,001,616; Thompson-Starrett Co., $1,115,119 (or $50,392 lower than its winning bid after re-advertisement); J. F. Casey Co., $1,173,257. (For corresponding unit prices, see Construction News Section of *Engineering News-Record*, May 18, page 255.)

The Columbus Construction Co. refused to execute the contract awarded to it under its bid of April 20 because of alleged errors totaling $73,500 and afterwards secured an order from the county court for the return of the certified check accompanying its bid (see *Engineering News-Record*, May 18 and 25, pp. 845 and 879).

C. B. Hoover is engineer in charge of the Columbus Bureau of Water Works Extension, and Prof. John H. Gregory, Baltimore, Md., is consulting engineer.

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Annual Convention, Portsmouth, N. H., June 21-22.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, University of Pittsburgh; Annual Convention, University of Illinois, June 20-23.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual Meeting, Atlantic City, N. J., June 26-30.

NEW ENGLAND WATER WORKS ASSOCIATION, Boston; Annual Convention, New Bedford, Mass., Sept. 12-15.

The Western Society of Engineers held its annual dinner on June 7, at which time the new officers were presented. The principal speaker was Dr. R. C. Richards, until recently with the college of engineering at the University of Illinois but now president of Lehigh University.

The Engineers' Club of Baltimore, at the annual meeting on June 1 elected the following officers: President, Douglass Barnett; first vice-president, Frank M. Bowles; second vice-president, G. J. Requardt; treasurer, Henry Adams; directors-at-large, A. G. Decker, Adrian Hughes and A. L. Penniman.

The Engineers Club, Seattle, recently entertained Col. W. G. Atwood, director of the committee on marine piling investigations of the National Research Council, who delivered an illustrated address on "The Teredo and Other Marine Borers." Col. Atwood intends to further the organization of a committee in Seattle to carry on investigations in Puget Sound waters, co-ordinating these efforts with similar investigations being conducted in New York, Boston, San Francisco and the Gulf ports.

Personal Notes

H. Ralph Hadlow and Noel H. Hick have formed an engineering partnership with offices in Cleveland, Ohio. They will specialize in the design, supervision and construction of industrial and commercial buildings. Mr. Hick was formerly engineer in charge of building and Mr. Hadlow vice-president and general manager for the Watson Engineering Co., Cleveland, Ohio.

E. L. Martin, engineer of maintenance-of-way for the Missouri, Kansas & Texas Ry., has resigned that position and has purchased an interest in the Hutt Contracting Co. of Kansas City, Mo. His resignation was effective June 1. Mr. Martin is vice-president of the contracting company. For 23 years he has been identified with several railroads in the Southwest on important engineering projects.

William J. Knauer, county engineer of Chautauqua County, N. Y., with offices in Jamestown, has resigned and will engage in contracting work with his own organization.

G. H. Stanchfield has been made city engineer of Fond du Lac, Wis. He succeeds R. B. Petters who recently resigned.

F. H. Rood, formerly assistant engineer of tests of the Pittsburgh Testing Laboratories has resigned to do highway research for the Advisory Board on Highway Research of the National Research Council. Mr. Rood will be stationed at Harrisburg, Pa.

H. G. Dimsdale, engineer of the Lacombe Northwestern Ry., has been appointed highways commissioner of the province of Alberta, Can., under the new Public Highways Act.

Hal M. Scott and John P. Bonner have opened an office in Beckley, W. Va., for the practice of civil and mining engineering.

H. O. Bagley has been made field engineer for the Scott Brothers Construction Co., Rome, N. Y., the contractors in charge of the reconstruction of the Erie Canal, Rochester, N. Y., to fit it for rapid-transit purposes.

Roscoe K. Earle, former city engineer of Davenport, Iowa, has opened offices in that city for the practice of general civil and sanitary engineering. He will specialize in town planning, sewerage, sewage disposal, water supply, flood relief, drainage, paving, surveying, and subdivision work.

R. D. Orders, who has been bridge inspector for the Department of State Roads and Highways of Kentucky for sevreal years past, recently resigned and is now connected with the Speed-Parker Co., general contractors of Louisville. Mr. Orders will be in charge of the construction of the Gulf Beach Highway in Florida, a project costing approximately $450,000.

Dr. Tobias Dantzig, former instructor of mathematics in Columbia and Johns Hopkins Universities and until recently research engineer of SKF Industries, Inc., New York City, has resigned to engage in scientific and technical consulting work. He will specialize in bearing problems and mathematical research of an engineering character.

John B. Hunter, city engineer of Denver, Col., has resigned after forty-three years of continuous service in the city's engineering department. He began as a chainman on a surveying crew and became city engineer in 1891. Ill health was the cause of his decision to retire. In recognition of his long service, the city has made him consulting engineer at a salary of $1,200 a year. A. K. Vickery, superintendent of parks, has been appointed his successor and the duties of the two offices will be combined. Mr. Vickery's engineering experience includes service with the Colorado & Southern and Colorado Midland Railroads and the Colorado Fuel & Iron Co.

Business Notes

COL. H. M. BUSH has been named district representative in the Columbus district for the Illinois Engineering Co. He will have offices in Columbus, Ohio. Col. Bush also represents the Steel Fabrication Corp.

HARVEY L. MILLER who has been district sales agent in St. Louis for the Youngstown Sheet & Tube Co., Youngstown, Ohio, since 1914, has become associated with the Jones & Laughlin Steel Co., of Pittsburgh, as St. Louis district sales agent.

H. E. MARKS, INC., Pittsburgh, Pa., a firm specializing in reinforced-gypsum roof and floor construction materials, has opened a district sales office in Cleveland, Ohio. A. W. KREAMER, formerly of the Dravo Contracting Co., is in charge of the new office.

EDWARD P. PALMER, who recently became associated with the Arthur McMullen Co., New York City contractors, has been elected secretary of the company. Mr. Palmer was with the Pennsylvania R.R. for some time and later was superintendent for the Rapid Transit Subway Construction Co., New York City, on that company's Seventh Avenue subway contracts.

H. L. SCHWARTZ, formerly of Schwartz & Pease, Philadelphia, has opened an office in the Franklin Trust Bldg., that city, where he will continue to represent the American Well Works of Aurora, Ill., and the Dean Brothers Steam Pump Works of Indianapolis, Ind.

Obituary

OBED J. PEASE, general contractor, of Long Beach, Cal., died there recently. Mr. Pease formerly lived in Wichita, Kansas, but moved to Long Beach about eight years ago, where he became one of the important contractors in lower California.

DAVID M. KIDDER of East Weymouth, Mass., a constructing engineer and of late years connected with the Boston Bridge Works, Inc., East Cambridge, Mass., died recently at the age of 76 years.

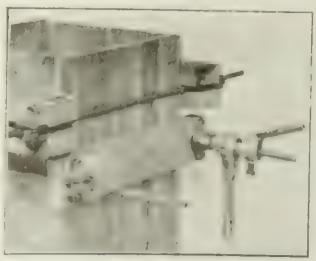
ARTHUR S. MORRIS, auditor of capital expenditures of the Chicago & Northwestern Ry., died May 22 at his home in Oak Park, Ill. He was born at Chicago in 1880 and after graduating from Princeton University in 1902 he entered the engineering department of the Chicago & Northwestern Ry., becoming assistant engineer in 1910. In 1918 he was appointed engineering auditor and in 1920 was made auditor of capital expenditures. Mr. Morris was second vice-president of the American Association of Engineers and a member of the Western Society of Engineers.

WILLIAM C. EDES, former chief engineer of the Alaska Engineering Commission and for many years associated with the Southern Pacific Co. in construction work in Oregon and California, died recently in Merced, Cal. Mr. Edes was 66 years of age. During the early part of his professional career Mr. Edes was associated with the Southern Pacific Co. on locations through Arizona, New Mexico and Texas. Later he engaged in general engineering work in Boston and vicinity with M. M. Tidd, acting as assistant engineer in charge of constructing water works at Weymouth, Mass., among his other duties. He then became assistant engineer in charge of constructing a portion of the Oregon and California R. R. for the Southern Pacific Co. and as engineer on construction of various branch lines. In 1895 he was made principal assistant engineer of the San Francisco and San Joaquin Valley Ry., a position he held for several years. He was appointed a member of the Alaska Railway Commission in 1914, resigning his position as chief engineer of the Northwestern Pacific R. R. During his professional career he was associated with John F. Stevens, then with the Great Northern Railway and with William Hood, former chief engineer of the Southern Pacific Co.

Equipment and Materials

A New Form Clamp

To hold the ends of rods clamping concrete forms together a rod-gripping clamp has been devised which has teeth on a cam making the clamp self-locking by a tap of a hammer on the cam. The forms are cinched up by means of a



ratchet tightener which slips over the rods against the clamp and is secured in place on the rod by a lever-handled cam grip. The form clamp and tightener are made by the Victor L. Phillips Co., Kansas City, Mo.

Strengthened 20-Ton Steam Shovel

A general strengthening of the older patterns has been undertaken in the design for the new 20-ton shovel of the Thew Steam Shovel Co., Erie, Pa. The new machine has digging power enough to handle a full size 3-yard dipper (water measure) even with a 21-ft. boom and 15-ft 6-in. dipper handle.

Improvements in the trucks include a reinforced truck-frame, a propelling shaft with ample strength to stand the severe abuse that this shaft sometimes receives on a caterpillar-type machine in cold weather when the treads have been frozen in; and split collars on the rear axle, for throwing the propelling gears on a traction-wheel shovel out of mesh so that the shovel can be towed behind a motor truck. The new turntable casting has flanged webs for greater strength and has guards to keep water off the cone-roller path so that this path remains absolutely dry and the rollers do not slide. A new boom hoist provides instant accessibil-



ity for the hoisting engine crank-shaft bearing. The hoisting engine crank shaft is heavier. There is also a new 3-feed oil pump for positive lubrication of the hoisting, swinging, and crowding engines.

Another improvement is the new design of the main swinging shaft bearing, by which the bushings can be renewed in a few moments, by the insertion of interchangeable bushings of a special bronze. Smoother operation has been assured by machine-cut gears on the hoisting, swinging and crowding trains. Even the bevel gear and pinion at the beginning of the swinging train is machine-cut instead of cast.

To provide still greater strength in hard digging, the supporting lugs are placed outside of the boom, so as to compact instead of spread the boom members when the boom is subjected to twisting strains. Another entirely new feature is the automatic tripping device—a drum which turns with the dipper-shaft and keeps the trip rope taut, automatically winding and unwinding the trip rope as the dipper handle is moved in or out.

The dipper is provided with a double-hinged latch lever; a lever which moves freely from side to side and does not bend if it strikes a car or wagon, nor can it break wagon boxes nor car sides. Accordingly no time is ever lost by the operator having to straighten this latch lever, and there is no expense for repairing wagons and cars. The dipper itself has been strengthened by a heavier lip, and also stronger hinges.

The particular improvement at the power plant end of the new machine is a larger boiler, with steaming capacity up to the full limit of speediest shovel operation. To economize fuel, the shovel is equipped with an auxiliary exhaust—a new feature which permits exhausting to the rear of the shovel instead of through the stack at times when the large boiler is providing ample steam and induced draft is not required

Business Side of Construction

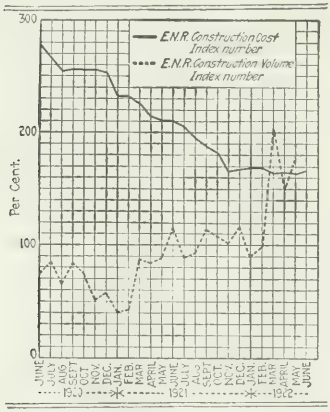
Facts and Events that Affect Cost and Volume

Construction Cost Is Likely To Advance

Engineering News-Record's Index Numbers Show Reason—Analysis of Past and Coming Demands and Prices

Since June, 1920, the construction cost curve has declined steadily. The heaviest drops from one month to the next were during January, 1920, and October, 1921. The latter drop—16 points or 9 per cent, according to *Engineering News-Record's* Cost Index Number, pictures the final slump of the steel market and labor deflation, and was the last important decline to be recorded. Since then cost has been about the same from month to month, even creeping up slightly.

Prices are stiffer, and there is a growing feeling that they may rise generally. Warrant for this feeling may be found in a study of the accompanying chart, in which the *Construction Cost Index* (CC) and the *Construction Volume Index* (CV) are plotted to the same scale. The C V Index shows the rate at which contracts are being awarded compared



with 1913 activity. From June, 1920, to June, 1921, the average monthly rate (70 per cent) was 30 per cent lower than in the year before the war—and 1913 itself was a subnormal construction year. On the other hand the average rate for the last twelve months has been 122 per cent, which is 22 points greater than for 1913 and 74 per cent higher than for the preceding twelve months.

Confidence began to return to the construction industry with the opening of 1921. This is clearly reflected in the jump of the C V Index from 43 to 88. By May the 100 per cent level had been reached, activity being equal to the average 1913 rate. This general level was maintained during the rest of the year. Only minor ups and downs of the curve appear during this period.

The abrupt increase in contracts let in February, 1921, followed by a continuance of this higher volume rate, began to show visible effect in November, 1921—ten months after the first impetus. Construction cost climbed slightly. It settled back during February, 1922, but the rise was resumed in March, and the advance since then has amounted to about 4½ points, or nearly 3 per cent.

It is plain that the second great impetus of the last two years—beginning with 1922—has not yet had anything like its full effect upon prices of construction materials. It is not likely that the experience of the first impetus will be repeated in the second instance, and that ten months will pass before prices react to promised increased demand. There was a reason for this ten-month period in 1921. It would have been a difficult feat to have stemmed the 1920-1921 decline in cost, even if anyone had wanted to do so. Prices had to come down, and only a practically impossible call for materials and labor could have kept them up.

Therefore, even with the increasing prospective demand for materials, prices and labor rates continued to decline until balanced by actual ordering of materials for the new construction. As stated, this steadying took place beginning November last.

The construction impetus initiated last January by the final price drop is already beginning to stiffen prices and labor rates. Steel and cement are firm. Brick, on the other hand, is jumping upward in a most unhealthy manner. Lumber is rising generally. The average rate paid common construction labor is slightly higher than a month ago.

Obviously, then, construction cost is due for an increase; how much and for how long cannot be predicted. It is easily conceivable that steel—the material hardest hit in the slide from the peak—may return to $1.75 per 100 lb. for structural shapes. Last fall the feeling was quite general that this would have been a workable price. As there was practically no actual demand for steel at the time, the market continued to weaken until steel could be bought at $1.30. Future prices of cement depend largely upon the coal situation. Adding $2 to the price of a ton of coal at the mines increases the cost of cement 20c. per bbl. One such advance, in the East, was announced in the May 18 issue. Prices elsewhere are generally steady. Brick prices are already out of reason, but with continued demand and insufficient production there is nothing to prevent still greater inflation.

What will be this increase in construction cost? A guess that would be as good as the next would be five per cent (an Index Number of 175).

Professor Irving Fisher writes: "In reply to yours of June 2 I would say that I think the 'new normal' is a delusion and a snare." His excellent letter will be published here next week.

Revised Building Materials Index of Labor Bureau

The Bureau of Labor Statistics recently made a radical revision of its Building Materials Index Number. Revision of the data regarding lumber is largely responsible for lowering the index number for April from 203 on the old basis to 152 on the new basis. The Bureau offers this explanation:

"The index numbers hitherto published by the Bureau have been influenced to a large extent by lumber prices in the New York market. These were practically the only prices available to the Bureau at the inception of its series of weighted index numbers in 1913. It has recently become possible, however, to substitute lumber prices in other and more representative localities for those previously obtained in the New York market. In all such cases the new prices have been carried back to 1913."

"In addition to the changes with respect to lumber, structural steel and a number of other important building materials not previously included in the index have been introduced into the revised index number and carried back to 1913. A comparison of the articles in the old and new index numbers is as follows:"

"**Old series**—Brick, Chicago; brick, Cincinnati; brick, New York; portland cement, mill; plate glass (2 series), New York; window glass (2 series), works; spruce lath, New York; lime, plant; Douglas fir (2 series), mills; hemlock, New York; maple, New York; plain white oak, New York; quartered oak, New York; white pine, New York; yellow pine flooring, New York; North Carolina pine, Norfolk; poplar, New York; spruce, New York; white lead, New York; linseed oil, New York; turpentine, New York; zinc oxide, New York; putty, New York; rosin, New York; cypress shingles, mills; and red cedar shingles, mills—total, 29 price series."

"**New series**—(a) Lumber: Douglas fir (2 series), mills; gum, St. Louis; hemlock, Chicago; maple, Chicago; plain white oak, Cincinnati; white pine, Buffalo; southern yellow pine flooring, mills; southern yellow pine timbers, mills; poplar, Cincinnati; spruce, Boston; yellow pine lath, mills; cypress shingles, mills; and red cedar shingles, mills; (b) Brick, average of 82 yard prices; (c) Structural steel, Pittsburgh; (d) Portland cement, average of 6 plant prices; crushed stone, New York; gravel, average of 22 plant prices; hollow tile, Chicago; lime, average of 15 plant prices; sand, average of 26 plant prices; slate, quarry; plate glass (2 series), New York; window glass (2 series), works; linseed oil, New York; putty, New York; rosin, New York; turpentine, New York; white lead, New York; zinc oxide, New York; cast iron pipe, New York; sheet copper, New York; copper wire, mill; lead pipe, New York; wire nails, Pittsburgh; reinforcing bars, Pittsburgh; roofing tin, Pittsburgh; and sheet zinc, mill—total, 41 price series."

"Besides the substitution of lumber prices in other localities in place of the New York city prices and the inclusion of a number of new articles in the revised index, the figures have been further revised by the use of the more recent 1919 census data for weighting purposes instead of the 1909 data formerly employed. In the case of lumber, particularly, the use of the more recent information has appreciably affected the index numbers, since the cut of most kinds of lumber was much smaller in 1919 than in 1909."

It should be understood that revision of the Labor Department's building materials index number in no way affects the *Engineering News-Record* Construction Cost Index Number, which is computed exclusively from original sources of price data.

Production and Materials Stocks In Ten Cities

Steel Output Increases—Lumber and Sewer Pipe Stocks Lower—Brick Shortage Extends

Steel—Production of steel ingots proceeds at 70 to 75 per cent of capacity, which is the same as a month ago (73 per cent). Sheet mill operations are at 80 to 90 per cent at present, while fabricated steel output recently reached 98 per cent of capacity. The coal strike has had little effect upon steel production, current figures being slightly in excess of the output at the beginning of the strike. Steel ingots are being produced at the rate of about 38,000,000 gross tons a year, as against 35,000,000 for April and 30,000,000 for March. In proportion the foundries have not been nearly as active as the steel mills. Stocks of raw materials, at pig iron producing centers, are said to be slow.

Lumber—An average of 391 mills reporting weekly to the National Lumber Manufacturers' Association for the first three weeks in May, show 690,992,165 ft. cut, or a weekly average of 230,330,721 ft. b. m. as against 228,841,250 ft. per week during April. Latest available figures show lumber production at only 5 per cent below normal, while shipments stand at 5 per cent and orders 20 per cent above normal.

Cement—Production of portland cement in April, according to U. S. Government reports, totaled 9,243,000 bbl., an increase of nearly 40 per cent over March and 600,000 bbl. more than a year ago. Shipments also increased, but less rapidly than production, with the result that stocks rose 650,000 bbl., with a total of 14,498,000 bbl.

Brick—Reports from 99 members of the Common Brick Manufacturers' Association of America show more orders on the books than a month ago, nearly double the amount of brick produced in the last month as compared with the previous month, and a largely increased amount of shipping from the plants. In some few centers the reports show a shortage of labor and fuel, but none for raw materials.

Detroit—Small stocks of asphalt, granite block and hollow tile; ample supplies of sewer pipe, lumber, cement, lime and brick. Dealers' stocks of sand and gravel heavy; moderate supply of crushed stone. No wood paving blocks on hand; deliveries require several days. Nearby mills producing cement at full capacity to meet present demands.

Minneapolis—Retail lumber stocks trifle below normal; wholesale stocks about as a month ago but mills in this section are oversold to about 25 per cent of normal. If production does not increase the mill situation will be reflected in the wholesale and retail trade in about 30 days. Supplies of other materials ample excepting sewer pipe in the smaller sizes, 12-in. and under. Demand for smaller sizes in excess of supply. Sewer pipe manufacturers reported out of Illinois and Indiana soft coal and to be buying eastern Kentucky and West Virginia coal at twice the price and five times the freight rate.

Seattle—Lumber business in Pacific Northwest and particularly in Puget Sound district experiencing prosperity not exceeded by any year since the close of the war. Weekly cuts, orders, sales and shipments of the past few weeks mark the high point since the signing of the armistice and lumbermen admit a "return to normal" in the industry. Stocks of practically all building materials in good shape with Eastern shipments coming through satisfactorily. Ample stocks of cast iron pipe and heavy stocks of steel bars and shapes but light demand.

Denver—Supply of brick entirely exhausted. Plants resuming work and ample supply will be available in about two weeks. Lumber dealers have plenty of open stock on hand but mill shipments are very uncertain.

Philadelphia—[illegible] Asphalt demand active; sufficient quantity on hand. [illegible] paving bricks in good demand, [illegible] building and sales of [illegible] the 100 per cent [illegible] brickyards working at full capacity. Lumber demand heavy; supply running low.

New Orleans—[illegible]

CONDITIONS OF MATERIALS STOCKS IN IMPORTANT CENTERS

Stocks on hand in approximate figures, example: cement, Denver 10,000 bbl.; time required for delivery of carload lots to city, in example of sewer pipe, Atlanta, 24 hr., and stocks on hand in general terms, example: (common brick, New York, shortage.)

	Detroit	Minneapolis	Seattle	Denver	Philadelphia	New Orleans	Atlanta	Los Angeles	Chicago	New York
Sewer pipe	Plenty	Shortage, smaller sizes		Del. 24 hr., local plant	Coal strike may cause shortage		Del. 24 hr	Large stock	Heavy	Sufficient Del. prompt.
Cement	Ample	Enough		10,000 bbl.	Sufficient		25 @ 35 cars	Fair	Ample	Enough; drawing on reserve.
Lime, common and hydrated	Regular shipments local plants	Sufficient			Fair del. from kilns in 3 days		25 @ 30 cars	Enough	40 @ 50 cars	Plenty.
Common brick	Yards in city	Ample		Shortage	Shortage		Plenty	Prompt delivery	Yards nearing 100 per cent capacity	Shortage Some new brick received.
Hollow tile	Del. take several days	Large			Plenty		3 @ 4 days delivery	Yards well stocked	Large	Nearby [illegible]
Lumber	Receipts exceed demands	Retail stocks trifle below normal	Mills operating two shifts	Mill shipments uncertain	Stocks running low	Mills behind orders; demand exceeds supply	Plenty pine	No pine or spruce	Sufficient	7 @ 8 wk. from mill
Asphalt	Small			10 cars	Ample, at present					Refineries near city.
Structural steel			Heavy				5 cars			Heavy.

Is Brick Importation Practicable?

Relative to the recent suggestion that brick be imported into New York in order to relieve the stringency and reduce the price, the latest Monthly Digest of the Common Brick Manufacturers' Association of America comments as follows:

"Talk about importing brick is as foolish as some of the other statements coming out of the New York situation, when the facts are known. Brick is selling at a lower price in the principal markets in America today than in any of the English markets. The average price of common brick in England today is $15 a thousand. The price of brick delivered on the job in Chicago is $12 a thousand. To the price of brick delivered in New York City always must be added the exorbitant transportation charge which now exists, plus a dealer's profit, and local delivery charge. New York is one of the very few markets in America which buys its common brick through a dealer. In almost every other large city brick is produced within a short haul of the city and sold directly by the manufacturer."

"Why debate to individual account is superior to having bank clearances, as indicating general business activity, will be set forth in a special article contributed by the Federal Reserve Bank of New York.

blocks on hand; manufactured when ordered. Lumber mills in this district away behind on orders for yellow pine; demand exceeding the mill output by about 24 per cent. The demand is confined chiefly to the Gulf and Atlantic coast states. Recent high water in the timber districts has curtailed lumber production to a considerable extent.

Atlanta—About 35 carloads of cement; 30 carloads of lime and 5 carloads of structural steel on hand. Plenty of other materials. Deliveries of hollow tile in 4 days; sewer pipe in 48 hr.; sand, gravel and crushed stone in 24 hr.

Los Angeles—Plenty of building materials to meet present demand; deliveries prompt. Not on the market for paving block, spruce and yellow pine lumber.

Chicago—No shortage of construction materials but lumber demand becoming extremely keen.

New York—New brick of this season's manufacture are now arriving in this market, the supplies of last year's burned brick having been exhausted. No shortage of other materials. There are over 2,000 carloads of coal on hand in or about the Metropolitan district, representing an increase of over 200 per cent above the quantity on hand two weeks ago.

Hoover Plans to Limit Coal Price

Coal operators controlling nearly 85 per cent of the output in the fields now producing have agreed to accept for the duration of the strike $3.50 a ton for run-of-mine coal as a maximum with differentials fixed according to the plan established by the war-time fuel administration. This step has been taken as the result of action by the Secretary of Commerce to prevent a runaway market following a shortage which is beginning to make itself felt. Secretary Hoover is trying also to effect an arrangement for the same purpose with the retail coal dealers.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual buildings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of June 1; the next, on July 6.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$2.58	$3.50	$4.00	$2.48	$2.76	$3.50	$3.10	$3.60	$3.75
Structural rivets, 100 lb	3.50	4.25	5.50	3.10	3.90	4.45	4.50	3.75	6.50
Reinforcing bars, ¼ in. up, 100 lb	2.48	3.50	3.50	2.38	2.66	3.52½	2.55	3.60	2.75
Steel pipe, black, 2½ to 6 in. lap, discount	61%	61.15%	45%	59½%	61.9-5%	44%	+49.1%	53%	30.00
Cast-iron pipe, 6 in. and over, ton	+48.80	@49.80	−46.25	48.30	44.10	+50.50	+57.00	51.00	52.00	50.00
Concreting Material:									
Cement without bags, bbl	2.40	@2.50	−2.34	2.25	1.97	2.24	2.90	2.83	2.94	2.48
Gravel, ¼ in., cu.yd	1.75		1.85	2.25	1.80	1.50	−1.75	2.25	−1.25	1.50
Sand, cu.yd	1.00		1.15	2.25	1.80	1.00	−0.75	1.50	−1.25	1.25
Crushed stone, ¼ in., cu.yd	1.75		1.90	2.73	1.60	2.25	3.50	2.25	3.00	−1.60
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	+49.00	38.00	34.50	+45.00	39.00	36.75	+27.00	+21.50	47.00
Lime, finishing, hydrated, ton	15.80	@16.80	+22.50	25.00	18.00	29.00	24.00	22.00	24.00	21.00
Lime common, lump, per bbl	2.75	@3.18	+1.75	2.50	1.40	1.40	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	23.50		+10.00	11.15	11.00	16@17	12.00	15.00	14.00	16.00
Hollow building tile, 4x12x12, per block	Not used		−.075	.115	−.0707	.082	.08	....	.12	.09
Hollow partition tile 4x12x12, per block	.1112		−.0707	.115	.0657	....	.08	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal	−.88		−.94	1.09	−.98	−1.00	1.18	1.04	.86	.97
Common Labor:									
Common labor, union, hour	.75		.35	.....	.80	.....	.50@.55	.56¼	.50@.60	.....
Common labor, non-union, hour	.44@.60		.20	.25	.72½	−.35@.50	.35@.50	.47½@.50	.....	.20@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or − signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks.

Montreal quotes on fir instead of pine. Sand, stone, gravel and lump lime per ton. Lime and tile are delivered; cement, sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.19 cents). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $30; 6-in., $110.

Changes Since Last Week

Pittsburgh mill price of structural shapes and bars firm at $1.60 per 100 lb., with quotations reaching 10c.@20c. higher in points farther west. No change in warehouse prices throughout the country; buyers evidently holding off in anticipation of freight rate cut, effective July 1. Wrought steel pipe advanced in San Francisco and cast-iron pipe up $2 per ton in New York, Minneapolis and Denver.

Active demand for steel-pipe; rise in cast-iron pipe due to higher pig iron and scrap quotations.

Cement down 5c. per bbl. in Atlanta during last two weeks. Owing to improved handling facilities and larger volume of business, sand is quoted in Denver at 75c. as against $1.10 and gravel at $1.75 as compared with $2.50 per cu. yd., at pit. Sand and gravel both down 25c. in Seattle.

Long-leaf yellow pine, base sizes, up $1 in New York and $5 per M. ft. in Chicago. Douglas fir advanced $1 in San Francisco. Lime and brick prices climbing higher in Atlanta. Slight declines in hollow tile both in Atlanta and Chicago.

Linseed-oil declining throughout the country. Raw oil down 7c. in New York and 6c. per gal., 5 bbl. lots, in Chicago, Atlanta and Minneapolis.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, President

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren, Editor

Volume 88 — NEW YORK, JUNE 15, 1922 — Number 24

Playing Up the Local Chapter

AS THE report in this week's news columns show, the Salt Lake meeting of the American Association was active if not overly well attended. Attendance, however, was by delegate and the chapter representation insured distributed expression of opinion. In fact, the emphasis on the chapter is the high spot of the report of the convention. No other technical society is paying so much attention to its chapter conduct or studying as closely how to reach the individual member and to make him both function for and appreciate the profession.

Getting More for the Railroad Dollar

TO DATE the Railroad Labor Board has authorized wage cuts to the amount of $110,000,000 and current comment foreshadows another cut that would bring the total to about $150,000,000. It would be a capital mistake to regard these sums as net savings. They simply represent so much more money available to spend on way, structures, and rolling-stock, in order that the railroad properties of the country may be enabled to play the part that will be theirs in the promised revival of business.

A Setback for Special Privilege

WERE it not for his consistent advocacy of special privilege for organized labor, it would be difficult to understand the fury with which Samuel Gompers assails the Coronado decision of the Supreme Court. But merely to recall his insistence that legislatures should not "interfere" with trades unions, however vicious their activities, will explain his resentment at their being held amenable to existing law. The decision lays down no new or startling doctrine. It simply applies to labor unions the elementary principle that the rights and privileges enjoyed under the law by organized labor carry with them a compensating obligation to respect the law and a responsibility for its violation. Decision by decision over a period of several years, the courts have been extending the mantle of fundamental law to cover these powerful organizations. The Coronado decision is but another step toward the abrogation of special privilege.

Warren Patents Lose

IN THE first legal contest involving claims by Warren Bros. Co., of Boston, of infringement of the Wallace bituminous paving patent, which it controls, the U. S. District Court in California has rendered a decision in favor of the defendants. The case was based upon work done for Fresno County, by Thompson Bros., contractors. Notwithstanding the fact that the decision is by a lower court and may be appealed, the decision is noteworthy as the latest chapter to be added to the volume of paving-patent litigation in which the Warren interests have been engaged for [illegible] years. The expiration of their basic Bitulithic patent (No. 727,505) on May 5, 1920, placed the company in the position of relying upon other claims for the collection of royalties. They turned to the so-called Wallace patents, of which No. 959,976 is the principal one, covering a "composite" pavement in which a lower course of mixed bituminous concrete is covered, before compression, with a thin layer of finely graded bituminous top, the two layers then being compressed simultaneously to bond them into a compact, rigid mass, densest at the top. In the Fresno case infringement was claimed in spite of the fact that on all of the county's work the lower course was rolled prior to the application of the top course. The Warren interests, however, maintained that infringement existed if an upper course of pavement were laid upon a lower course while the latter was in a hot or plastic condition, irrespective of whether or not there was an intermediate rolling. Basing his opinion on a study of the prior art, Judge Bledsoe held that the Wallace patent claim could not thus be construed, inasmuch as two-course construction of this type had been covered in the original Warren patent already expired. In connection with this decision the reader may find it worth while to examine the article on the status of the Warren patents published in *Engineering News-Record* of Dec. 15, 1921, p. 969. Pending the outcome of an appeal it would be premature to generalize upon the effect of the Fresno decision in other localities. The result does indicate, however, that under such specifications as governed the California work, the Warren company's right to royalties under the Wallace patent is open to question.

Engineers and City Planning

ONE of the speakers at last week's City Planning Conference blamed engineers for not having introduced city planning long ago. The same criticism was voiced privately by another person at the conference who said that Cincinnati has had city engineers for 125 years but no one of them ever made a plan for the city. Both these critics were lawyers—men who draw our city charters and define the powers and duties of city engineers. Why did not the lawyers provide for city planning in municipal charters decades ago and entrust the work to the city engineers? Even now, after twenty years of city planning agitation in America, only a few city councils stand ready to back city planning by enabling ordinances and appropriations. Until recently, engineers have worked on this or on that element of the city plan—such as water-works, sewers, main thoroughfares—because the city fathers think [illegible] work piecemeal instead of on a comprehensive and co-ordinated city plan. Engineers have been present [illegible] at the various city planning conferences and were prominent last week—presenting two of the leading papers, abstracted elsewhere in this issue. That engineers might have done more toward city planning

in the past, ought to be doing more now and to be preparing for still more in the future is undeniable. Some 10 to 15 per cent of the total registration of over two hundred at the conference last week were engineers. The number hereafter should be materially increased, as new city planning boards are created and old and new boards are provided with engineering staffs, as is becoming increasingly common.

An Object-Lesson Road

IN SPITE of the name it bears, the Ideal Section of the Lincoln Highway, the design of which is discussed in detail by Mr. Thompson in this issue, is not offered by its proponents as the ultimate in highway development. Its purpose is, frankly, educational—an object-lesson road. Representing the composite judgment of a committee of fifteen technical specialists, every detail of the design has a reason behind it. It is in the study of these reasons, as Mr. Thompson gives them, and the weighing of them with regard to local conditions in every case that the highway engineer can benefit most. While the paved width of the Ideal Section is 40 ft., it would bankrupt most states if they proceeded on the policy that all trunk-line roads now should have an equal traffic-carrying capacity. The lesson of the Lincoln design of paved roadways is that widths should be suitable not merely for carrying the daily flow of vehicles, but also for minimizing accidents. A study of the ideal design should impress upon engineers again the need for safety, particularly at curves. Then, too, there is the feature, greatly neglected in American practice, of beautifying the roadside by means of shrubbery and trees. The ideal design stresses this detail. From the engineering point of view the Ideal Section of the Lincoln Highway is most valuable not as a model to be copied blindly, but rather as a means of making highway engineers think and of suggesting features which should be incorporated where local conditions make them desirable.

Acts of God?

MORE bridges are destroyed annually by flood washout than fail or are removed through any other cause. Current months have made a large addition to the record, with many washouts during the spring months, culminating in the loss of a 300-ft. steel span in Texas, and more recently the destruction of numbers of small bridges by summer-storm floods. Such facts do not accord with the idea of a permanent transportation system. What is at fault, Are bridge washouts unpreventable accidents, so-called "Acts of God," or are they the result of bad engineering? The answer lies with the engineer, but he must give heed to the public's viewpoint on the subject. The engineer knows that flood action is capricious and that the construction of a foundation proof against scour is very costly, in many cases far beyond reason. In consequence he is inclined to limit his foundation cost to an ordinary figure and, if the structure is washed out, to call its destruction unpreventable. But the public expects bridges to survive; it knows that bridges are built by engineers, and knows that when a bridge washes out it is the engineer's handiwork that has failed. It is imperative that these divergent views be harmonized. This must be accomplished by a change in the engineer's view, and acceptance of the principle that bridges should be built to resist floods. If we are to hold to the attitude of the past, and look with equanimity on wholesale destruction of bridges by washout, then it is a question whether we are not designing wastefully, by putting more money into superstructures than the vulnerability of the foundation warrants. A sound basis for progressive thinking on bridge design is demanded. The first need is to determine what degree of natural stress represents reasonably possible service, and how great must be the storm or how high the flood to constitute an "Act of God." When this is done and when the practice is established of building bridges to last indefinitely, our permanent transportation system will be nearer realization than now.

Ford's Offer Revised

HENRY FORD'S Muscle Shoals offer as embodied in the majority bill of the Committee on Military Affairs is materially changed from his original proposal in two particulars. The bill makes it a requirement that the Ford company manufacture, and sell at a profit of not more than 8 per cent, fertilizers with nitrogen content of at least 40,000 tons of fixed nitrogen, which would be a very substantial proportion of the fertilizer consumption today. This provision Mr. Ford agrees to. The bill, however, does not give away the Gorgas steam plant and at last reports the Detroit manufacturer continued to hold out for that property as a necessary part of his offer, although it is inconceivable that he will continue to do so if he really wants Muscle Shoals. He shows characteristic knowledge of human nature when he gives in on the fertilizer matter. On every count but that the offer of the Alabama Power Co., so slightingly dismissed by the congressional committee, is superior to that of Ford. But Henry Ford knows that Congress, especially now that farmers' votes are needed, wants to make a gesture toward cheap fertilizer. That the government is but poorly compensated for the Muscle Shoals investment and that the 100-year lease offered is an invidious violation of the water-power act are made secondary to the promise to make fertilizer, though there is no promise in the offer to sell it any cheaper than any other fertilizer, unless the manufacturing costs turn out to be very low.

What Are Navigable Waters?

EVER since Congress in 1920 passed the Federal Water Power Act it has been apparent that sooner or later the Supreme Court would have to pass on the constitutionality of the definition of "navigable waters" in that act and on all the powers under federal control that definition prescribed. In granting permission to the State of New York to bring the law to test the court has now insured a fairly early settlement of the issue. The decision when rendered will rank as one of the most important of constitutional interpretations and will have a farreaching effect upon power development and the economic life of the country.

One little sentence in the Constitution, "The Congress shall have power . . . to regulate commerce . . . among the several states," is involved. By direct application of this power the whole economic course of transportation has been changed in the past three decades, and by its implication millions have been expended in the development for commerce and transportation of streams actually or potentially navigable. Through a long line of court decisions this latter power

of the federal government to control intrastate waters has been so well established that there is no possibility of its being contravened. Extension of the federal power to flood control, too, has been steady and for the most part unopposed, though the exact wording of the Constitution has to be severely strained to permit this construction. With the development of electric transmission, however, a new phase of waterway use arose, one which could not have been conceived by the authors of the Constitution and which is not directly covered by that document. This is the use of water for power. Acting under the interstate commerce clause of the Constitution, Congress in the Federal Water Power Act assumed control of so-called navigable waters for power use and it defined navigable waters as those of which any part is "used or suitable for use for the transportation of persons or property in interstate or foreign commerce."

By broad interpretation this might include all useful waters in the country, for practically any stream of potential power value can somewhere along its course float a log or a rowboat—"property," it will be noted, "in interstate or foreign commerce." Is so broad a federal supervision permitted by the Constitution? Several of the states deny it and New York is bringing the case to the highest authority. Its settlement will not only clear up an ambiguity in the Federal Water Power Act which is worrying the public officials of many of the states and the promoters of many water-power projects but it will be another milestone in the century-old states rights dispute.

Why Engineers Stay Home

FROM the news we learn that in many quarters folks are giving a thought to the waste chargeable to guff. An unusually succinct budget report by the British Chancellor of the Exchequer won, even from a political opponent, commendation for its merciful brevity. The Quebec Board of Trade forbids its members to talk in its meetings for more than three minutes unless they have something to say, in which event they are allowed ten minutes in which to say it. A fledgling senator has recorded his bewilderment as senatorial prolixity and has dared to predict that some day senators will be required to speak to the point. On every hand we find a desire to impose an embargo on twaddle.

All this, unfortunately, rouses memories of technical society meetings we all have attended. Today, most technical societies are seeking to increase their usefulness to their members. We suspect that no other one thing they might do could accomplish more to that end than would the elimination of the interminable and oft-times irrelevant discussions that drag out in many technical meetings until all hours. In some of the large cities many members live out of town and must catch certain trains. Frequently, these men, who have gone to the trouble and sometimes incurred the expense of staying in town for the meeting, must hurry off in the middle of the discussion because [illegible] have been permitted to fritter away precious minutes on airy nothings. Others, who live in town, may have few spare evenings and resent the dissipation of the time they are willing to devote to their technical societies.

The genus *loquacitor* [illegible] There is, for example, the chap who can't stick to the point and wanders off into byways that [illegible] most interesting but that contribute nothing to the subject in hand. Sometimes the digression takes the form of an alleged funny story of vague point and doubtful application. Most engineers, to be sure, have a sense of humor and are glad to have a technical discussion illumined by an appropriate anecdote; but few can sit patiently and listen to ancient and inappropriate yarns just because the speaker happened to hear them only that afternoon. So far as genuine discussion is concerned, a presiding officer of tact and resource can do much to keep it to the point; but suppression of the would-be humorist is more properly the task of discerning, heartless, and courageous personal friends.

Much of the rambling—most of it, probably—results from a lack of clear-cut purpose in the speaker. Many do not prepare in advance, even in their minds, what they propose to contribute to the discussion. Sometimes, of course, ideas are suggested by what another has said; but it would seem that from the very nature of such cases the comment would be to the point. Digression of this sort is in general unconscious and can easily be eliminated if speakers will formulate clearly in their minds just what they want to say, get up and say it, and when they have said it, sit down. It takes a good man to know how to talk; it takes a better one to know when to stop. More pernicious than all this, however, is the case of the perennial discussor who seems to fear that unless he talks on every subject that comes up he will be overlooked and forgotten. Much time is wasted by those who feel bound to talk, and who, if they know nothing about the subject under discussion will gladly oblige with a dissertation on the nearest thing to it that they do know something about. To be seen and heard seems to be their chief object.

A third species is the hobby-rider. Amazing it is, how deftly this specimen can hitch his steed to any vehicle that may happen to be traveling the highway of technical intercourse. Whatever its nature, we find it serenely bobbing its way through every discussion its master attends, be the subject anything from microscopical investigation of steel fractures to the newest theory for valuing a public utility.

While the sheer waste of time and energy caused by this sort of thing is regrettable, a deplorable by-product is the exclusion by the time-wasters of men who really could say something. Although our technical gardens may be overrun with ramblers, sunflowers, and forget-me-nots, there will still be found lurking in obscure corners violets of true worth that blush unseen under the competition of the more hardy perennials. We believe that if conciseness were more generally the vogue in technical discussions and loquacity were more openly frowned on as being decidedly unsportsmanlike and in bad form, many of these younger and more modest and otherwise [illegible] men would be encouraged to say their say. To be sure, much of the fault is their own for not tossing their hats into the ring, but under the circumstances their reticence [illegible]

While calling attention to this particular evil we are not forgetting that some societies labor under the opposite difficulty—a dearth of [illegible] that leaves many meetings fruitless and uninspiring. But that is another ailment which calls for different treatment.

Engineers have talked much about elimination of waste. We suggest that here is a chance for them to do a job right in their own household.

Design Features of Lincoln Highway "Ideal Section"

Technical Committee Has Planned Object-Lesson Route in Every Detail of Which Best Highway Engineering Practice Will Be Embodied

By W. G. Thompson
Consulting Highway Engineer,
Ideal Section, Lincoln Highway Association and Former State Highway Engineer of New Jersey

During 1919 and 1920, it became evident to the officials of the Lincoln Highway Association that the need for stimulating interest in highway development no longer existed, because of the then country-wide demand for more and better highways and the unprecedented provision of funds for their construction. Their thought then turned to comprehensive specifications and more durable construction, the need for insuring safety and convenience to highway users, and the protection and amplification, where possible, of the existing natural beauties of the road sides. Thus, the Ideal Section of the Lincoln Highway, a 1½-mile length between Dyer and Schererville, Ind., 32 miles south of Chicago, was conceived.



SITE IN INDIANA FOR IDEAL SECTION

Its proponents do not consider it the ultimate in highway development, nor do they set it up as a pattern to be minutely followed by all authorities. Rather, they submit it as a guide, hoping that the general principles outlined may be adopted and improved upon when improvement of main routes of heavy travel is being considered. Criticism of the Ideal Section is invited and expected.

In order to avail itself of ideas from every section of the country, the association mailed 4,600 questionnaires to highway engineers in public employ and to college professors of highway engineering, requesting suggestions as to specifications and design. A summary of the replies was used as the basis of discussion by a technical committee of highway engineers and authorities, appointed by the association to serve without pay in determining the essentials of the general specifications and requirements. At meetings of this committee held in New York in December, 1920, and in Chicago in February, 1921, discussion of the problem covered 18 principal points, which, as briefly enumerated below, were adopted for the guidance of the consulting highway engineer and the consulting landscape architect appointed by the association to prepare the working design and specifications.

1. The standard width of right-of-way for the Ideal Section shall be 100 ft.: Highway authorities must anticipate future requirements by the securing of options on adequate rights-of-way in advance of the time the additional right-of-way widths may be necessary, and thus, while not hampering abutting property owners in the use of the additional right-of-way, still make economic provision for its future use.

2. The specifications shall be predicated upon an average traffic of 15,000 passenger automobiles per 24-hr. day, traveling at a speed of 35 miles per hour and 5,000 motor trucks per 24-hr. day, traveling at an average speed of 10 miles per hour: The width of paving shall be 40 ft., laid in one continuous slab in the center of the right-of-way, to allow four lanes of travel on the metal.

3. The specifications shall be predicated on the ultimate statutory regulation of motor-truck design, limiting the superimposed load to 800 lb. per inch of width of tire actually in contact with the road surface and to 8,000 lb. per rear wheel: Assuming the total rear axle load at 16,000 lb. as 75 per cent of the total gross load, then the total permissible load per truck would be 21,333 lb., which is somewhat under the maximum load now permitted by statute in several states.

4. The drainage shall consist of submerged drain tile and catch basins.

5. The Ideal Section shall be constructed of concrete, 10 in. thick, of uniform section, with reinforcing steel embedded: Reinforcing steel shall be considered as ties to hold the slabs together in case of cracking and to prevent the widening of cracks. It is not to be considered as reinforcing steel in the sense that steel is used in reinforcing a concrete building. Approximately 80 lb. per 100 sq.ft. of steel mesh or rods shall be placed near the top of the slab.

6. The design shall require the placing of tie steel across the longitudinal and transverse joints.

7. Earth shoulders shall be provided on each side of the concrete.

8. The Ideal Section shall be lighted.

9. No curves shall have a radius of less than 1,000 ft. and all curves shall be superelevated for a speed of 35 miles per hour. Wherever reasonably possible, curves shall be eliminated.

10. A foot-path shall be provided for pedestrians.

11. The Ideal Section shall be equipped with guard and warning signs and all embankments protected by guard rails.

12. All crossings at grade shall be eliminated.

13. All wires shall be placed underground: Item 13 was later qualified as follows: While the technical committee understands that at the present time there are economical and technical objections against placing wires underground, it recognizes that this practice may become possible in the future, and recommends that they be so placed when it becomes feasible and prac-

ticable. Further, it urges research work along this line.

14. All advertising signs shall be prohibited along the right-of-way and all signs of direction or distance, except those placed or authorized by proper state authority, shall be prohibited.

15. Obstructions to vision at intersecting roads for a distance of at least 500 ft. each way from the intersection shall, in so far as practicable, be removed.

16. All distance marking should originate at the municipal headquarters of any town or city.

17. Neither the Ideal Section nor any other road should be built without provision for adequate, intelligent, continuous and prompt maintenance.

18. Comfort stations, park sites and ideal camp-site facilities are recommended.

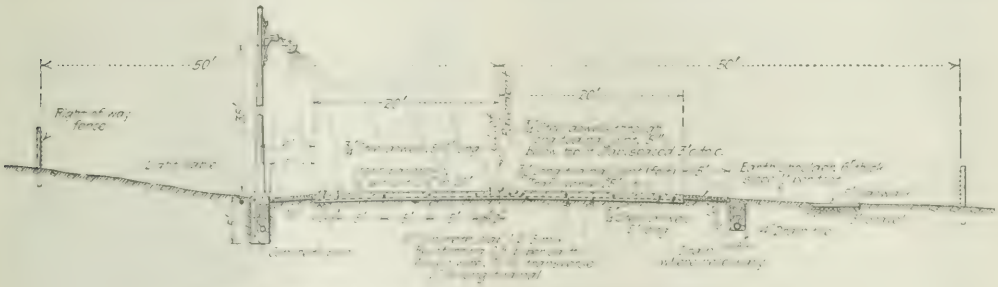
A brief presentation of reasons for adoption of the above principal features follows:

1. Width of Right-of-Way—Especially for those highways between great cities obviously destined to become heavily traveled during coming generations, measures should now be taken to prevent encroachment and provide for additional pavement width as traffic demands. In providing for a 100-ft. right-of-way, and the further provision of securing options on 12½ ft. additional on each side, the technical committee had in mind not only the future utilitarian development, but possible æsthetic development as well. The property required, additional to that on the existing right-of-way, will be purchased by the Lincoln Highway Association and deeded to the State of Indiana.

2. Pavement Width—Opinions on width differ widely. Many contend that after traffic reaches a certain density parallel highways should be provided. However, vehicles usually follow a certain road and for many years attempts to divert traffic to parallel highways, for any reason outside the owner's volition, will meet with resistance from highway users. In future design pavement width will continue to be a matter subject to local determination.

A. N. Johnson, dean of the Engineering College, University of Maryland, gave in the June 9, 1921, issue of *Engineering News-Record*, p. [illegible] an analysis of methods for determining pavement widths. His conclusions, based upon careful observations of traffic covering several months on the Baltimore-Washington road, are that "highway plans contemplating an extended system of highways of greater width than is required for two lanes of traffic are extravagant and have no economic justification." This he predicates upon the fact that with a 25-mile speed and 132-ft. center to center spacing, 1,000 vehicles per hour can pass a given point in single file; therefore, a two-traffic-lane road can easily pass 1,000 to 1,500 vehicles per hour, and during rush hours may handle double that number.

If economic reasons alone are to govern highway design, provision for four lanes of traffic, as in the proposed Ideal Section, is indefensible. However, in the death-registration area of the United States 9,000 persons were killed in motor accidents in 1920, a decided increase over any previous year. Many of those killed were pedestrians in cities, and many deaths were due to causes other than narrow pavements, but in the aggregate they demand that we consider the future, and its inevitable increase in the number of vehicles, particularly motor trucks, which, due to their low speed, will largely affect the traffic capacity and consequently the safety of the two-lane highway, unless provision be made to minimize their interference with high-speed vehicles. In many localities the traffic problem is not so much due to the high-speed driver, as it is to the interference by the cautious, inexperienced, slow drivers, and the slower motor trucks holding tenaciously to the center of the present two-lane road. Collision, ditching, overturning, injury and death, frequently result from attempts to pass these vehicles on narrow roads.



DESIGN DETAILS ADOPTED FOR IDEAL SECTION, LINCOLN HIGHWAY

In its discussion of this phase of the subject the committee considered, not especially the problems of today, but tried to visualize conditions as they will exist 20 years hence. If no motor trucks were to be considered the committee would undoubtedly have agreed on a two-, or at most, a three-lane design. There was no dissent to the proposition that separation of trucks and passenger vehicles, particularly between large cities, will be desirable in future design whenever feasible. This decision is based principally on the fact that human safety and convenience should be predominating influences in future design. Who can truthfully say there is recreational value, or anything but constant danger and nervous strain, in driving over our present two-lane highways anywhere within 50 miles of our large cities on holidays?

Economic considerations must always govern our highway policies, but the motor vehicle is fast reaching a place in the life of our people where economic policies will increasingly be tempered and influenced by demand for greater freedom from restraint, coupled with safety, than is now possible or practicable on our two-lane highways. *In the last analysis, human safety is of paramount importance, and should be subordinated to no other element or consideration in designs for engineering works.*

3. Truck Loadings—Wide differences of opinion have thus far prevented adoption of a common standard of maximum vehicle loadings, though the matter is now before many legislatures with fair prospect of general adoption, by statute, of not to exceed 28,000 lb. gross load, with not to exceed 75 per cent of the load on the rear axle. Realizing the futility of hoping for an early agreement on this subject the committee arbitrarily predicated the pavement design upon a maximum gross loading of 8,000 lb. per rear wheel, limiting the superimposed load to 800 lb. per inch of tire width.

Subfoundation conditions at the proposed site in Lake County, Indiana, were known to be good and of uniformly high supporting value, and although it is admitted that the 10-in. slab thickness was arbitrarily decided upon, that decision is supported by the results from subsequent tests conducted by the U. S. Bureau of Public Roads at Arlington, Va., and described by C. A. Hogentogler (see *Engineering News-Record*, Dec. 8, 1921, p. 944). The tests showed that, as representing the average relation of thickness to impact resistance, the 10-in. slab of 1:1½:3 unreinforced concrete on a good subfoundation will resist single-wheel impact of 44,000 lb., at least until permanent subgrade deformation occurs. Granting a uniformly smooth pavement surface, a uniformly resistant subfoundation and uniformly good, unbroken vehicle tires, this figure is well above any impact force to be expected in the near future, especially considering the increasing use of pneumatic tires. Because of the conditions under which they were conducted, the tests, Mr. Hogentogler admits, are not to be taken as infallible guides to design. The technical committee of the Lincoln Highway Association, however, feels that in the absence of definite information the results of the bureau's tests justify the adoption of the above loadings and the 10-in. slab thickness. Addition of metal reinforcement and dowel bars across the joints will measurably increase the above-mentioned impact resistance, which is given for unreinforced slabs.

4. Drainage—The committee emphasizes the fact that subfoundation drainage is the first and predominating requisite to the success of any type of pavement. For safety reasons no open drainage ditches are to be permitted immediately adjacent to the roadway. Sufficient right-of-way is provided to enable placing them at a distance. Where the topography precludes this practice, catch-basins leading to pipes under the road or to covered drains will carry off surface water. Wherever necessary trenches, 4 ft. deep, with bottom tile and backfilled with coarse stone will be placed to intercept and carry off subsurface water.

One 30-ft. span, of reinforced-concrete, flat-slab bridge is included in the Ideal Section construction. It will have 40 ft., clear of vehicular roadway, and 5-ft. sidewalks. A strong parapet wall of simple design will be placed outside the sidewalks. Unusual care will be taken to compact the approach backfill. In order to minimize cracks due to possible settlement at the approaches to the bridge floor reinforced pavement approach slabs 15 ft. long will be laid to act as beams with their bridge ends resting on the abutment, and outer ends on the subfoundation. This method will minimize the effect of impact on the bridge floor slab, the destructive effect of which is so noticeable where breaks in the grade exist between the approach slab and the bridge floor.

5. Type of Pavement—The technical committee unanimously decided that the pavement should be one-course portland cement concrete, 1:2:3 mixture, of 10 in. uniform thickness on a crowned subfoundation with reinforcing metal embedded. It is not intended to convey the idea that concrete is considered the ideal pavement. We probably shall never attain that desideratum. The committee considers concrete the least expensive of the several more durable pavements now in use; if properly laid it can be used for many years as a pavement, and if its surface ever wears so that it is undesirable as a riding surface, it may be resurfaced with concrete, asphalt or brick. This practice has successfully been demonstrated.

It is generally admitted that other types of pavement for main highways should have a concrete base to insure the integrity of the surface, whatever the type. The initial cost of the concrete type, as thus far developed, being lower than that of any other type of surfacing on a concrete base, plus its comparatively low maintenance cost, plus its freedom from slipperiness in



BRACKET TYPE SERIES HIGHWAY LIGHTING UNIT

wet weather, and smooth riding qualities (when properly finished) gave it the preference in this selection.

Little is definitely known of the causes of cracking in concrete-pavement slabs, or rather, definite means of prevention under any and all conditions are unknown. Recognizing this fact, a majority of the committee favored the placing of reinforcing metal to assist in holding together the cracked sections, and to prevent widening of cracks, which are readily repaired by filling with bitumen. Reinforcing metal will consist of steel mesh or rods. About 80 lb. per hundred square feet will be placed 3 in. below the top of the slab; ¾-in. steel bars, 5 ft. long, will be placed across the longitudinal joint, about 3 ft. center to center, to assist in preventing slab edges from rising above each other and to prevent possible widening of the longitudinal joint. Dowels to assist in preventing slab movement will be placed across transverse joints, which will be spaced at 75-ft. intervals.

7. Shoulders—Five-foot shoulders of earth are pro-

vided. These will be thoroughly compacted and a layer of good top-soil placed on them to be later seeded to grass. These will enable occasional use by vehicles without danger of injury. It is believed the 40-ft. width of pavement makes more durable shoulders unnecessary and that the grass or sod will minimize the unnecessary use and wear of the shoulders by vehicles. This has successfully been demonstrated in many places.

8. Lighting—The lighting of highways, except in the vicinity of cities, will continue to be a debatable question. Much of the objection to the lighting of interurban highways was, and still is, due to improper and inadequate lighting systems, where open lamps throw the glare into the drivers eyes and the type and position of reflectors cause the illumination of the fields alongside the road instead of confining it to the pavement proper. Given a uniform diffusion of light on the roadway and an economical maintenance of a lighting system, there can be no question of its desirability, for the following reasons: Prevents accident at dangerous curves and other obstacles; reduces headlight glare and consequently relieves eyestrain; facilitates making repairs; discourages holdups; encourages night motor freight traffic, thereby relieving daytime congestion; helps bring electricity to the farms by providing power lines.

The General Electric Co., through W. D'Arcy Ryan, will provide a system of lighting, developed after long experimentation, which, due to a highly efficient reflector, provides a uniform diffusion of light over the roadway surface, entirely eliminating the glare and effectively confining the illumination to the roadway proper. The lighting unit, a view of which is shown, will be mounted on concrete poles of simple design, 35 ft. high, and spaced 250 ft. centers, staggered. Lamps will be 2,500 lumens (250 cp.) Mazda C series, operated from a constant circuit, supplying 6.6 amp. received from a transformer on a primary line of 2,300 v., 60 cycles. Lighting current will be carried by a steel-armored cable buried about 12 in. in the ground.

Bearing in mind that the following lighting cost summary is based upon an installation for only about 2 miles of roadway, it will be admitted that the annual cost is not staggering, considering the benefits derived.

LIGHTING COST PER YEAR ON A TEN-YEAR BASIS

Assuming the system to be salvaged at the end of [illegible] for 25 per cent of the original cost [illegible] with interest at 6%, payable in advance, which is [illegible] per cent of the original cost.

Investment or fixed charge	[illegible]
Operation and maintenance	[illegible]
Total cost per year for system	[illegible]
Cost per lamp per year, based on [illegible]	[illegible]
Cost per year, per linear foot of roadway	$0.25

This installation is designed to illuminate a 40-ft. pavement. Cost of installation and operation for narrower widths would be somewhat lower.

10. Care of Pedestrians—Many pedestrians are killed and injured by motors, because no way is provided for them outside the pavement. Decision for human safety demands that wherever practicable foot-paths or sidewalks be provided. A 5-ft. gravel foot path 3 or 4 in. thick will be placed outside the roadway of the Ideal Section.

11. Warning Signs and Guard Rail—[illegible] of opinion exist as to the necessity for these safety factors. Adequate warning signs will be placed where necessary. Embankments over 3 ft. high will be protected by guard rail. The posts will be of concrete about 6½ ft. long and 6 x 6-in. square, having no top railing. Two side rails of 2 x 6-in. timber, properly spaced and painted white, will be fastened to the posts by U-bolts. These will enable ready replacement of broken wooden rails.

12. Grade Crossings—No railroad lines cross the proposed Ideal Section site at grade. The committee, in voting for the elimination of grade crossings, fully comprehended the economic problem involved, and realized that many years must elapse before attainment of this ideal is accomplished. It is on record, however, to the effect that ideal highway conditions preclude the existence of railroad grade crossings.

13. Underground Wires—Because in most instances pole and overhead wire lines along a highway detract from its sightliness, and in winter constitute an actual menace to users of the road, the technical committee voted to have all overhead wires placed underground. This action was taken in absence of knowledge of technical and practical telephone and telegraph operating requirements. Subsequent discussion of the matter with officials of the companies involved developed the fact that, especially for long-distance lines (those along the Ideal Section being transcontinental lines), the placing of wires underground is impracticable.

Submitting to conditions beyond its control and acknowledging the seriousness of interference with telephone and telegraph communications, the committee will make the best possible disposition of the pole lines. Full and cordial co-operation is assured by the companies involved.

15. Advertising Signs, Highway Markers—The indiscriminate placing of advertising signs within and along the public rights-of-way should be prohibited by law. Frequently placed across the inside of curves, or at road intersections, they constitute a positive menace to public safety. The committee unqualifiedly recommends their removal and future prohibition, by statutory enactment, in every state.

Owing to inconsistencies noticed where highway marking is done by many different agencies, the committee recommends that all distance and direction markers be placed only by proper state or local authority and that all distances should originate at the municipal headquarters of any town or community.

17. Maintenance—Maintenance of the roadway will be cared for by the State Highway Department of Indiana, since it is a part of a state highway route. Dis-annexation of the portions within the incorporated limits of the towns of Dyer and Schererville was effected by those towns to permit future maintenance by the state.

18. Comfort Stations, Camp Sites, etc.—It is the intention of the Lincoln Highway Association later to establish a comfort station and camp site for tourists. A generous acreage for this purpose has been promised by a citizen in the vicinity. Simple facilities will be provided to make the camp site comfortable for overnight stops.

Except in public parks little attention has, as yet, been paid to the systematic development of the natural beauty of our roadsides. Where there are underdrains whose functions might be obstructed by spreading roots, the close proximity of shrubs or trees is undesirable.

However, where no underdrains exist, the growth of natural bushes and shrubbery is an actual benefit in preventing erosion of slopes. Preservation of our roadside trees is a public duty, the evasion of which finds but little justification in the claim that they interfere with agricultural production, or the services of public utilities.

The Ideal Section is to be 1½ miles long. It will be built on the Lincoln Highway between the towns of Dyer and Schererville in Lake County, Indiana, about 12 miles south of Hammond, and 32 miles south of Chicago. Nationally central location, favorable topography and nearness to Chicago for inspection purposes determined the selection of the site.

Through the interest of C. B. Seger, chairman of the board and president of the United States Rubber Co., and J. Newton Gunn, vice-president, United States Rubber Co. and president, United States Tire Co., there was contributed toward the cost by the United States Rubber Co. $120,000. The State of Indiana, through its highway commission, with the approval of the Governor, contributed at the rate of $33,000 per mile, $49,500. Lake County, Indiana, will contribute $25,000. The total funds available, therefore, are $194,500.

Mr. Gunn is president of the Lincoln Highway Association and A. F. Bement, of Detroit, is vice-president, in active charge of its work.

The personnel of the technical committee appointed by the association to determine the general features of the specifications follows: W. D. Uhler, state highway engineer, Pennsylvania; A. R. Taylor, state highway commissioner, Ohio; H. E. Breed, consulting engineer, New York; Clifford Older, state highway engineer, Illinois; T. R. Agg, professor of engineering, University of Iowa; F. R. White, state highway engineer, Iowa; A. N. Johnson, dean, Engineering College, University of Maryland; Edward R. Hines, chairman, highway commission, Wayne County, Michigan; Col. Sidney D. Waldon, consulting automotive engineer, Detroit; L. H. Wright, former highway commissioner, Indiana; A. R. Hirst, state highway engineer, Wisconsin; Arthur H. Blanchard, professor of highway engineering, University of Michigan; Major J. M. Ritchie, Motor Transport Corps., U. S. Army; W. G. Thompson, former state highway engineer, New Jersey; Elmer C. Jensen, chairman, Lincoln Highway Committee, American Institute of Architects, Chicago, Illinois.

The writer is consulting highway engineer and Jens Jensen of Ravinia, Illinois, is consulting landscape architect.

Lockwood, Greene & Co., engineers, will handle the contracts through their Detroit office, in charge of T. C. Morris.

Traffic Increase in Iowa

In 1921 the total highway revenues, including motor vehicle fees, in Iowa amounted to $24,097,463, or 4.4 times those of 1910. During the same time, however, the number of motor vehicles registered increased from 10,422 to 481,535 or 46.2 times. In other words, the number of motor vehicles in the state, and consequently the traffic on the highways, has increased during the past 11 years, eleven times as rapidly as have the highway revenues. Thus, in 1910 the highway revenues from all sources amounted to $552 per motor vehicle as compared with $50 per motor vehicle in 1921.

Estimating Reproduction Cost of Buildings for Valuation

Establishment of Standard Types of Structures Allows Curve Cost to Be Plotted on Convenient Unit Basis

By F. E. Barnes
Supervising Building Valuation Engineer, New York Central Lines
(*Copyright, 1922, F. E. Barnes*)

THERE CAN BE found in any large railroad system buildings of almost every type—anything from a flag shanty to the highest-grade office building. In the case of a system such as the New York Central Lines owning approximately 35,000 buildings, it became necessary, in its valuation work, to prepare methods that not only would give accurate results, but eliminate duplication of work and reduce to a minimum the effort and expense in arriving at the proper values. To this end extensive studies were made as to the method to be employed in both field and office work.

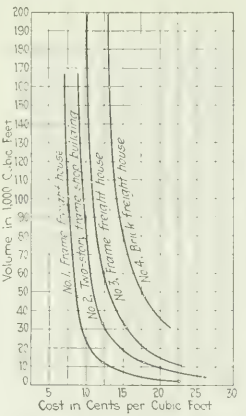


FIG. 1. UNIT COST, SHOP AND FREIGHT BUILDINGS

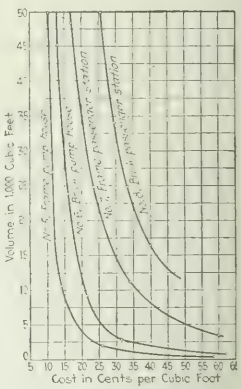


FIG. 2. UNIT COST FOR SMALL STRUCTURES

Three Methods of Valuation—The Interstate Commerce Commission ruled that all roads be valued on a basis of prices existing in 1914. To determine the cost of reproducing new, structures already built and in use, there are three practical methods of procedure. In the case of a building recently constructed and the cost of which is known, the easiest and perhaps the best method is to revise the original cost by applying the cost difference between the year actually built and the year for which the valuation is required. The second method is to estimate a bill of quantities and apply the unit prices that would be used by a general contractor if he were bidding on a similar building. The third method consists in grouping a number of similar structures and estimating the cost of construction of a part of them to determine the correct cost of the others. For the third method usually spoken of as the type method, the prices can be applied either per square foot, cubic foot or any other suitable unit.

On the New York Central Lines it was more or less arbitrarily decided to use the first method where the buildings had been constructed since the year 1900 and where the original cost to date was known. This method was fully described in an article by the writer in *Engineering News-Record*, Oct. 7, 1920, p. 702.

The second method has been resorted to in cases in which the first or third method was found unsuitable.

Method Used in "Typing"—The third or type method has been used on the New York Central Lines for at least 80 per cent of the building structures. The typing was carried out as far as possible before the field work was done and the field survey was written up using the types. They were prepared not only for the buildings themselves, but for each portion of a building, such as roofing, flooring materials, wall surfacing (both exterior and interior), chimneys, etc.

If a building were of a decided type the field-survey man immediately placed it in that type and described only those portions differing from the type, but if a building did not easily fit into one of the types it was fully described. The work of description, however, was greatly shortened by use of the sub-types for the various parts of the building. A 3¼-in. x 5½-in. photograph was taken of each structure and these aided materially the work in the office. After the field work had been done the typing was completed in the office.

To do this a tabulation sheet was prepared giving the complete description of each type of building including its location, year built, length, width, height, kind of foundation, chimney, exterior and interior surfacing, roof, kind of framing, flooring and volume. All buildings placed in a given type by the field men were described on one of these sheets, the description of each building taking but a single line. The photographs, mounted on 5-in. x 8-in. cards were then placed before the type man and the field typing checked by use of the description and the photographs. Many buildings had to be changed from the type in which they had been placed to a more suitable one. Also, many that had been left out of types could be placed in one of the field types.

Plotting Type Curves—With this review of the types completed a certain number of buildings were selected from each type. These buildings, usually comprising the smallest, the largest and two or three intermediate ones, were then estimated, unit prices applied to them and the price per cubic foot figured. They were then plotted on cross-section paper, the vertical scale denoting volume and the horizontal the price per cubic foot. As the volume becomes small the price per cubic foot increases rapidly so that the resulting curve is always concave to the right and has the general appearance of an hyperbola, but is not a true conic section.

One fact brought out in plotting the curves was that for most types there is a size above which the price per cubic foot no longer decreases as the volume is increased. For shop buildings this frequently is as much as 200,000 or 300,000 cu.ft., but for the smaller roadway buildings it is often only 20,000 or 30,000 cu.ft. Such information should be helpful to those engaged in the design of buildings, for where the space required is double or more the volume that ceases to show added economy by increasing the size, it would be as economical to construct two buildings instead of one.

The eight curves on the charts shown herewith are for actual buildings and are fairly typical of all curves worked up by this method. The prices used in preparing these curves were those existing in January, 1922.

The lower portion of curves 1 and 2 run in a lesser degree 1 and 2 are too flat for accurate use in pricing small buildings falling under these types. For cases of this kind it has been our practice to redraw this portion of the curve increasing the vertical scale sufficiently to make the prices easily read.

In carrying out the cost quantities for type buildings, it is necessary to give the cubic feet and to show such additions and deductions as the individual building requires to bring it within the type. For instance, if the type has a shingle roof and the building in question has a slate roof, it is necessary to give the area of roofing priced at the difference between the two kinds. In making up the price per cubic foot, the superstructure should be kept separate from the substructure treating the two as separate structures. Frequently a superstructure will fit into a type while its substructure is entirely different from the other buildings of its class. It is often found that the substructure is special and has to be estimated, while the superstructure is easily thrown into a type. Such items as plumbing, heating, lighting, platforms, furniture, etc., should always be estimated separately.

In preparing the estimates both for the special buildings and those used for plotting the type curves, the work of estimating is greatly shortened by the typing of the various portions of the building previously referred to. For instance it is much quicker to take off areas by the square than it is to carry out such surfaces in feet, board measure of lumber, thousand of shingles, slate, etc. This method of saving time can easily be carried too far, detracting from accuracy and often causing work instead of saving it.

Sewerage Conditions in Small Cities

TYPICAL conditions and difficulties of sewerage systems in cities of the smaller class are illustrated by the following abstract from the annual report of H. H. Edwards, city engineer of Danville, Ill. (population, 33,776 in. 1920):

The past year has shown the need of new sewers and enlargement of some existing sewers. Flooded basements, inundated districts and other damage by storm waters have brought many claims for damages to the City Council. But it is difficult to see why the city at large should pay for them. In most cases, steps to install adequate sewers would have met with much opposition if taxed upon those property owners. It was demonstrated, however, that more funds must be made available for sewer maintenance and extension if a repetition of this flooding is to be avoided.

Many parts of our sanitary sewerage system are overloaded. The unlawful connection of downspouts from roof has largely increased this overloading and must be stopped. Overflows have been cut into storm-water sewers to relieve the sanitary sewers, but this is a temporary relief and should not be allowed to continue, since the constant use of storm sewers for this purpose will be unsanitary and dangerous to the public health. Several new trunk lines and relief sewers are needed.

Recent rains have shown the need of better drainage on our streets and more storm sewers. In a number of these sewers were washed out by the excessive flow. The sewer on Collett St. has blown up the pavement almost yearly, and the expense thus caused warrants the laying of adequate pipe to take care of the flow. Many other sewers were damaged, while numberless culverts and small drains were washed away. It is a waste of money to put in such sewers, for the investment is swept away at the first excessive rain. Storm sewers help keep our streets clean, for most of dirt on the streets goes during storms. Vance Creek, which drains a large part of the city, is being made narrower and shallower by the continued dumping of refuse and rubbish along its banks. This can only cause more frequent flooding. Steps should be taken to stop all dumping and to clean out the channel.

Battling with the "Devil's Hole" in the Mississippi Flood

The Story of a Victorious Nineteen-Day Struggle to Save a Main Levee—Detailed Description of the Methods by Which a Crevasse Is Fought

By A. L. Dabney
Consulting Engineer, Memphis, Tenn.

IN THE lower Mississippi River, the flood of 1922 is now receding. For duration above bank-full stage, it broke all former records. For nearly 600 miles of the river's length, it broke all records for flood elevation. It is another and stronger vindication of the levee system. Between Cairo and New Orleans, there was only one break. There was much emergency work on the weaker sections of levee (not yet up to standard), and there were several weeks tense with apprehension.

Unique in the writer's experience was the development recently named the "Devil's Hole," in Tunica Co., Mississippi, in the Upper Yazoo Levee District. For nineteen days, large forces were engaged, day and night, in a successful effort to prevent the engulfing of a large section of the levee by this monstrous hole, which in one month enlarged more than it had in 19 years and developed into a veritable maelstrom. The accompanying maps almost tell the story. Around the bend of the river opposite the point of attack, the distance is about twelve miles. (See Fig. 1.) Across the wooded neck, it is a mile and a quarter. The slope across the neck is, therefore, ten times as steep as the river's slope. Water flows from the river through the intervening woods, to the cleared borrow-pit area along the levee. It rushes through this cleared strip at a high velocity.



FIG. 1. LAYOUT OF LEVEE
The point of land enclosed by the bend in the river is wooded except for a cleared borrow-pit area along the levee. The river swept across this neck rounding the point formed by the levee.

Origin and Growth — Before 1903 there had been some trouble in maintaining a bulkhead at the end of the spur which projected from the angle in the old levee (see Fig. 2). During the 1903 flood a hard fight was made to hold the bulkhead, which was lost during the latter part of that flood. The same year, a new levee was built behind this angle. Thereafter, no effort was made to hold the spur.

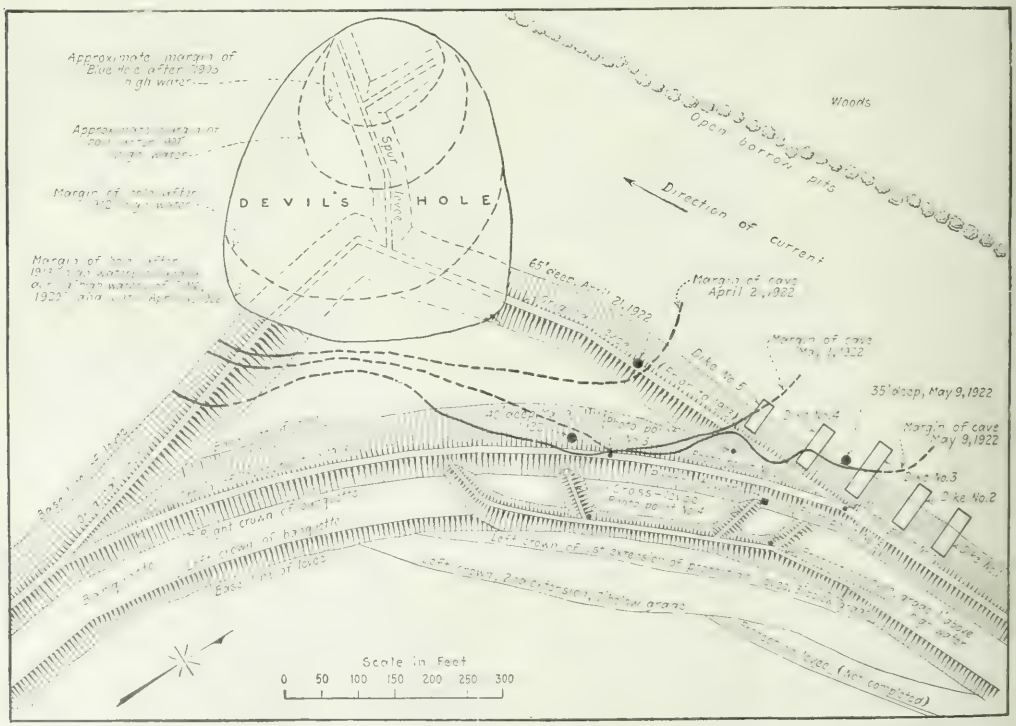


FIG. 2. PLAN SHOWING PROGRESSIVE CAVING AND OPERATIONS TO SAVE LEVEE AT DEVIL'S HOLE
Here is shown the progressive enlargement of the "blue-hole" of 1903 and its invasion of the main levee section during the flood of 1922. The point from which the photographs in Figs. 5, 6, 7 and 8 were taken is marked "photo tower," and the several "photo-points" shown in this plan are indicated in the photographs by poles having white bands to denote the number of the point. The line marking the margin of cave on May 9 indicates the limit of the caving.

Whenever a levee crevasse occurs on the lower Mississippi, a deep hole is washed in the levee gap. Such holes are locally known as "blue holes." Usually they are about 50 ft. deep from the ground surface. Such a hole, of comparatively small area, was bored by the eddy action as the spur levee was washed away by the floods of 1903, 1907 and 1912; the last named flood cutting away the old main levee at the angle. A little more of the old levee was taken, by an enlargement of the hole, in 1913; and the "blue hole" had become a good fishing and swimming resort in low water time. It did not become the "Devil's Hole" until after April 16, 1922.

During the 1916 and 1920 floods, and for the first



FIG. 3 DUMPING REVETMENT FROM DIKE NO. 1
This picture was taken May 6, looking upstream from a position very near to photo-point 2. The shore line shown is just about that marked May 9 on Fig. 2. Dike No. 1 was almost entirely undermined before the flood began to recede.

three weeks of the 1922 flood, no appreciable enlargement was noticed. On April 16 the old levee ends were observed to be in about the same positions as after the 1913 flood. On April 20 a levee guard noticed that the upper spur was rapidly going away. On April 21 the chief engineer of the district made a personal inspection and found that about 200 ft. had been lost in 5 days. He immediately set machinery in motion to organize for a hard fight. Twenty thousand empty sacks from storage were delivered the same day and a large force of plantation labor spent the night filling them. By the next morning half the levee board's organized team forces, distributed over 50 miles of levee were on the ground and at work building a secondary levee.

Early the morning of the 22nd, the writer, hastily called in, accompanied the chief engineer to the scene. Immediately, men were set to making large wooden mauls for driving hand-piling. Others were sent to the woods a mile distant to cut brush; and wagons were set to hauling it. Within two hours trucks were bringing lumber from four mills and lumber yards in the county. The same day, two special trains from Memphis (40 miles north) brought sacks and small piling timber, and trucks hauled [illegible] miles from the nearest station. In the afternoon, a quarter boat borrowed from the U. S. Engineers at Memphis, was delivered at the [illegible] This boat served dinner every day to from 300 to 400 laborers from the plantations. Later it quartered and fed 225 state convicts. One day it served dinners to nearly 800 men. The levee board's team forces were quartered in a hastily built tent camp.

Plan of Action—When we reached the scene, a very brief inspection was convincing that heroic measures must be adopted. It was immediately decided to first build permeable spur-dikes to divert the current farther from the levee and to be governed thereafter by developments; also, to build an emergency levee behind the main levee.

The team force had already begun a narrow fill on the landward edge of the banquette. Water was ponded behind by a permanent sub-levee, to depth of about 2 ft. at the base of the banquette. The sub-levee basin is 500 or 600 ft. wide and the field beyond was wet from seep water. Accordingly, material for the emergency levee was borrowed from the top of the main levee, for a length of about 1,500 ft. each way. Opposite the emergency levee, the top of the main levee was reserved for filling sacks.

About two hours after we arrived, a skiff had been brought from some miles away on a truck. With some difficulty a line was got across the 250 ft. of open water opposite the upper junction, and made fast to a tree. Holding the boat by this line, in an 8 to 10 ft. velocity,



FIG. 4 PLACING "SNAKES" TO REVET MAIN LEVEE
This picture was taken May 6 looking down stream from a point near photo-point 2. [illegible] indicated by the stake near the three white [illegible] The method of making and placing the "snakes" is described under the subhead "Fighting the First Cave."

soundings were taken that showed a maximum depth of 15 ft.

Immediately after this, Dike No. 2 (see Fig. 2) was begun. At first, 2 x 4 in. gum scantlings, doubled, were used for piling, driven about 4 ft. into the ground with heavy wooden mauls. Bents were spaced 4 ft. apart. The dikes were made 16 ft. wide, with 4 piles to the bent. In the afternoon, 300 4 x 4 in. sticks, 20 and 22 ft. long came from Memphis by special train, and with 24-ft. lengths received later, were thereafter used for piling. Caps and walings were 2 x 6 in. gum and pine.

By evening this dike had been extended about 30 ft. from the water's edge. The end was in such swift water that it was almost impossible to get in the last bent. As we advanced into deeper water, it had become



FIG. 5. BUILDING EMERGENCY PROTECTION LEVEES
This picture was taken from the photo tower (see Fig. 2), looking between photo-points 4 and 5. Figs. 5, 6, 7 and 8, all taken on May 7, form an almost continuous panorama extending from photo-point 5 around to dike No. 1. A cross-levee appears in the immediate foreground.



FIG. 6. CAVE IN MAIN LEVEE
Photo-point 3 is indicated by the tall stake in the center of the picture having three white bands near its upper end. At the left end of the cross-levee connecting the emergency and main levees is seen photo-point 4. Maximum penetration of the cave into the main levee was just beyond photo-point 3.

necessary to hold the bottoms of the piles, six men on the levee upstream holding them by the two ends of a line passed around the pile. It now became impossible to force the bottoms outward from shore against the diagonal pull of the line. This dike was temporarily discontinued and a start was made on Dike No. 1. During the night it was pushed out about 30 ft. Next day Dike No. 2 was extended to a length of about 50 ft. By stationing men at the end of No. 1 to hold the piles for No. 2, the pull on the line was more nearly directly against the current. With considerable difficulty, Dike No. 1 was later extended to a total length of about 45 ft.

A Critical Moment—The evening that Dike No. 2 was completed, an accident occurred which caused the writer more serious apprehension than was experienced at any other time. Due to ignorance on the part of a workman, an attempt was made to draw a skiff upstream from the end of this dike, pulling by a line from Dike No. 1. The current whipped the boat round against the upstream side of No. 2 and capsized it, open side upstream. Even after the boat was torn partially in pieces with pike poles, no force that we could apply would move it. For fear that it would cause an underscour and start a new "Devil's Hole" very near the base of the levee, three bents of the dike were sacrificed by cutting the walings and pulling the piles, in order to free it from the wrecked boat. It took half the night to accomplish this.

When the dikes were begun, it was planned to drive later a line of piling at about 1-ft. spacing, revet the bottom within the dikes with sacks and partly fill the dikes with brush. It was found that the open pile bents created so much head that it would be hazardous to increase the obstruction. There would be great danger of creating a scour at the ends of the dikes. An attempt was made to partially revet the bottoms by forcing down bundles of cane and poles with several sacks tied on for weight, having each bundle bear against two piles. Most of these were swept through, as was suspected at the time, and later confirmed after the water fell. Although the total head created by three of the dikes was 0.8 ft., there was no erosion under them as long as they were subjected only to the action of the direct down-stream current. The levee and the ground are both a very stiff "buckshot" material.

Dikes Nos. 1 and 2 so retarded the current near the levee below them, that Dikes Nos. 5, 4 and 3 were built (in order named) with much less difficulty, except the outer bents of Nos. 4 and 3 for which it was necessary to hold the piles by a line from the dike above. No. 5 was built with a hand pile driver (piles 8 ft. in the

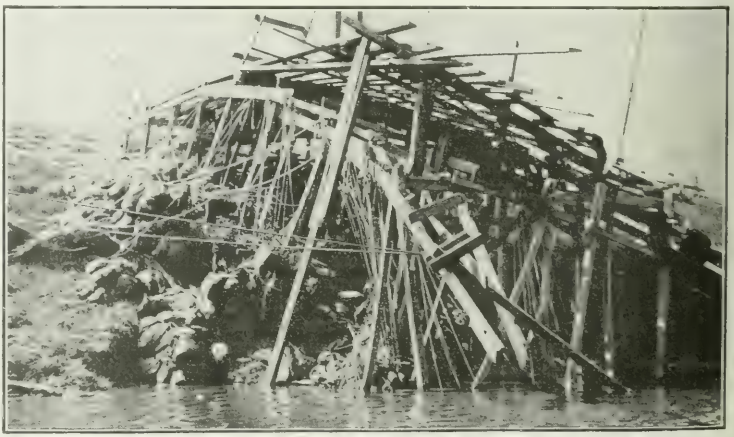


FIG. 9. DIKE NO. 2 AFTER FLOOD SUBSIDED
Here is shown the upper end of the caving into the slope of the levee and the extent to which the dike was undermined.



FIG. 7. REMNANT OF OLD LEVEE

To the left is seen photo-point 2, indicated by the stake with the two white bands. The men are standing on a remnant of the crown of the old levee. Dike No. 5 was at this point before it was swept away. Note the eddies and boils in the river.

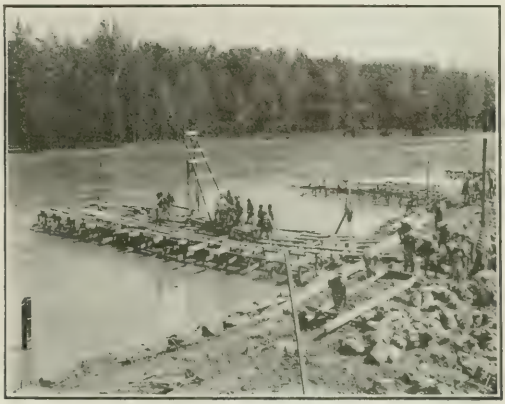


FIG. 8. DIKES NO. 1, 2, AND 3

Dike No. 3 is in the foreground. Photo-point 1 is on the extreme right, indicated by the stake with one white band. These dikes were built at the beginning of the struggle to help divert the current from the threatened face of the main levee.

ground). Later, this driver was used to double up on the hand driven piles in the other dikes, driving spliced piles 10 to 14 ft. deep.

Fighting the First Cave—The dikes so retarded the advance of the gorge that for a week after they were begun, its enlargement was very slow. On May 1 there appeared the first cave above water in the main levee. Work was immediately begun rolling "snakes" of sacks and brush into the cave. Each earth-filled sack was belted with a ¾-in. line. A row four sacks high was laid, sides touching, along the brink of the cave, each sack tied to the one under it. A ¾-in. line was then laid along the top, and the small line from each top sack tied to it; then brush was applied liberally and tied to the large line, the end of which was anchored to posts and "deadmen," allowing 30 to 40 ft. slack for the snake to sink. The mass was then rolled into the water. This operation was repeated until four to six snakes had been made, then a number of detached bundles of brush with eight to twelve sacks tied to each were rolled in to take lodgment on the snakes. More "snakes" were then applied, followed by more bundles. After 24 hours of constant work, the top of the mass appeared at the water surface. The next 24 hours were spent applying snakes and brush so as to extend both ways, the revetment formed in the cave.

The Second Cave—Two days after the first cave in the levee, a large cave occurred in the old spur, immediately behind Dike No. 5 which, during the preceding two days, had been undermined by the eddy working up to its lower side. The gorge had advanced upstream on a line further out than its original course. For *four days and nights*, sack "snakes" and brush bundles were poured into this last cave, before the top of the revetment appeared above water. It remained so for three hours, then subsided about 15 ft. and the application was resumed for some additional hours before the top of the revetment could be held at the water surface.

The next "thrill" occurring about this time, was a 20-ft. subsidence of the revetment in the cave of May 1, and immediately thereafter, the sliding in of another section of the main levee, to the line dated May 9. A call was sent out for more labor, and during that day about 650 men filled, carried and applied sacks; while 20 wagons hauled brush from the woods. This cave was revetted in 24 hours. For the next few days we were occupied applying liberal revetment to check the advance of the cave toward Dike No. 4. Later on, as the river fell, Dike No. 4 was almost entirely undermined by the advance of the eddy, while the main gorge took the line of Dikes No. 3 and No. 2.



FIG. 10. CAVE IN MAIN LEVEE ACROSS HEAD OF DIKE NO. 3

Taken at photo-point 2. This point is now [illegible]

Work Behind the Levee—For the first few days of operation, the team force was engaged in "edging out" with a base lift, extending from the banquette slope over the mud and water after the sub-levee had been cut to drain the ground. This work was done by "side dumping" and rolling the large clods forward by hand. As this base was sufficiently widened for space to work them, additional teams were brought. The maximum team force was 70 wheel scrapers, with "snap" and plow teams.

After May 10, the fall in the flood water was so rapid that work was discontinued.

Summary of Result—The cross-section (Fig. 11) shows the nearest approach of the flood water to the temporary levee. Had the caving advanced 60 ft. farther and then stopped, this temporary levee would have been worth to the district, on a hasty estimate, about ten million dollars. It was determined at the beginning to hold the main levee at any cost. If this could be done, we would not have a break. If not, the result would be very doubtful. If the maximum stage of this flood had been sustained for several weeks longer, even more heroic measures would have been necessary, and the outcome would have been questionable.

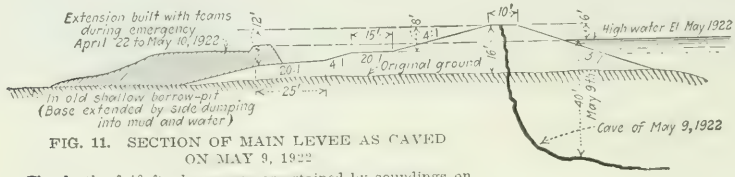


FIG. 11. SECTION OF MAIN LEVEE AS CAVED ON MAY 9, 1922

The depth of 40 ft. shown was ascertained by soundings on May 9. On the rear slope of the main levee is shown the emergency levee which was not brought into service.

In ten days we poured into "Devil's Hole" at least 100,000 sacks, between 500 and 800 wagon loads of brush, about 50 coils of ¾-in. and 250 coils of ½-in. rope. The cost of the work, not computed as yet, will probably exceed $50,000. The investment paid, at a conservative estimate, ten thousand per cent.

Before the next flood season, a new levee will doubtless be built a very safe distance back, and substantial pile dikes will be built to retard the current and stop the enlargement of the gorge.

W. L. Head, chief engineer, was in general charge of high water work in the Upper Yazoo district, while Major T. G. Dabney, consulting engineer, acted in an advisory capacity. The writer was in direct charge of the work at "Devil's Hole."

Forestry by Scranton Gas & Water Co.

A total of 985,000 trees, of which 505,000 are white pine, have been set out by the Scranton Gas & Water Co., of Scranton, Pa., in its work of reforesting its water-gathering ground. This fact was brought out by George R. Taylor, of the company named, in a paper read before the recent convention of the American Water Works Association. In conjunction with the Pennsylvania State Forestry Department, the water company has erected a steel fire tower in which the state maintains an observer. In addition, the company has a wood tower of its own. During the current year the Pennsylvania Forestry Department will send out 1,000,000 trees for planting. It expects to supply some 3,000,000 next year and 20,000,000 a year by 1925.

Court Denies Infringement of Warren Paving Patent

Fresno County, Cal., Is Victor in First Suit Involving the Wallace Claims—Appeal Likely

CLAIMS of infringement of the Wallace patent (No. 959,976) for bituminous pavement, with respect to both process and product, were denied Warren Bros. Co., of Boston, in a decision which Judge Benjamin F. Bledsoe, of the U. S. District Court, rendered May 29 at Los Angeles, Cal., in the case against Thompson Bros., contractors, and others, involving road construction in Fresno County, Cal., under specifications prepared by Chris P. Jensen, county surveyor. In the Fresno County work the lower course of the pavement was rolled prior to the application of the top course, while the Wallace patent provides specifically for the "bonding and blending" of the two courses with only a single rolling. (See article "The Status of the Warren Company's Pavement Patents," in *Engineering News-Record*, Dec. 15, 1921, p. 969). Supplementing the announcement of Fresno County's victory in last week's news section (p. 970) the full text of the Court's memorandum opinion is given below:

THE COURT'S OPINION

"In this case I have given very careful study to the numerous and rather lengthy briefs filed by respective counsel herein. So, also, I have endeavored to familiarize myself with the prior art involved in the paving business. The patent sued upon, No. 959,976, in view of the prior art and particularly in view of the prior art as exhibited by patent No. 727,505 granted May 5, 1903, is to be rather narrowly construed. In other words, within the limitations then existing there was not much left for the patentee to patent and this is peculiarly opposite in view of the specifications in patent No. 727,505 to the effect that the pavement therein provided for 'may be covered, if desired, with relatively thin surfacing of clear asphalt-cement or an asphalt or bituminous composition of any desired nature. In some instances there may be rolled into this thin surfacing while it is yet soft sufficient sand, gravel, or fine stone to prevent its displacement by traffic.'

"The first claim of plaintiff's patent being for a process, in the light of the specifications and in the light of the claim itself, must be read as a claim for a pavement consisting of an upper layer laid upon a lower layer without any intermediate compression of the lower layer. Obviously, this claim was not infringed by defendants' structure unless it may be said by the court that the laying of the upper layer of defendants' pavement after the preliminary rolling with the 12-ton roller, was merely the substantial equivalent of the laying of the pavement without any preliminary rolling of the first course at all. This, the court, from an inspection of the pavement laid no less than from a consideration of the process actually followed, cannot find to be the fact.

"The second claim of the plaintiff's patent is for a product. Read in the light of the specifications it is for a product laid in pursuance of the process indicated in the patent. I understand the law to be, however, that a product having definite characteristics by which it may be identified and which distinguish it from the process by which it was produced may be properly described by such characteristics, and when so claimed and described, the

claim will not be limited to the process specified. (Walker on Patents, Sec. 106.) Construed in the light of this principle, I am persuaded that the second claim is not to be limited by the precise process specified in the patent. It does, however, specify a product or pavement composed of two courses, the upper course disposed on the lower course and made up of finely divided mineral matter mixed with sufficient bituminous binding material to thoroughly coat all of the particles 'and blended with the coarse mixture at the top of the mass.' Construed in the light of the specifications, as the court should construe any claim of a patent, (Walker on Patents, Sec. 182) the requirement that the upper course shall be 'blended' with the lower course is to be read in the light of the specification that the two courses were to be laid one upon the other without any intermediate rolling. In truth and in fact, in this wise only could there be a composite, blended course.

"I am persuaded from a consideration of all of the facts involved, including an inspection of the pavement produced by the defendants, that the two courses of the pavement produced by them were and are not blended within the meaning of that term as used in plaintiff's patent. In my judgment, therefore, there is no infringement of plaintiff's patent shown by the product of defendants. The specifications employed by the defendants do not infringe the first claim of the patent for the reasons heretofore suggested.

"The real contention of plaintiff seems to be that its patent is infringed if an upper course of a pavement be laid upon a lower course of the same while the lower course is yet in a hot or plastic condition, irrespective of whether it is rolled intermediately or not. In view of the prior art I cannot conclude that plaintiff is entitled to have its patent thus construed, because the patent No. 727,505 issued to Warren in 1903 and which expired before defendants' structure was produced, as hereinbefore referred to, indicated the laying of a 'bituminous composition of any desired nature' upon an undercourse and the rolling into this 'while it is yet soft' of sand, gravel or fine stone. This contribution to the art, in my judgment, negatives now the broad claim which plaintiff seeks to have injected into his patent.

"The usual decree of dismissal will be entered."

Mr. Jensen's Comment

Engineering News-Record has received the following comment on the case from County Surveyor Jensen:

"This case is based upon as what is known as the Wallace patent, (No. 959,976). This contemplates the laying of an asphaltic concrete made up with a coarse aggregate and spreading the same to as uniform a surface as possible, without rolling; then the patent contemplates that a small amount of sheet asphalt mixture be spread over the coarse mixture; and then that the whole structure be given the only rolling to which it is subjected.

"In our observation of the product produced by this process we noticed that some considerable quantity of the coarse mixture from the lower layer was disturbed to such an extent as to protrude through the upper layer of sheet asphalt mixture. This, in effect, rendered the wearing surface pervious to moisture. In our observation and study of this pavement, we conceived the theory that a more impervious wearing surface would be produced if the coarse mixture was rolled prior to the application of the sheet-asphalt seal coat. We therefore revised our specification as to include this intermediate rolling. We also changed the mixing formula slightly from that of the Warren specifications.

"Our specification then, really, is nothing but the ordinary sheet asphalt pavement of proved use, except that instead of having a 2-in. or a 1½-in. sheet-asphalt wearing surface, we employ a surface only [illegible] in thick. The Judge has grasped the idea, as indicated by his reference to the old Warren patent, (No. 727,505) in which it is stated that a relatively thin surface of asphaltic mixture may be placed over the pavement.

"Fresno County has laid some [illegible] of pavement under our revised specifications and we contemplate the construction of 50 or 60 miles more. It is hard to predict what further effect the decision will have on local work. I anticipate that, under bond-issue work, advantage will be taken of this decision immediately, but under assessment district proceeding, I rather fear no change will be noticed until the decision has been affirmed by the Circuit Court of Appeals at San Francisco. The decree of dismissal will be written about the first of July. In view of the issue at stake we are expecting that the Warren company will appeal."

American Engineering Council Adopts Report on Registration

At the meeting of the Executive Board of the American Engineering Council of the Federated American Engineering Societies held in Pittsburgh on May 27, the following report by the committee on Registration of Engineers was adopted:

In considering matters of government as affecting the engineering profession of the United States, the ancient principle which states "that country is governed best which is governed least," has been accepted by your committee as representing ideal conditions, and it holds that in an ideal social organization, where man can be left free to follow the trend of his individual bent without resulting injury to his fellow, each should be free to follow such calling as he may adopt, without state interference or regulation.

Engineering in the United States under absolutely untrammeled conditions in the past, has developed effective skill and a high degree of constructive ability among its practitioners, during which period the provisions for safety have been adequate under average conditions, and the failures which may have occurred have not been rated serious enough to demand legal control. Within the past few years, however, a widely supported movement had appeared, resulting in the passage of laws, requiring licensing or registration of engineers in various states, and attempts at similar legislation in others.

It is, therefore, a condition and not a theory which is before the engineering profession for consideration, and the F. A. E. S. should decide whether it will lend the weight of its advice upon principle only or will accept and travel with tendencies.

The registration or licensing of engineers with consequent elimination from practice of all not registered, can be supported upon two grounds: (a) the benefit of the profession; (b) the good of the public. Your committee has grave doubts whether licensing can benefit the profession enough to justify the cost and annoyance of the proposed measure. Further, your committee holds it should be beneath the dignity of engineers to fence themselves against qualified competition by the artificial barrier of a statute.

Your committee, while recognizing that required registration might not have been recommended ab initio believe that the plan has now reached such development as to deserve consideration and possible direction by the F. A. E. S. (or A. E. C.).

(a) Your committee recommends to the A. E. C. (F. A. E. S.) an expression of opinion that such legislation may properly cover engineers and architects charged with responsibility for public works.

(b) Your committee is agreed that the reasons which justify the registration of engineers responsible for public works do not apply to mining engineers.

(c) Your committee is unable to agree as to the wisdom or unwisdom of registration of engineers engaged in other classes of work.

(d) Registration laws should provide reciprocity of registration admitting to practice engineers registered in other states and should further provide for the admission to practice of properly accredited engineers from states having no registration laws.

(e) Registration laws should provide for classified registration, that the certificate may indicate those branches of engineering in which the registrant is qualified to practice."

Field Check on Formulas for Earth Pressure

Thrust of Saturated Bank Measured by Deflections of Cofferdam Wales—Extent to Which Drainage Reduces Pressure

By H. S. Schick
Supt. U. S. Engineer Department, Wheeling, W. Va.

THE pressure on vertical steel sheetpiling under a 24 ft. dept of submerged bank was measured by observing the deflection of wale timbers in a cofferdam 41 ft. 7 in. wide x 180 ft. long during the construction of Ohio River Dam No. 23. The purpose of these measurements was to obtain information as to the intensity and distribution of the pressure exerted by a saturated bank against a vertical wall and especially to learn what reduction in pressure would result from drainage under the sheetpiles. Many investigations have been made of the pressure exerted by granular

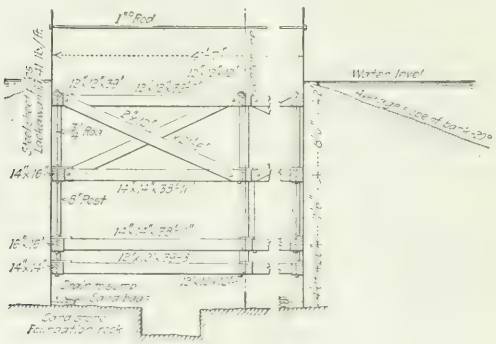


FIG. 1. CROSS SECTION OF COFFERDAM
This section, taken together with Fig. 2, shows type of cofferdam framing.

materials, and the design of retaining walls is usually based on such analyses, but very little information is available as to the pressure actually exerted by saturated material, although a wet bank is generally recognized as the final test of most retaining walls. Weep holes, or some form of subdrainage, are provided to relieve hydrostatic pressure but we have no means of knowing how effective they are.

The measurements at Dam No. 23 included field tests of two full sized wales, 12 x 12 in. and 14 x 14 in. to determine the modulus of elasticity of the timber used; the deflection of nearly all the wale timbers in the cofferdam was measured as soon as the cofferdam was

TABLE I—MODULUS OF ELASTICITY OF BOGALUSA PINE COFFERDAM WALES.

Test No.	Wt. Lb.	Defl. In.	E
12 in. x 12 in. 31.33 ft. free span; Symmetrical, Concentrated Loads, 2 ft. 2 in. From Center of Span			
1	380	0.106	2,230,000
2	760	0.205	2,280,000
3	1,140	0.306	2,320,000
4	1,520	0.403	2,350,000
5	1,900	0.513	2,310,000
6	2,280	0.669	2,120,000
7	1,900	0.531	2,230,000
8	1,520	0.436	2,170,000
9	1,140	0.334	2,130,000
10	760	0.213	2,230,000
11	380	0.106	2,240,000
Average for 12 in. x 12 in.			2,237,000
14 in. x 14 in. 29.25 ft. free span; Symmetrical, Concentrated Loads, 2 ft. 0½ in. From Center of Span			
1	380	0.0376	2,720,000
2	760	0.108	1,890,000
3	1,140	0.169	1,820,000
4	1,520	0.225	1,820,000
5	1,920	0.291	1,760,000
6	2,280	0.357	1,720,000
7	2,280	0.357	1,720,000
8	1,900	0.296	1,730,000
9	1,520	0.240	1,709,000
10	1,140	0.183	1,680,000
11	760	0.122	1,680,000
12	380	0.057	1,830,000
Average for 14 in. x 14 in.			1,839,000

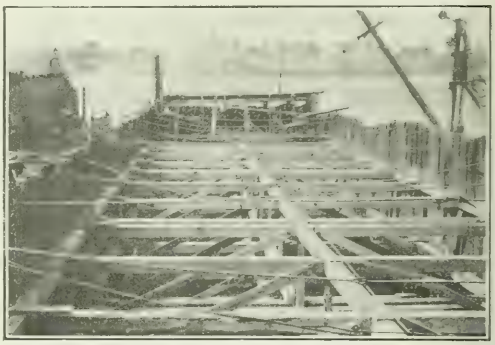


FIG. 2. VIEW LENGTHWISE OF COFFERDAM
Details of cross-bents are shown in Fig. 1. These were 13 ft. apart and the wales were continuous over four supports. The double transverse struts mark the ends of each wale timber.

unwatered; soundings were taken around the cofferdam to determine the slope of the submerged bank and samples of the material were measured and weighed both wet and dry.

The modulus of elasticity was determined in the material yard by measuring the center deflection of the timbers with approximately 30 ft. spans under known concentrated center loads varying from 380 to 2,280 lb. The deflections were measured by a simple device which showed readily variations of 0.001 in. The loads used were structural units all of which had been weighed. They were carefully placed one over the other near the center of the beam; readings were then taken just after each increment was applied until the total of 2,280 lb. was reached; this was allowed to rest about two hours and readings were then taken as each load was removed. The results of this test are shown in Table I. The values are considerably higher than those usually given in standard handbooks, but as standard tables give little information as to the probable limits of the values recorded and as the results of the test seemed reasonably consistent, a value of 2,000,000 lb. per square inch was used in the subsequent analysis.

The wales in the cofferdam were continuous over four supports and the alignment of the wales on their supports was good, but to have measured the deflection over the intermediate supports and to have measured that of the middle span would have greatly increased the labor required without any appreciable compensation in increased accuracy. The measurements, therefore, were confined to the end spans, between the end supports and the nearest points of contraflexure. The distance between supports was uniformly 13 ft. so the point of contraflexure was assumed to be uniformly 10.4 ft. from the end support and the deflection was measured 5.2 ft. from that support. Measurements were made with a gage by offsets from a fine thread nearly parallel to the wales. The observed deflections are shown in Table II together with the corresponding loads W, which, distributed over the 13 ft. span, would produce the observed deflection. The deflection at the points marked "?" were not measured because of obstructions in the cofferdam. As would be anticipated the measurements show considerable variation, but the differences can readily be accounted for by imperfect alignment of the wales. imperfect alignment of the sheet piles, varying pene-

tration and support in the rock foundation, and varying moduli of the elasticity of the timber.

Faulty alignment of the wales will account for much variation but errors arising therefrom will be compensating, so the average of a large number of observations should give a true value. Errors due to the alignment of the sheetpiles are of two kinds. Those due to poor horizontal alignment are compensating, for excessive deflections due to concentration of pressure at the center are offset by concentrations at or near the supports. This is not true, however, of errors in vertical alignment, because in order to facilitate lowering the wales before the pumps were set, the sheetpiles were driven, insofar as possible, so that they would stand

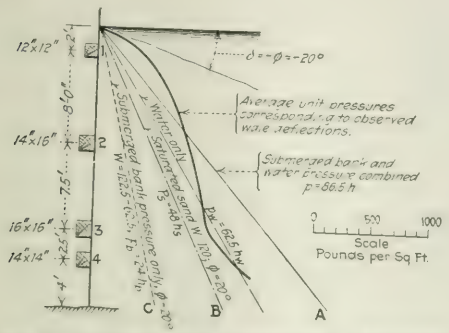


FIG. 3. OBSERVED AND THEORETICAL PRESSURES

The higher pressures at the level of the topmost wale are due in some measure to the piles having been driven with a slight batter so that they stood away from the lower wales before load was applied.

slightly off of the lower wale, thereby giving the piles a slight batter toward the inside of the cofferdam before driving. The result of this was a concentration of pressure on the top wale. In the table and in Fig. 3 this concentration is obvious. There is some tendency also to error caused by variation in the bearing on the rock. Wherever the piles stood off from the wales, the rock took an excessive share of the load, but where the piles did not penetrate the rock at all, it could take no horizontal reaction and the wale took an excessive share. To what extent errors result from variations in the moduli of elasticity it is impossible to tell definitely; the pieces selected were in every way representative of those in the cofferdam; they were of the same lot and had actually been used in another section so that they had been thoroughly water soaked as well, but because of the variability of the modulus of elasticity of timber there is some question whether the timber in the cofferdam was of the same elasticity as that measured on the bank. The results of the test, however, seem to show that there was little net error due to this cause, for if the saturation of the timber was sufficient to cause appreciable variation in the modulus of elasticity, those timbers which showed the most thorough saturation, those in the lowest two courses, Nos. 3 and 4, would have shown the largest proportional deflection. But the contrary is true. The upper timber was fairly dry when the measurements were made; yet it showed higher deflections than the lower timbers, which were always soaked. The fact that the total of the observed loads on the four wales is so nearly equal to the pressures determined by a reasonable application of the theory of earth pressure indicates little net error due to variation in elasticity.

In Fig. 3 is shown a comparison between the loads as measured by the deflections and the pressures determined by theoretical analysis. The pressure lines are so drawn that horizontal ordinates at any point show the pressure per square foot at that point to the indicated scale. The line *B* shows pressures derived from the general equation for earth pressures taking ϕ at 20 deg. and *W* at 120 lb. per cubic foot. This line is shown because many retaining walls subject to saturation of backfill have been designed on that basis. The line *C* shows pressures computed on the same basis except that *W* is the actual weight of the saturated material diminished by the weight of a cubic foot of water. That is, 122.5 — 62.5, or 60 lb. per cubic foot was taken as the submerged weight of the material. The line *A* shows the combined hydrostatic pressure and submerged bank pressure as shown by *C*. The corresponding equation, $p = 86.5h$, therefore, represents the horizontal component of the total saturated bank pressure with the water level at the top of the bank.

The reduction in pressure due to the drainage under the sheetpiles was about 16 per cent of the total theoretical pressure. The total observed pressure on the four wales in one panel was 235,080 lb., while the total theoretical pressure corresponding to this was 279,480 lb. leaving 44,400 lb. reduction to be accounted for by drainage under the piles. This drainage was considerable, requiring under the given conditions the service of two 10-in. centrifugal pumps to keep the cofferdam dry. A reduction of 16 per cent, therefore, is as much as can be hoped for with such drainage. This, of course, takes no account of the differences in the reaction of the rock. If it were assumed that the rock actually carried no horizontal load whatever it could be made to appear that the reduction amounted to 25 per cent, but although there was no opportunity to measure the reaction of the rock directly, it is known that this was considerable for at one place it was sufficient to shear off a 3-in. layer of rock between sheetpile and key.

The above observations seem to justify the conclusion that steel sheetpile cofferdams offer favorable opportunities to study the intensity of earth pressures. The values here derived may be applied directly only to similar cases of continued complete saturation but the relatively small reduction in pressure due to drainage is of special significance.

TABLE II—DEFLECTION OF COFFERDAM WALES

Wales were 39 ft. long and were continuous over [illegible] spans of 13 ft. Deflections of each end span between the [illegible] point of contraflexure, only were measured. [illegible] spans 14 ft. 6 in. long. Deflections in each [illegible] spreading load in pounds on full span of 13 ft.

Wales	No. 1	12x12	No. 2.	14x16	No. 3.	16x16	No. 4.	14x14
Panels	D	W	D	W	D	W	D	W
B	0.175	29,800	0.135	63,600	0.17	[illegible]	0.245	[illegible]
D	0.120	20,400	0.48	226,000	0.14	75,700	0.14	44,100
F	0.23	39,100	0.00	0	0.195	73,100	0.175	53,500
G	0.19	32,300	0.08	37,700	0.00	0	0.115	34,600
H	0.055	9,350	0.14	66,000	0.00	0	0.25	[illegible]
K	0.28	47,700	0.19	89,500	[illegible]	[illegible]	[illegible]	[illegible]
L	0.16	27,200	0.17	80,000	0.29	157,100	[illegible]	[illegible]
M	0.14	23,800	0.09	42,400	[illegible]	16,230	[illegible]	0
B'	?	?	?	?	[illegible]	[illegible]	0.22	69,300
D'	0.29	49,300	0.185	84,800	[illegible]	18,950	[illegible]	44,100
E'	0.20	34,000	0.21	99,000	[illegible]	[illegible]	[illegible]	72,400
G'	0.22	37,400	?	?	[illegible]	[illegible]	[illegible]	[illegible]
H'	0.15	25,500	0.23	108,000	0.28	[illegible]	0.22	69,300
K'	0.125	21,200	0.21	98,900	[illegible]	[illegible]	[illegible]	[illegible]
L'	0.155	26,400	0.16	75,400	0.145	[illegible]	[illegible]	[illegible]
M'	0.24	40,800	0.36	170,000	[illegible]	0	0.165	[illegible]
Totals		30,950		88,660		[illegible]		47,450
Theoretical Values	A	13,980		96,500		[illegible]		[illegible]
	B	7,750		53,500		58,660		[illegible]

The theoretical values A and B were computed [illegible] A and B given under Fig. 2.

Solving the Problems of the Portland Cement Industry

What the Portland Cement Association Is Doing To Improve Cement and Its Ultimate Product, Concrete

By F. W. Kelley
Chairman, Committee on Technical Problems, Portland Cement Association

Some editorial remarks in "Engineering News-Record," notably in the article "Concrete—Past and Future" in the issue of Jan. 5, 1922, have been construed as giving the impression that the cement manufacturers are not carrying on sufficient research work to insure an increasingly better quality of cement and concrete. In defense of the manufacturers, Mr. Kelley has prepared the following statement of the philosophy and purpose underlying the work of the Portland Cement Association, in which is centralized the research and promotion activities of the industry.—Editor.

It is now almost one hundred years since portland cement was invented. It is now manufactured in almost every country in the world. It is made from a great variety of materials, all of which, however, contain the essential ingredients of lime, silica, and alumina, combined invariably with other ingredients, such as magnesia and iron, and smaller quantities of rarer elements.

The methods, processes, and machinery for handling these diverse raw materials and converting them into a product which can be relied upon to give substantially similar results when used in concrete, are as diverse as are the materials. No two cement manufacturing plants are alike, although as the result of experience and through the establishment of standards, it has been found possible to reach by an almost infinite variety of means, a substantially uniform end.

Specifications—In every country, largely as a result of practical experience, there have grown up specifications which in general place a maximum limit upon the quantities of non-essential materials which may be present, and prescribe certain minimum physical requirements for the product, in order that it may be deemed satisfactory as an article of commerce, and be relied upon to give results consistent with those of past experience.

The specifications for cement in the United States are now a uniform standard, known as Specification No. 1 American Engineering Standards Committee, adopted by the United States government departments, by substantially all of the engineering societies, and are guaranteed by cement manufacturers.

The manufacture of portland cement calls for very large capital investment; the capital turnover is less than once yearly; and the power consumption per unit of output is enormous when compared with other industries. By reason of its heavy shipping weight, it is peculiarly essential that its manufacture be conducted as close as possible to the point of use, and it is only because its manufacture has been successfully accomplished throughout all parts of this country, that this convenient building material has been made everywhere available to the user at a per pound price which has been less than that of most manufactured materials of commerce, and comparable with partially treated natural products, like common salt.

Object of the Association—Portland cement when completely manufactured and ready for the consumer is, in its relation of usefulness to the community, a means and not an end. Its useful end is that of an essential ingredient in making concrete. Concrete is a mixture of cement and water, generally combined with aggregates. Concrete may be made by anyone possessing cement, water and aggregates. Good concrete may be obtained only by properly selecting these materials, proportioning them rightly, mixing them by suitable methods and for the right length of time, placing them in suitable forms and under appropriate conditions, and protecting and curing them adequately and properly.

The very ease with which the materials may be handled leads to their use. Any one of the active adult population of the United States is a possible user of cement, and the problem facing the manufacturer of the product is not so much that of urging people to use cement, as to use it right. This object has been basic in the organization and development of the Portland Cement Association, and in the work of its several service departments.

A few years' experience in this co-operative service work indicated that so-called practical experience in the use of cement in making concrete was an insufficient basis for development. In almost every case, materials and conditions varied, even laboratory investigations had been generally conducted in such a way that more than one variable had been left uncontrolled. The results of laboratory tests made in different places were frequently inconsistent, and sometimes misleading. The need for further study and a sound determination of fundamentals grew constantly more apparent. Only a determination of the effect of a variation in each of the essential materials and conditions involved in the making of concrete, could give us sound knowledge.

Research Laboratory—With this idea in mind, after a number of years' study and consideration of the matter, in December, 1914, a comprehensive report was presented to the Portland Cement Association covering scope and details of a research laboratory, based upon such information as could be obtained from laboratories undertaking somewhat similar work. This report resulted early in 1916 in the arrangement between the Lewis Institute in Chicago and the Portland Cement Association, under which they jointly established and agreed to operate the Structural Materials Research Laboratory under Prof. D. A. Abrams. Much important research work in concrete had already been done in the laboratory, and this was continued and enlarged in scope; the physical equipment increased and improved and the operating staff enlarged.

The appropriations of the association for research work which were $3,150 in 1914 increased to $20,000 in 1916 and to $81,000 in 1921, there being a gradual development, enlargement, and improvement in the work. These are laboratory expenses only, and are in addition to the much larger sums required for co-ordination with field work and for providing the necessary service to the public.

The report of the laboratory in 1919 showed that important information had been gained on—(1) How to make concrete tests; (2) Effect of size and grading of aggregates; (3) Effect of quantity of water; (4) Effect of quantity of cement; (5) Effect of fineness of cement; (6) Effect on wear of materials, proportion and manipulation; (7) Effect of organic impurities; (8)

Effect of powdered admixtures, and (9) Effect of time of mixing.

The effect of the work of this laboratory on the knowledge and practice of making concrete is now pretty well recognized by engineers. No claims for originality are made for this work, except that the conditions under which it has been carried on have permitted a character of control, a completeness, a comprehensiveness, and a relatedness of tests which have given definite indications and established definite relations which heretofore have been open to question. It has had a profound effect not only in increasing the quality of concrete, but in decreasing its cost.

Economic Bearing—From time to time questions have arisen as to certain inherent features of a given cement which affect its quality. For instance, there was a time when increased fineness of grinding of cement was advocated as a means of improvement. Most careful researches were made into this phase of the subject, and it was established that an increase of strength of about 1 per cent resulted from each 1 per cent increase in fineness. It was also found that 1 per cent increase in strength resulted from the use of 1 per cent more standard cement and that the increased strength gained by the use of more standard cement cost much less than when gained by using finer ground cement. The reason for this is quite evident when it is realized that the present cement of commerce is ground to within about 10 per cent of the practical ultimate fineness, and that the decrease in output of grinding mills and the increased cost of grinding grow rapidly greater as we increase the fineness toward this ultimate. All such questions have an economic bearing and while increased fineness is recognized as an ultimate refinement, there appear to be other matters pertaining to its use, requiring more immediate attention.

The experiments show that a variation of over 100 per cent frequently results in strength of concrete from variation in the quantity of mixing water used, while variations of almost equal importance follow changes in the quality and proportion of the aggregates, in the time and manner of mixing, and in methods of placing, handling, protecting, etc.

It must appear evident that the additional cost of grinding at extreme limits is so great that it will only be justified as an extreme refinement in cement making, after the practice of using cement in concrete has been brought to a point where the effect of such refinement will be secured in the quality of concrete.

Constitution of Cement.—Questions have also arisen as to the effect of variations in the chemical constituents of the cement. These relations are so complex that notwithstanding some fifty years of research on this problem which is capable in many of its aspects, of attack by individual chemists and experimenters, there is still much which is the subject of controversy and offers a field for a vast amount of research work.

While interesting, much of the information to be gained by such investigations must remain academic, although it must be recognized as offering possibilities for better knowledge of the material and its improvement, and its pursuit continued parallel with the more practical aspects of the subject. Portland cement to be useful must be relatively cheap, and this means ability to produce from essential materials, existing in combination with other non-essential materials, in as widely distributed locations as possible. It seems probable then that the most immediately useful research in this aspect of the problem will be the study of how portland cement, having the necessary characteristics of strength and permanence when used in concrete, may he made from as widely diverse materials as possible.

Improvements in Manufacture—Because this problem is to a large extent individual, it has heretofore been studied chiefly by individual manufacturers as applied to their individual operations. Most manufacturers while perhaps not knowing fully all and each of the complex chemical reactions and combinations which take place, yet generally understand the proportions and methods which will result in making from their particular materials a product which measures up to the standards developed by experience and research, and tested by time. The advancement and improvement in methods and processes to secure uniformity, as well as quality of product, have been steady and marked.

The process of manufacture is an exact chemical-mechanical one in which conditions must be maintained within narrow limits and with large quantities of materials.

Each plant must and does work out the best methods for handling efficiently its particular raw materials so that they may be supplied in a continuous stream of uniform and proper chemical proportions and in suitable physical condition, to furnaces in which uniform white heat temperatures must be maintained, so that the resulting clinker, of a hardness after cooling, capable of scratching glass, may by gradual reduction be brought to a fineness of at least 78 per cent through a sieve having 40,000 meshes per square inch, and exceed all the other rigid requirements of the standard cement specifications.

A considerable amount of difference of opinion in many matters relating to cement and concrete has existed because the nature of the problems presented made extremely difficult the application of methods of precision.

Public Service—In order to make effective and readily available to the cement using public, the results of the work of the Structural Materials Research Laboratory as well as to put that laboratory into practical touch with the problems of the cement user, which is necessary if laboratory work is to avoid becoming academic, there have been established by the Portland Cement Association twenty-four district offices, placed conveniently accessible to consuming centers, each in charge of a qualified district engineer supplied with a suitable trained engineering organization.

The keynote of association work has been service based upon the facts provided freely to all.

The manufacturers of portland cement found themselves making a product which was apparently simple and easy for anyone to use, and which because of its flexibility, convenience and merit was being widely adopted. Given the most perfect cement which could be made, this very convenience and ease, where not coupled with the necessary skill and knowledge, brought results which were unsatisfactory and sometimes even dangerous. The industry therefore addressed itself to the problem of directing the attention of all users to the necessity of learning how to use cement, and making readily and conveniently available, the necessary information to all inquiries. To do this required the dis-

tion of attention to the product itself, its manifold uses, as well as its frequent abuse, and provision for the necessary organization to reach the widely distributed people in this entire country.

Attention has been directed toward those factors of concrete making in which there was the greatest need and opportunity for improvement, just as attention has been brought particularly to those forms of construction for which there existed the greatest need, and for which the material offered the greatest economic advantage.

Future Developments—As the work develops in its different lines, it is expected that it will cover all phases of the subject in greater detail, and it is hoped that the practice of concrete making will become so well understood and so perfectly carried out that further refinements will be possible in all its elements, not excluding cement. Cement is, however, probably nearer its ultimate possibilities as now apprehended than are any other elements of concrete making, but no man could today, in view of the constant advances of knowledge, say what are its ultimate possibilities.

The very existence of the cement industry and each individual manufacturer depends upon providing cement which is of high quality and suited to the conditions existing.

The average quality of concrete is improving. The knowledge of cement and cement making is improving. If the art of concrete making reaches a point where any change in portland cement is an economic advantage, if it is possible to provide such cement, it will of necessity be offered by the manufacturers.

The end sought is better and more concrete, and wider demand for portland cement by satisfied users. In this way only can the industry build soundly for the future and justify its slogan "Concrete for Permanence."

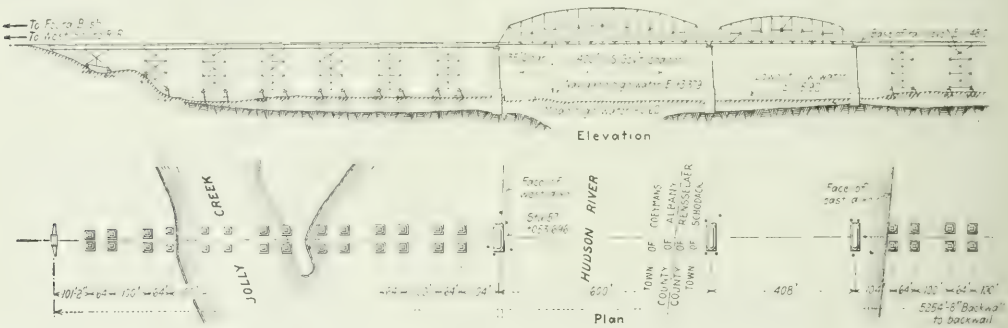
Automobiles in France

In France, according to information sent to the Department of Commerce from Paris by J. F. Butler, assistant commercial attaché, there are 202,500 automobiles, or one car to every 205 persons, as compared with 10,500,000 automobiles in the United States, or one to every 11 persons. Owing to the high initial cost and the great expense of upkeep, the ownership of even the lowest-priced automobile is beyond the means of the great mass of French people. A popular low-priced automobile of French make costs about 14,000 francs.

Castleton Bridge Contracts Let

Long-Deferred Railway Cutoff Crossing Over Hudson River Taken in Hand—River Spans 600 and 400 Feet

AFTER a postponement of nearly ten years since the beginning of the project, the New York Central R.R. has let contracts for the construction of the bypass or cutoff line around Albany and Schenectady which includes the much discussed high-level bridge across the Hudson River at Castleton, N. Y. Difficulties of financing due to the war followed a period of opposition by Albany and New York State interests, who by state legislation and lawsuits endeavored to compel the construction of a single-span structure more than 1,100 ft. long between main piers. An outline of some factors in the bridge controversy will be found in *Engineering News-Record* of May 30, 1918, p. 1033, while the railway project as a whole was fully outlined in *Engineering Record* of Feb. 24, 1917, p. 312. The project as described in the last mentioned reference has now been taken in hand actively. Contracts for the construction of the 12-mile railway connection have been let to the Walsh Construction Co., of Syracuse, N. Y., whose work will include building the piers and abutments for the bridge. The superstructure of the bridge will be furnished and erected by the McClintic-Marshall Co. of Pittsburgh.



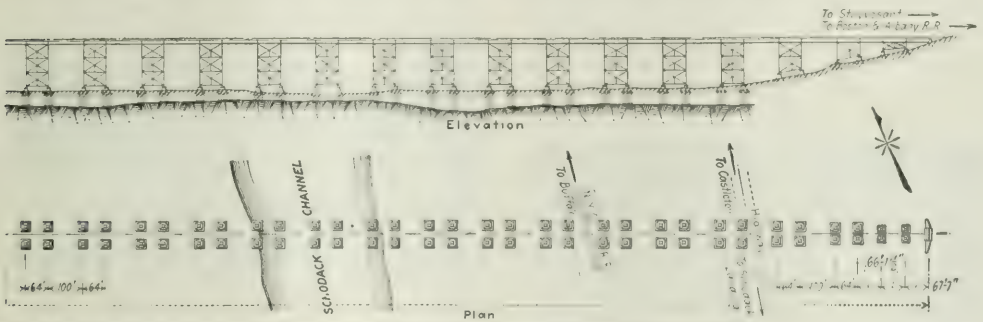
CASTLETON CROSSING, SECOND BRIDGE OVER THE HUDSON RIVER BELOW ALBANY, WILL

Briefly outlined, the cutoff will connect the New York Central lines on the east bank of the Hudson at a point about 10 miles below Albany with the main line of the West Shore R.R. (a New York Central property) west of the Hudson, and by way of the latter line will pass to the south of Schenectady, reaching the main line of the New York Central proper by means of connections located near Schenectady. By this means both Boston and (ultimately) New York through freight traffic will avoid the heavy grades and congested yard trackage between Albany and Schenectady, where the grades are 1.63 and 0.75 per cent against westbound and eastbound traffic respectively; the ruling grades of the Castleton cutoff will be 0.35 and 0.60 per cent respectively. In addition, several miles of distance will be saved. The cutoff makes connection with the present Boston & Albany line at Post Road, 4½ miles east of the Hudson River, and with the West Shore R.R. at Feura Bush about 7 miles west of the Hudson.

The finally adopted plan for the bridge follows closely the railroad company's original sketch design for the

crossing. This part of the line is shown in the accompanying drawing. The river is crossed by a channel span of 601 ft. 6 in. center to center of piers, and a side span of 409 ft. 2 in., both simple truss spans. Long viaducts on either end make connection with the high ground. The total length of the structure between abutment backwalls is almost exactly a mile (5,354 ft. 8 in.). The clearance height of the river spans is 135 ft. above high water, and the track grade across the entire structure is level.

Some General Design Problems—Because of the magnitude of the structure, well represented by the figure of 23,000 tons for the steel weight of the superstructure as contracted for, questions of economy and permanence of service assumed special importance. The demand of Albany interests for a clear span between dikes, for example, would have brought the total



HAVE 600 AND 400-FT. RIVER SPANS FLANKED BY LONG STEEL APPROACH VIADUCTS

weight of the structure up to 41,300 tons, only a little less than double the weight of the structure as it is being built; this figure was computed for a cantilever of 1,130-ft. main span and 1,748 ft. total length, together with the necessary approach viaducts.

For the viaduct portions, both concrete and steel construction were investigated by detail designs. Under price conditions existing some years ago a reinforced-concrete viaduct compared favorably with a steel design, but under present conditions a steel viaduct is most economical. The height of this viaduct dictated the use of the longest practicable spans, so that 64-ft. tower spans and 100-ft. intermediate spans were decided upon. Each pair of spans will form an independent unit with respect to stability and expansion. Where the pedestals for the viaduct towers are in the valley bottom they are to be founded on piles to rock, which is 30 to 50 ft. below the surface, but the piers on the slopes will have direct soil footings.

The viaduct superstructure consists of four lines of deck plate girder, carrying a ballast floor on reinforced-concrete floor slab. The main objective in the adoption of the solid floor was protection of the steelwork from brine drippings. It was believed specially important in the case of this particular structure to minimize all abnormal corrosive influences, in view of the difficulty of repair or replacement of steel height above ground and with the span lengths used. With the adoption of a solid floor, ballasting for the track followed as a matter of course.

For the two long truss spans [illegible] floor construction was considered to involve too great an increase in dead weight. An open floor of ties resting directly on the stringers will be used here. The main truss members are not exposed to corrosion from brine drip, and repair of damaged floor parts is practicable.

Curved-chord trusses with subdivided web system have been adopted for these spans. The panel length is about 33 ft. Full riveted construction will be used.

Main Piers—For the main piers, stone facing and concrete core will be used in the shafts, and these will rest on pneumatic caisson foundations. Transverse reinforcement in the concrete is provided by the plans, and at intervals of several courses the face stones will be tied in by anchor rods extending from face to face course through the concrete core.

Designs for the bridge have been worked out by H. T. Welty, engineer of structures, New York Central R.R., with advisory assistance of Olaf Hoff, consulting engineer. G. L. Taylor, chief engineer, McClintic-Marshall Co., is directing the detail design for the fabricators.

California Citizens May See City Records

The Supreme Court of California has decided that practically all municipal records in that state must be open to reasonable public inspection. (*California Decisions*, Dec. 20, 1921, p. 630.) The decision was made on appeal by both parties from a lower court decision in two suits brought originally by the San Francisco Bureau of Municipal Research and by its secretary as a taxpayer, on account of having been refused access by the city engineer of San Francisco to certain engineering data relating to the Hetch Hetchy dam and water-supply project. The trial court granted a mandate to see the records. The district court of appeals upheld this decision except as to "working papers" not formally approved by the city engineer and also data turned over by the city engineer to the city attorney for his information in connection with litigation. Both parties to the suit appealed. The Supreme Court held that although the unapproved data are not "public records" in the meaning of the California statute they are "other matters" to which the public has right of access. The court also held that such "other matters" were open to citizens even if the city engineer had communicated them to the city attorney; also that the privileged or confidential character of any such communications is lost when, as in a case in point, the city engineer had already let them be examined by others—the Civic League of Improvement Clubs.

Analysis of Economic Conditions in Soviet Russia

Department of Commerce Indicates Obstacles to Recovery—Trade Awaits Investment of Foreign Capital

Although not a matter of strictly technical interest the following statement by the United States Department of Commerce on Russian trade conditions is so illuminating a statement of fact and so incisive an analysis of the economic principles involved that we present it in full for the information of the engineering profession and the construction industries.—EDITOR.

THERE seems to be some misunderstanding as to the practical character of trade agreements made with Russia by foreign governments. There is nothing in the trade treaties between Russia and England, Germany, Italy, or other countries, which permits or establishes trade with private individuals in Russia. In substance, all that the treaties really provide is authority for the Russian government itself to establish buying agencies in the several countries. To be sure, these treaties nominally permitted citizens of the countries making them, under certain restrictions, to enter Russia, but when they arrived there, they found that trade was a government monopoly, that they could not sell to private concerns, and that, in fact, the Government usually referred them back to its buying agencies in their own countries.

In view of the fact that the total present imports of Soviet Russia are small, the interest of foreign concerns in selling goods there would necessarily lie chiefly in the hope of laying foundations for the future. No such hope can be entertained so long as the Soviet government monopolizes import trade. Under that practice there can be no establishment of business connections, no building up of trade reputation. Within the past few months, co-operative institutions, which had been converted into purely government organs, have been restored to some measure of independence, and have been given limited rights to engage in foreign trade at the same offices as the Soviet government. Still more recently importation of some agricultural implements has been permitted to private Russian individuals. The great bulk of foreign trade, however, remains in the hands of government organs.

Uniformed persons often speak of the so-called blockade maintained against Russia. As a matter of fact, for two years time now no such blockade has existed. The real blockade on trade, not only with us, but with all the world, is that maintained by the Soviet government itself. By its monopoly of commerce, it has hampered the export even of the small quantities of goods which were available and has discouraged the production of more goods. Our government puts no obstacles whatever upon selling to Russia. One result has been that even in countries having trade agreements no merchants have been able to establish themselves in Russia or to undertake manufacturing enterprises.

The trade of Russia today consists of importing goods and paying out gold from the old Imperial reserve. She can not pay for commodities by commodities. The magnitude of these gold-bought imports has been much less than many seem to suppose. According to official Soviet statistics, the 1921 imports were valued at 248 million gold rubles, or approximately $125,000,000. This is only one-sixth of the prewar imports. Exports amounted to the sum of $10,000,000 (20,283,000 gold rubles); in 1913 they were 75 times as great. These exports consisted largely, and probably chiefly, of commodities left over from the pre-Bolshevik regime. The difficulty of exchange of commodities is evident from the fact that before the war, two-thirds of Russia's exports in value were foodstuffs, while today the country is in the throes of a terriffic famine and a large part of its imports are foodstuffs. In February, two-thirds, in weight, (values not yet available), of Russian imports were foodstuffs, the larger part of which were furnished by the charity of the American people.

There is little prospect that Russia will have any more to export in 1922 than she had in 1921. Meantime, the gold reserve is approaching exhaustion and with it is disappearing what might have furnished a start toward reëstablishing a workable currency. The paper money of Russia is hastening to the ultimate catastrophe of utter unacceptability within the country itself. The recent attempt of the Bolshevik leaders to restore something resembling individualistic methods in the conduct of industry, and particularly by payment of wages in money instead of a communistic division of commodities in the form of rations to the workers, has itself hastened the currency debacle. There being a fundamental shortage of foodstuffs and other necessaries, wages paid in money naturally can not buy enough to support life. Prices soar and though wages are multiplied by constant emissions they can not catch up with "galloping prices," as a leading Bolshevik journal calls them. Prices in Moscow now are doubling every month, which means multiplying 4,000 times in a year. A day's ration of food cost, in April, a million rubles. The time must apparently come soon when paper money will no longer buy. Then, in the absence of precious metals, all business will have to be done by barter—a method so cumbersome that it will almost inevitably check the increase of production which might otherwise be hoped to follow from the so-called "new economic policy."

As a matter of fact, despite the absence of a trade agreement, our exports to Russia compare very favorably with those of our two principal competitors—Great Britain and Germany. For example, in 1913, British exports to the Russian empire amounted to $135,000,000; in 1921, to $33,500,000, or only one-fourth as much. The United States never had a large share in Russian trade before the war. Our exports to that country in 1913 were $27,000,000. In 1921 they were over two-thirds as much—$19,257,000, and most of this represented sale of goods, though a part consisted of relief supplies, which during the present year 1922, have become much larger. A considerable fraction of British shipments to Soviet Russia last year consisted of reexported foodstuffs, and these, if they did not come directly from the United States, virtually created a demand for the equivalent quantity from this country. The British have been grievously disappointed in the results of their trade treaty. Much had been made of the enormous needs of the huge Russian population so long deprived of goods. It was forgotten that need for goods does not constitute demand for goods. Demand implies ability to produce and pay.

The really important problem confronting American business men with respect to Russia is not that of trade but that of investment. Without a large investment of foreign capital as a means of restoring production, the prospects are that, at least for some years to come, there will be even less opportunity to sell goods to Russia than in 1921, for with the exhaustion of the gold reserves, her means of payment will shrink to a minimum. The feasibility of investing capital in Russia depends essentially on the policy of the Bolshevik government and on the general internal situation, and not upon action of foreign governments.

Concrete Ships in England

The London *Times* notes that the fleet of 1,000-ton sea-going barges and steam-tugs, built in concrete for the Ministry of Shipping during the last stages of the war, has been purchased by a shipping firm whose intention is to employ the vessels for the transport of coal from Newcastle to London. In spite of the structural success of concrete ships and the thoroughly satisfactory record of the "Armistice," the only British-built concrete cargo steamship, the concrete shipbuilding industry seems to be extinct in Great Britain, according to the *Times*. The cost of construction under government auspices was far too high, the numerous yards established have been closed down on terms satisfactory to their former owners, and most of the firms concerned have reverted to their original occupation of public works contracting.

Public Roads Bureau to Expand Research Program

A COMPREHENSIVE program of road-building research during the coming season at the Arlington Experimental Station near Washington, D. C., is announced by the U. S. Bureau of Public Roads. Impact tests on pavements, subgrade studies and other experiments conducted last year will be continued and new investigations will be started.

Bituminous wearing surfaces are to be investigated to determine the reason for the formation of waves, proper mixture and the proper mineral aggregates. More than 30 sections of different types of bituminous construction will be built on a circular track about 600 ft. in circumference, the roadway being 13 ft. wide,



COMPLETED BASE FOR TEST OF BITUMINOUS SURFACES
The rails mounted on the small concrete piers are to be used to guide the truck automatically.

On this roadway a 5-ton army truck, with solid tires, will be operated in a varying path so as to cover practically the entire width of the roadway and will travel at a speed of from 12 to 15 miles an hour for five or six months, or until some results are obtained leading to the solution of the problems involved.

Resistance to Wear—At present the selection of concrete aggregates for the greatest amount of resistance to wear is based on wear tests made in the laboratory, upon the compressive strength of concrete, and upon the structural strength of concrete beams constructed and broken in the laboratory. The comparison of the wear of concrete in actual use on road surfaces with the indications obtained in laboratory experiments is not wholly satisfactory.

To throw more light on this subject a wear test is to be made with the conditions approximating those actually found on the road. This test will include about 65 sections of concrete wearing surface to be constructed on a circular runway about 650 ft. in circumference, the runway being 4 ft. wide. On this runway will be operated a specially constructed car with two truck wheels equipped with solid-rubber tires and loaded to represent a truck. The car will be guided by small railroad rails to hold it in position, the power being applied by means of an electric motor to the rear wheel. This apparatus will be operated around the circular runway at a speed of probably 20 miles an hour. The test will involve the use of truck wheels equipped with different kinds of tires and will include the use of non-skid chains. A steel-tired wheel will probably also be used to get the effect of an accelerated wear test. This test will be in operation continuously.

Impact on Roads Studied—The effect of impact on concrete pavements and several types of road on concrete base was studied and reported on last year; this series of experiments is to be continued and enlarged. Over 120 road slabs have been constructed in duplicate series. One series is on a carefully drained dry subgrade; the other series is on the same kind of subgrade except that it is kept wet and as nearly saturated as possible by means of an underlying drain tile and side ditches filled with water.

The testing of these slabs will be by means of a new impact machine which simulates the action of the rear wheel of a truck. On this machine may be mounted truck wheels of different sizes and weights carrying different kinds of truck tires. The slabs will be hammered by means of this machine in the center, on the corners and on the sides, so as to obtain the relative strength under these different conditions.

Subsoil investigations are being continued for the purpose of studying and investigating relative stability, moisture condition, and supporting value. Different methods of determining the bearing value of soils are



CONCRETE SLABS FOR IMPACT TESTS
The cylinders are for compression tests being cured under the same conditions as the slabs.

also being studied, that is, as to whether small or large areas should be used in determining the relative bearing value.

The warping effect of temperature and moisture conditions on concrete pavements is also being investigated. Temperatures and movement are being recorded graphically on continuous charts. In addition the pressures on the subgrade under the concrete slab are obtained by means of soil pressure cells. This investigation, which has been under way for some time and will continue probably for a year or more, will give definite information concerning the support offered by subgrades to rigid concrete roads.

The transmission of loads through different types of pavements to the subgrade is being investigated by means of soil-pressure cells placed on the subgrade under the pavements. This test will also serve to show the relative support offered to brick and other types of block pavement by concrete bases and broken-stone bases. This investigation has been under way for about one year and will continue.

It is intended to have all these projects in full operation by the middle of June. Visitors are always welcome and those in charge of the work are always glad to give any information desired about the experiments.

Papers and Discussions on City Planning

Abstracts of the More Important Proceedings of the National Conference on City Planning at Springfield, Mass., June 5-7

Fundamentals of Transit Planning For Cities

By Daniel L. Turner
Consulting Engineer to the Transit Commission of New York City

FROM a transit standpoint, our cities are planned today very nearly as they were planned 100 years ago, when people were living in a man-and-horse civilization. If a street system in a small town to properly function as a circulating and distributing medium must practically traverse the town in all directions in a lattice-like fashion, how much more necessary is it for the street railway system. When street railway transit superseded foot transit then the street railway system rather than the street system should have been accepted as the principal circulating medium of the town, and the town should have been planned and constructed accordingly. But this was never done, and is not being done even now.

When Transit Facilities Should Be Provided—City transit should precede the population—not follow the population. This is the fundamental basis of a proper transit development. The principle cannot be emphasized too strongly. Only by utilizing this principle as the guiding policy of future transit development can the existing transit conditions in our cities be cured. This principle of transit development is the reverse of that followed under private ownership and private operation. Expressed in another way, the principle means providing transit service for the whole city area —not for the traffic immediately in sight—not for profits primarily.

Providing transit in advance of the population means that when it becomes necessary to open up a new area for the growing population, the transit system and the street system should spread out over the new territory simultaneously; the two systems should expand together. Then the other services, such as water, sewers and light, can follow.

Convenience of Access—It may be assumed that a city will be conveniently served if a prospective passenger is not required to walk more than a quarter of a mile—or walk longer than five minutes to reach a surface line, either a motor-bus line or a street railway line, routing towards the business center, which is the objective point for most of the traffic. This means that the lines would be about a half a mile apart in the residential districts. For crosstown service, lines one mile apart will conveniently serve the community.

In the case of subway or elevated lines, that is rapid transit lines, if the lines routing to and from the center are one mile apart, and the crosstown lines are two miles apart, convenient rapid transit service will be afforded the community; every one could reach a rapid transit line within a 10-minute walk. The surface lines and the rapid transit lines would route closer together than described above as they approach the business center, to the extent of traversing every street in extreme cases.

Routes—A study of most of the larger cities indicates that they conform closely to the semi-circular shape and can be included within a 6-mile radius. For this reason an analysis of the route mileage standard can be based on the theoretically semi-circular city. Such a semi-circular city of one mile radius contains an area of approximately 1,000 acres, and the area increases as the square of the radius; so, squaring the radius in miles and multiplying by 1,000 will produce the approximate acreage of any semi-circular city.

Upon this basis, it would require approximately one mile of motor-bus or street railway line, or route, for every 200 acres of city area. In the case of a single track, with the average sidings, this would reduce to one mile of single track for every 180 acres; or in the case of a double-track line (neglecting yards, etc.), one mile of track for every 100 acres. Usually the acreage served by one mile of track should be between these limits.

For rapid transit lines the corresponding standards are: One mile of rapid transit route for every 400 acres of city area; and one mile of rapid transit track for every 200 acres of city area, assuming a two-track line.

For motor-bus lines and surface car lines approximately the number of routes can be obtained by extracting the square root of the city acreage and dividing by 6.3. For rapid transit lines, the square root of the city acreage divided by 12.6 will give the number of routes approximately.

The routes should be distributed throughout the city so as to furnish the same character of service to all sections. The up-and-downtown routes should be as direct as possible. Their function is to provide quick transportation between home and work. As far as practicable, up-and-downtown routes serving opposite sides of the city should traverse the business center cross-town-wise through the same street. In this way one pair of tracks in the congested area would accommodate two pairs serving opposite residential sections; that is, for every four outlying tracks only two tracks would be required through the business center. In the morning and at night both such tracks would be utilized by loaded cars with workward-bound passengers in the morning and homeward-bound passengers at night. This constitutes the development of a two-way traffic through the business center and consequently is the most economical use of the streets within the congested area.

Ideally arranged, the central pair of up-and-down routes would penetrate farthest downtown, across all of the cross-wise business streets, except the one nearest the water-front, which would be traversed by the cross-town connection for two-way traffic above described. Thus the movement of the cars would be along a U-shaped route downtown on one side, across-town

through the business center and then up-town on the other side. The pair of routes next removed and on either side of the central pair would continue downtown as before across all of the crosswise streets to next to the last one. (This U-shaped arrangement would be continued as needed, the U having a continually wider spread and the bottom higher up.) With this route arrangement a passenger could reach almost any point in the business section by one transfer from his own up-and-down line.

The cross-town lines are for a different purpose. They will be used by transfer passengers chiefly. They should run directly across town and thus intersect all up-and-down lines. Their function is to articulate the entire railway system. By means of them a passenger will be able to reach any point in the city from any other point.

Necessity for Municipal Ownership—Municipal ownership is essential if city transit facilities are to be developed and utilized in the best public interest. Of course, this means municipal ownership with proper planning. Municipal ownership and municipal operation are two separate and distinct things. Do not confuse them. We can have municipal ownership without having municipal operation. We are ready for municipal ownership now, but we are not yet ready for municipal operation—the price is too high—that remains for the future in the natural process of evolution.

In preparing for the extension of any city, the streets should be laid out, graded, sewered, water supplied, and paved, beforehand in order to induce the population to follow. These things are all appurtenances of a street system and are recognized municipal functions. We should not wait for the population to accumulate and then build the streets and their appurtenances. But transit lines are really moving streets—or at least they are street appurtenances. Therefore it is even more important that we should not wait for the population to accumulate before constructing the necessary transit lines. Yet, this is the policy the operating companies would have us adopt in the case of transit lines when they own and control them. They are averse to developing new territory. The traffic returns from such territory would be too lean. They are after the fat only. They contend that municipal transportation should not be furnished to a community until there is a population ready to be served. They insist that it is better to follow old lines of travel than to create new ones. They would parallel already congested lines by new facilities, instead of deflecting the new facilities into undeveloped territory.

From the viewpoint of the operating companies, with profits the primary consideration, the correctness of the principles just described cannot be disputed. Such principles have served as the guiding policy in the past, and have produced the transit conditions which now prevail. If the same principles are to control in the future, then the present transit condition will be the public's portion for all time in our cities.

The transit facilities required in our largest cities today to properly accommodate the public not only include the rapid transit lines, but they also include the surface car lines and the bus lines. All of these facilities are a necessary and desirable part of the transit program.

Consolidated Operation—Everybody should be served alike with transit facilities wherever he may work and wherever he may live. Therefore, everybody should be able to utilize all the facilities necessary to carry him from his home to his work for a single fare—either bus lines, surface car lines, or rapid transit lines, separately or in combination. This end can only be attained under a system of universal transfer, and under a system which utilizes all of the facilities coordinated under a general plan. A single operating company can best perform this service. Therefore, monopoly of operation is desirable.

As between municipal operation and private operation there can only be one answer, as I can see it. The public cannot yet perform any function as cheaply as a private company can do so. Public employees cannot be held under the same strict discipline that can be exercised over private employees. Under present political conditions, it would be impossible to keep municipal operation free from political dictation and domination. At the present state of civil development, municipal operation to me, is unthinkable. The only alternative is private operation under public control, a control aimed to insure a service for the whole public that is convenient, adequate and safe.

The most desirable things to be achieved in transit development in the public interest, such as new facilities when needed, of a suitable type, and properly distributed throughout the city, can all be satisfactorily accomplished under municipal ownership without resort to municipal operation.

* * *

Street System Design in Relation To Vehicular Traffic

By Ernest R. Goodrich
Of the Technical Advisory Corporation, New York City

In the study of the district centering in Springfield, Mass., the following conclusions as to the design of street systems have been arrived at:

1. Vehicular traffic is found to vary in amount at the business point in a community in proportion to its size.

2. The total radial street traffic at equal distances from large communities of varying size is proportional to the population of each community.

3. The total radial street traffic at different distances from the center of each community varies inversely as the distance from the center.

4. A definite relationship exists between the amount of through traffic and the total number of automobiles licensed in that part of the country in which the community is located.

5. Through traffic may be expected to vary in the future in proportion to the degree of saturation of automobile ownership.

6. The amount of vehicular traffic originating in, and destined to residential districts is today approximately one vehicle per day per family.

7. Vehicular traffic from and to [illegible] stations bears a definite ratio to the population and the proportion employed in industry, depending to some extent upon the dominating types of manufacture.

8. The amount of vehicular traffic created by industry may be closely approximated on a [illegible] foot basis of land and of floor space thus employed.

9. An industrial survey is the most [illegible] of approaching the station of a city plan because it will provide data on the basis of which the future use of the streets can be estimated.

10. A zoning ordinance will definitely limit the amount

of street traffic and provide the basis upon which it may be estimated.

11. The growth of communities shows that a general law is followed upon the basis of which estimates of future population can be made with considerable precision.

12. Cities will grow to a definite size depending in large measure upon the distance to larger surrounding communities.

13. The distribution of future population throughout a community can be closely estimated on the basis of the law of growth, the limit set by the zoning ordinance, topography, and social conditions which the community can establish.

14. In general, the density of population varies inversely as the distance from the center of a community.

15. The traffic during the maximum hour of the day varies from 115 to 140 per cent of the average hour.

16. The traffic during the maximum week is approximately double the average of the year.

17. Roadway widths should be designed on the basis of the number of lines of traffic which they must handle.

18. Traffic conditions at intersections limit the number of vehicles per line per hour to a maximum of about 600.

19. The main thoroughfares in single family residence districts should be spaced not to exceed 3,000 ft. apart; 2,000 ft. in two-family house districts and 1,250 ft. in multi-family house districts.

20. In industrial districts the main thoroughfares should not be spaced more than 750 ft. apart.

21. The total number of radiating streets which should be provided in any community can be determined on the basis of the amount of traffic which is to be expected.

22. The total width of the roadways of radiating streets can be determined on the basis of the traffic which must be carried.

23. The area allocated to zones for different uses in a community can be determined on a scientific basis.

24. The whole street transportation and street design problem can be worked out on a scientific basis.

* * *

Shorter Abstracts

Parks and Playgrounds—Henry V. Hubbard, School of Landscape Architecture, Harvard University: Playgrounds for small children under five years of age require 16 to 18 sq.ft. per child and for children up to 12 years, 140 sq.ft. Playfields require 4 to 6 acres each. There is a tradition that 10 per cent of the total area of the city should be devoted to parks. Playgrounds and small parks have little influence on the street layout of the city but the larger parks do. As a rule, automobiles should carry people by rather than through parks, but they may go to parks and through reservations.

School Buildings and the City Plan—George G. Strayer, Teachers' College, Columbia University: In 1921 school bond issues totaled $240,000,000. An issue of $2,000,000,000 would *partly* eliminate unfit school buildings of the country. Elementary schools may draw pupils from a radius of ½ mile; junior high schools, from 2 to 3 miles. High school locations should be governed by the availability of sites, so as to provide ample grounds. They may be in outlying districts, where land is inexpensive and the pupils will be going outward on trolley lines at a time when business traffic is inward. In the outer districts, sites of 10 to 40 acres, exclusive of the land occupied by buildings, may be provided, the area depending upon the prospective tributary populations, which snould be made a matter of study. Discussion:, Several speakers endorsed the idea of large school sites, selected in outlying sections. At Gary, Ind., school site areas were increased from 10 to 12 acres, then to 20, 25 and 34 acres, the latter including a stadium.

River Front Treatment—Col. Stanhope E. Blunt, President Park Board, Springfield, Mass., reviewed the experiences of that city with relation to the railway tracks along the river and efforts to eliminate them or reduce their number particularly in connection with the plans for the bridge over the Connecticut now nearing completion. At one time the New Haven R.R. would have agreed to a plan under which all but two through tracks would have been located across the river but criticism and opposition were fatal. Some of the river front has been parked but most of it is occupied by tracks, up to as high as fifteen.

Place of the Beautiful in the City Plan—John Nolan, Cambridge, Mass.: American towns and cities, if they are to fulfill their purpose, must be beautiful. This they cannot be without a city plan. Beauty is achieved largely through works of landscape architecture, architecture, sculpture and engineering, but these must be placed under conditions that can be made possible only by a city plan which provides location, elevation or gradient, the foreground and background, the vistas, balance, scale, broad relationships, the environment and the opportunity for placing and assembling the works indicated, under conditions that render them truly and permanently beautiful. Andrew W. Crawford, president of the Municipal Art Jury of Philadelphia, a second speaker on this part of the program, said that art does not consist of ornament, but of design. The Philadelphia Art Jury, in passing on plans for public structures, has often cut out ornament and saved the city expense.

Winning Support of Planning Programs—Dr. Samuel B. Woodward, Chairman City Plan Committee, Worcester, Mass., and C. J. Hamlin, Buffalo, N. Y., described methods employed in securing public interest in and support for city planning, including private subscriptions in each case to launch the work. At Buffalo a comprehensive persistent campaign was carried on which included mailing thousands of copies of a series of bulletins to a list selected with aid of civic, social, commercial, political and other organizations.

Canadian Bridge Specifications Revised

A revised edition of the standard specifications for steel railway bridges of the Canadian Engineering Standards Association, the first edition of which was issued two years ago (see *Engineering News-Record*, Dec. 16, 1920, p. 1199), has just been published. The revision was carried out by the sub-committee on steel railway bridges (ch., P. B. Motley) of the sectional committee on steel bridges and construction (ch., G. H. Duggan). The part of the original specifications dealing with movable bridges has been eliminated, so as to prepare for a separate issue of a specification on movable bridges. On the other hand a section covering erection has been added. Various clauses have been modified in more or less minor ways. Painting has been covered more definitely than in the earlier issue. The parabolic column formula of the original edition has been abandoned in favor of the straight-line formula of the American Railway Engineering Association. It is stated, incidentally, that the revision was carried out in consultation with the bridge departments of the three Canadian railways.

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Civil Engineering as a Career

THE YOUNG MAN AND CIVIL ENGINEERING. By George Fillmore Swain, Gordon McKay Professor of Civil Engineering in Harvard University; Past-President of the American Society of Civil Engineers; formerly Chairman of the Boston Transit Commission, etc.; Consulting Engineer. New York: The Macmillan Co. Cloth; 5 x 8 in.; pp. 203. $2.

To give a broad picture of the civil engineering field, to paint its future and its attractions, to make clear the abilities it requires if one is to be successful in it, are not easy tasks. They call for enthusiasm and at the same time restraint; they require knowledge of and sympathy with young men. Prof. Swain has done the job well. Here will be found a clear picture of the field of civil engineering, together with wise counsel to those who consider entering it.

After an introductory chapter defining the scope of the profession, there are chapters on the branches of civil engineering, on the qualifications needed, on the education of the civil engineer, on the characteristics of civil engineering as a profession, and on the outlook. A concluding chapter is a fatherly talk to the young fellows on the qualities that contribute to success in an engineering, or in any other, career.

The first chapter is an excellent treatise on the scope of engineering and its civil branch, somewhat heavy for the young fellow, but illuminating and helpful. In it Prof. Swain, after pointing to the deficiencies of other attempts, suggests a definition of engineering, as follows: "Engineering is the science and art of applying economically, the laws, forces, and materials of nature, for the use, convenience or enjoyment of man." In discussing the definition he lays emphasis particularly on the inclusion of both the words "science" and "art" and of the word "economically."

The chapters on education and on the characteristics of civil engineering as a profession are particularly well done and will make good reading not only for the young men and their parents, but for practising engineers as well. In discussing education Prof. Swain upbraids the liberal arts colleges for their emphasis on superficial "culture" to the neglect of the mental discipline which should be the aim of a college course. On the other hand, while he commends the disciplinary character of engineering curricula, he shows that they properly contain such broadening subjects as languages and history.

Nor does he, in a later chapter, save some of the fellow professions. As a means of emphasizing by contrast, the characteristics of civil engineering he deals pretty harshly with the doctors and lawyers and points out some of the sore temptations which lead men in these professions astray.

On the matter of compensation his discussion is brief. It might with advantage have been extended, even though it is well to deter any young man from selecting a career on the basis of probable financial return. He rightly points out that there are other compensations than mere money. In fact he does not fail in any chapter to impress on the young man the satisfaction which comes with doing well the big construction jobs which contribute to man's welfare. Long before Prof. Swain comes to the matter of compensation, the young reader will have got a clear vision of the breadth and attractiveness of civil engineering. If he then reads Prof. Swain's comments on compensation with the feeling that the advantages of this career are overcome by the relatively low average financial return, he is probably not a man who would be happy in civil engineering work.

If we would offer criticism, it would be that the tendency of the book is to be thorough—not more thorough than the subject deserves, but more thorough than the average young man (we ought to say "boy") wants. The young man, though, who is looking seriously at the possibilities of civil engineering as a career will have his questions well answered by Prof. Swain.

Notable British City Planning Studies

LONDON OF THE FUTURE—By the London Society Under the Editorship of Sir Acton Webb, K.C.V.O., C.B., P.R.A. New York: E. P. Dutton & Co. Cloth; 8 x 11 in.; pp. 286; plates of halftones and diagrams. $15.

Ten years ago the London Society was organized "to interest Londoners in London" and to bring an intelligent public opinion to bear upon the local and Imperial governments to the end that "a large view" may be taken "of London as a whole." It was not expected that all the needs of Greater London could be met at once, but it was hoped that the authorities might be led to "see the importance" of doing whatever may be done as "part of one great scheme, and so give a unity and completeness to London improvements of the future which has been denied to her in the past." The work of the society, although interrupted by the war, has borne fruit through its leadership when great plans for public improvements have been under discussion, and in the series of important studies included in this handsome and stimulating volume. The book is well designed to arouse interest in planning for the future London and adjacent territory. It should also further the cause of city and regional planning throughout the world.

Seventeen large city and regional planning problems are discussed by as many writers, most of whom have specialized in their respective fields. These studies are briefly summarized in an introductory chapter by Sir Acton Webb, chairman of the council of the London Society. Some of the chapter titles and authors are: Roads, Streets and Traffic of London, by Col. R. C. Hellard, formerly superintendent of the London Traffic Branch of the British Board of Trade; London Railway Reconstruction, by H. J. Leaney; the Bridges of London, by Sir Reginald Blomfield; the Channel Tunnel, by Sir Arthur Fell, chairman of the House of Commons Tunnel Committee; Central London, by S. D. Adshead, Professor of Town Planning at London University; and Some Thoughts on the Development of London, by Raymond Unwin, chief town planning inspector, Ministry of Health. Among the other subjects treated are commercial aviation, the port of London, housing, parks,

smoke abatement and the government of London—the latter being a controlling factor in city planning on account of "the complex machinery" of the Administrative County of London and its component two cities and 27 boroughs, to say nothing of "water," "police," and "Greater" London.

The absence of a chapter on zoning—the word does not appear in the index, although the principle is mentioned once or twice with emphasis—seems strange in view of the large amount of practical work done in that field in America.

Altogether, the volume is a notable contribution to city planning literature. It illustrates anew that much, if not most, of at least the preliminary city planning studies for a large city or group of cities must be undertaken privately until our city and central governments realize the urgency of providing adequate city and regional plans.

From Huntington to Harriman

CHAPTERS ON THE HISTORY OF THE SOUTHERN PACIFIC —By Stuart Daggett, Ph.D., Professor of Railway Economics and Dean of the College of Commerce, University of California; Author of "Railroad Reorganization." New York: The Ronald Press Co. Cloth; 6 x 9 in.; pp. 470; frontispiece. $5.

In view of the recent litigation in the United States Supreme Court concerning the relationship between the Central Pacific and the Southern Pacific Railroads, Prof. Daggett's historical study has a special interest. Besides this, it is illustrative of a kind of literature that has but recently come to the fore and that has yet to attain its deserved standing. With the development of American industry, especially in those departments that have the appeal of pioneer enterprise, are bound up many stories quite as interesting as the biographies of outstanding individuals. There is ample material and a genuine need for the "business biography" as a distinct department of literature.

It is true that in one form or another the stories behind many of our foremost industries have been told, and in some cases, retold. Unfortunately, these have usually been written from a partisan viewpoint. Some have aimed to glorify, or if necessary, to excuse the builders of the industry. Others have sought to attack their reputations and to descredit them. What is needed is the work of scholarship that will regard these developments dispassionately as human efforts to solve social and economic problems and that will bring to the telling of the story an ability to preserve that flavor of human interest which makes its palatable to the general reader. Although Prof. Daggett has had to deal with a subject notably difficult in spots, he has succeeded in tempering his judicial findings of fact with a fair measure of the story-teller's lure.

Engineers will be particularly interested in the earlier part of the story. There they will learn that the promoter of the Central Pacific R.R., the percursor of the Southern Pacific System, was a young engineer, Theodore Dehone Judah, who was a native of Bridgeport, Conn. In 1854 at the age of 28 he went to California. Becoming possessed with the idea of a transcontinental railway, Judah hammered incessantly at the mountains in search of a practicable pass. The one finally adopted appears to have been discovered as a result of collaboration between Judah and, strangely enough, a druggist of Dutch Flat. After he had determined upon a route he organized a company and set out to sell it. He tackled San Francisco and failed. Then he went to Sacramento where he seems to have encountered the traditional businessman's attitude that he might be a good *engineer*, but—

Eventually, he met Collis P. Huntington, Leland Stanford, Charles Crocker, and Mark Hopkins. Huntington, too, had been born in Connecticut and had worked his way out to California via the Isthmus. He was the dominating genius of the four who eventually put through the Central Pacific and Southern Pacific projects. Stanford had been a New York lawyer and was the politician of the four. Crocker had been a little of everything—peddler, iron maker, gold miner, and trader. His strong point was the handling of men. It was Crocker who drove through the work of construction. Hopkins was the inside man, the man of detail, the careful scrutinizer of contracts.

But the story of the Southern Pacific from Huntington to Harriman cannot be retold here. It is a story of far-sighted vision, of courageous enterprise, of ruthless competition, of sordid politics, of reckless finance, of heartbreaking suspense, of unscrupulous manipulation, of public exploitation, and of the early struggles of government to control a power that recognized no right of public regulation. No one can read this story without acquiring a background against which he can discern more clearly the why and wherefore of many current problems in railroad administration and regulation.

Although several maps are scattered through the book, it is unfortunate that there is not included a general map of sufficiently large scale to illustrate more of the pioneer work and to make clear the relationship that existed between the several roads that went to make up the Southern Pacific System. The only map that shows the Central Pacific and the Southern Pacific is quite small and wholly inadequate.

By and large the book is a notable contribution to business biography and will commend itself to the general reader.

A Handy Volume on Coal

COAL: Its Properties, Analysis, Classification, Geology, Extraction, Uses and Distribution—By Elwood S. Moore, Ph.D., Professor of Geology and Dean of the School of Mines of the Pennsylvania State College. New York: John Wiley & Sons. London: Chapman & Hall. Cloth; 6 x 9 in.; pp. 462; illustrated. $5 (25s. net).

Just now, with the miners' strike occupying some share of the public attention, an informative book on coal is likely to command the interest of the general reader provided it is so aimed as not to shoot over his head. Such a volume lies before us. It has been prepared, says the author, in an attempt to satisfy the demand for a handy volume on coal. This it appears to do. Although there may be in it little that will be new to the well posted expert in the field, much of its contents will appeal to the general reader and its arrangement and treatment will doubtless contribute to its value as a class-room text. The work falls generally into three divisions, of which the first, comprising about 25 per cent of the whole, is a resumé of the physical and chemical properties of coal together with descriptions of the ordinary processes of analysis. The central portion, comprising about 50 per cent of the book, will appeal most strongly to the general reader, for it is here that the author tells of the origin of coal, the formation of its deposits, and the organization and methods involved in its mining. It describes briefly also the operation of coke and by-product ovens. The

last quarter of the book also is of general interest as it surveys the geographical distribution of the world's coal resources.

The book is well illustrated throughout by maps, charts, and photographs which supplement the text to advantage.

English Practice in Railway Earthwork

EARTHWORK IN RAILWAY ENGINEERING—By John W. F. Gardner, M. Inst. C.E. [The Glasgow Text Books in Civil Engineering. Edited by G. Moncur, B. Sc., M. Inst. C.E., Professor of Civil Engineering in the Royal Technical College, Glasgow.] New York: D. Van Nostrand Co. Cloth; 6 x 9 in.; pp. 152; 74 line cuts and pen sketches. $3.50.

Although this book is interesting and instructive on foreign practice, it is of little use as a textbook or guide for the American engineer, since it deals with conditions and methods quite different from those which obtain here.

Among the conditions foreign to American practice may be noted the following: Slopes of cuts and fills dressed by hand with the aid of templets; surfacing of slopes with black soil and turf; tracks spaced only 11 ft. c. to c.; hand excavation favored for making cuts less than 15 ft. in depth and for widening single-track cuts; end-dump cars preferred; fills built in layers 15 to 20 ft. thick. Masonry culverts are shown with stone side walls, brick arch and concrete invert, both arch and invert being lined with hard-burned blue brick. Why the arch should be thus lined is not apparent. Pipe culverts include clay, cast iron and "riveted malleable iron or steel," but no mention is made of corrugated iron or concrete pipe. Reinforced concrete, disposed of in a few lines, is said to be "now largely adopted."

Construction equipment appears to be limited in extent and to consist mainly of small units. A 4-yd. standard-gage dump car is the largest mentioned for serving steam-shovel work, and the end-dump car is considered preferable for fills less than 30 ft. in height. Construction trestles are not mentioned, but reference is made to American practice in dumping from a track carried by a cableway. Wheelbarrows and one-horse carts are mentioned as ordinary equipment, but horse work must be slow since it is stated that with the ordinary cart the horse must be detached from the shafts before the cart can be unloaded.

An excavator of the ladder-dredge type is shown, but it has been used only to a limited extent on railway work. The ladder is at right angles to the track and the buckets cut on the upward travel as they ride against the side of the cut. Large steam shovels have 3¼-yd. buckets and small revolving steam shovels have 2- to 2½-yd. buckets. No mention is made of well drills for putting down blast holes. Drag and wheel scrapers are described as American devices, but there is no mention of fresno scrapers or of graders and spreaders for leveling the fill.

For subsidence in ordinary fills an allowance of 1 in. for every foot is given, the top width being increased proportionately. As to classification, the author considers "soft material" and "rock" sufficient, since "no advantage is gained by having an intermedjate class."

Preliminary chapters deal with railway location, test pits, culverts and waterways. A chapter on execution of earthwork covers plans, surveys, quantity estimates, construction railways, surface stripping and the handling of excavators and dump-car trains. The chapter on plant is of only casual interest. In discussing conditions which affect cost, the author approves of a bonus to gang foremen when the daily work exceeds a prescribed yardage, or the work may be sublet to these foremen "in order to give them a small financial interest in the work."

Finally, it may be said that a section of some practical interest to the American engineer consists of the 35 pages on slips and their prevention, roadbed drainage and the maintenance of earthwork.

A Text-Book on Land Drainage

LAND DRAINAGE—By W. L. Powers, M.S., M. Am. Soc. Agricultural Engrs., Chief in Soils, Oregon Agricultural College and Experimental Station, and T. A. H. Teeter, B. S., M. Am. Assoc. of Engineers, formerly Professor of Drainage and Irrigation Engineering. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 9 x 6 in.; pp. 270; illustrated. $2.75.

Although written particularly for students in agricultural engineering, farmers and owners of wet, overflowed and alkaline lands, this book may be read with interest and profit by the drainage engineer. Briefly and in a general way it goes over a broad field. After explaining the advantages of drainage, the book deals with soils, soil water, tile drains, open ditches, levees, outlets, cement and clay tile, vertical drains, and the needs and difficulties of maintenance. Methods of ditching, trenching and pipelaying are described and cost estimates and prices of material given. An increasing demand for machinery as a result of labor shortage is noted. Drainage laws, districts, assessments and bonds are reviewed. Hydraulic data include rainfall, percolation, evaporation and the measurement of velocity and discharge. Special subjects taken up are the drainage of tidal, marsh and irrigated land, and means of preventing erosion and gullying of land. Rural sewage disposal is touched upon, since some states prohibit the discharge of raw sewage into streams. A chapter on drainage surveying rounds out the long list of subjects. References to other books and to reports and pamphlets dealing with particular features of drainage work add to the usefulness of the book.

Report on London Refuse Disposal

REFUSE DISPOSAL. Final Report of Conference of Metropolitan Borough Council. London: Harrison & Sons, Ltd., St. Martins Lane, W.C.2. Paper; 8 x 13 in.; pp. 14; 6d. net.

In remarkably small compass there is here presented an extremely valuable report on the present refuse disposal practice of the 29 cities and boroughs forming the administrative county of London. The committee was composed of four staff engineers and ten aldermen and councilmen from the several municipalities. The report may well afford a corrective to the widespread idea in America that all municipal refuse in England is put through high-temperature destructors and yields a profit from steam production and the generation of current for electric light and power stations. Although 14 of the 29 municipalities in the county of London have destructors, less than 20 per cent of the 1,500,000 long tons of refuse collected yearly is burned. Most of the remainder of the refuse (garbage, rubbish, and ashes) is disposed of by dumping. The report describes one or two of the more notable London installations which do utilize the heat and cinders produced by their destructors. It also describes new plants in and out of London for utilizing refuse by

screening, sorting and pulverizing, a combination that seems to be growing rapidly in favor in England. The conference committee expresses the belief "that the great bulk of the refuse [of London] can be converted into marketable commodities and can be sold in relief of the rates" of local taxation.

Machinery for Docks and Locks

DOCK AND LOCK MACHINERY—By W. Henry Hunter, M. Inst. C. E., M. Am. Soc. C. E. [The Glasgow Text Books in Civil Engineering. Edited by G. Moncur, B.Sc., M. Inst. C. E., Professor of Civil Engineering in the Royal Technical College, Glasgow]. New York: D. Van Nostrand Co. Cloth; 6 x 9 in.; pp. 196; 97 cuts and pen sketches. $4.50.

Very little has been printed in book form in this country on dock and lock machinery; so that this book should be welcomed by the fairly limited number of engineers engaged in this sort of design. Mr. Hunter was one of the world's greatest harbor and canal engineers and his work at Manchester alone would have qualified him for the task of writing the book. In addition, he had an appreciation of the necessity for a readable style which adds much to his treatment of a quite dry subject. The subject matter is mostly the lock and dock machinery of the British harbors, but both the Panama and Erie canals come in for a fair and adequate amount of space.

Addresses on Railroad Consolidation

Three addresses on Railroad Consolidation, by John E. Oldham, of Merrill, Oldham & Co., Boston, Mass., have been printed in two pamphlets by the Investment Bankers' Association of America, of which Mr. Oldham was formerly a vice-president. The first address is entitled "A Plan for Railroad Consolidations Including a Discussion of Their Purpose and Practicability," and includes 13 folding regional maps. The other two addresses, which make up the second pamphlet, are entitled "The Place of the New England Railroads in the Plan for Railroad Consolidations."

Bibliography and Primer on City Zoning

The Department of Commerce, through its Division of Building and Housing, Washington, D. C., has published a quite extensive Bibliography on City Zoning compiled by Theodora Kimball, Librarian, the Harvard School of Landscape Architecture; also A Zoning Primer, compiled by its Advisory Committee on Zoning.

Lining Tunnels Under Traffic

Plant and methods employed in lining a number of railway tunnels without interrupting traffic are described in a 45-page report in the 1921 proceedings of the American Railway Bridge & Building Association (Secretary, C. A. Lichty, Chicago). The lining in most cases was concrete placed by hand or by the pneumatic method.

Flat Slab Investigation Report Reprinted

The notable report entitled "Moments and Stresses in Slabs" prepared by H. M. Westergaard and W. A. Slater for the American Concrete Institute and published in the Proceedings of that Institute, vol. 17, 1921, has been reprinted by the National Research Council, 1701 Massachusetts Ave., Washington, D. C. ($1.)

Publications Received

THE ACTIVATED SLUDGE PROCESS OF SEWAGE TREATMENT—Reprints of articles describing (1) plant at Woodstock, Ont., by W. G. Ure, in *Canadian Engineer*, Aug. 4, 1921; (2) Gastonia, N. C., by Fred W. Simonds, in *Public Works*, March 4, 1922. Rochester, N. Y.: General Filtration Co., Inc. Paper; 6 x 9 in.; pp. 16; illustrated.

COMMERCIAL LIBRARIES AND THE DEPARTMENT OF COMMERCE—A Report to Herbert C. Hoover, Secretary of Commerce, by the Committee on Co-operation with the Department of Commerce, H. H. B. Meyer, Chairman. Edited by Dorsey W. Hyde, Jr., President Special Libraries Association. Washington, D. C. Paper; 5 x 8 in.; pp. 23.

Outlines work of Committee of Special Libraries Association to secure co-operation with Department of Commerce on increasing usefulness of business libraries and of the publications of the department, as suggested by Secretary Hoover through F. M. Feiker, assistant secretary to Mr. Hoover.

CONCRETE-ALKALI INVESTIGATIONS IN MINNESOTA, 1919-20—By the Minnesota Department of Drainage and Waters in Co-operation with the U. S. Bureau of Public Roads. Address **E. V. Villard**, State Commissioner of Drainage and Waters, St. Paul, Minn. Paper; 6 x 9 in.; pp. 74; folding map, diagrams and half tones; many tables.

Studies in various counties in southwestern Minnesota and Iowa, including water and soil analyses, and examinations of concrete and clay drains. Disintegration found where salts in drain water exceeded 1,500 p.p.m. Contains also results of physical tests of concrete tile.

DER PRAKTISCHE EISENHOCHBAU — Von Alfred Gregor, Oberingenieur Bei Breest & Co. Berlin: Herman Meusser. Cloth; 8 x 11 in.; pp. 462.

DESCRIPTIVE GEOMETRY—By George Young, Jr., Professor of Architecture, Cornell University, and Hubert Eugene Baxter, Assistant Professor of Architecture, Cornell University. New York: The Macmillan Co. Cloth; 5 x 8 in.; pp. 310.

THE DESIGN AND CONSTRUCTION OF DAMS — Including Masonry, Earth, Rock-Fill, Timber, and Steel Structures and the Principal Types of Movable Dams, By Edward Wegmann, C. E., M. Am. Soc. C. E., M. Am. Water-Works Assoc. Seventh Edition enlarged and revised. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 9 x 12 in.; pp. 555; illustrated. $10 (50s. net.)

DIE STANDSICHERHEIT DER MASTEN UND WANDE IM ERDREICH—V on Dr.-Ing. Heinrich Dorr, Professor Am Staatstechnikum in Karlsruhe. Berlin: Wilhelm Ernst & Son. Paper; 7 x 10 in.; pp. 56; illustrated.

Aims to present a simple or practical method of calculating masts or poles, and also walls, that are so anchored in the earth as to be safe from overturning. Relatively simple mathematics are used.

FACTS AND FIGURES OF THE AUTOMOBILE INDUSTRY, 1922—National Automobile Chamber of Commerce, 366 Madison Ave., New York City. Paper; 6 x 9 in.; pp. 96; illustrated.

Gives 1921 figures on production of passenger cars and motor trucks, curves of motor vehicle registration and highway expenditures by years since 1910, tables showing ratio of motor vehicles to population by states, and digest of state laws governing motor vehicle regulation in respect to size, weight and registration fees.

FOURTEENTH ANNUAL REPORT OF THE BOARD OF SUPERVISING ENGINEERS, CHICAGO TRACTION: Covering the fiscal year ended Jan. 31, 1921. Cloth; 6 x 9 in.; pp. 116.

HEALTH PROBLEMS INVOLVED IN NOISE AND FATIGUE —By Prof. Henry J. Spooner, M. I. Mech. E., F. G. S., etc. Member of the International Committee on Industrial Fatigue, London, England. Reprinted from the *Nation's Health*, February and March, 1922. Chicago: The Modern Hospital Publishing Co. Paper; 9 x 12 in.; pp. 9.

STANDARD SPECIFICATION FOR STEEL RAILWAY BRIDGES —Canadian Engineering Standards Association, Ottawa, Ont. Stiff paper; 6 x 9 in.; pp. 78; illustrated. 25c.

A revision of the specification by the same association, published two years ago (see these columns, Dec. 16, 1920, p. 1199), which was based on a specification published by the Canadian Society of Civil Engineers in 1912. In the present edition, movable bridges is withheld for separate publication; a section on erection has been added; paints and painting have been more fully treated; and other changes and additions have been made. The preface states that "it has been possible to modify certain clauses so as to bring them into substantial agreement with the corresponding requirements of the American Railroad Engineering Association."

UBER DIE FESTIGKEITSBERECHNUNG VON SCHIEBETOREN UNE AHNLICHEN BAUWERKEN—Von Dr. Ing. Adolf Eggenschwyler, Dipl. Ingenieur. Leipzig: H. A. Ludwig Degener. Paper; 6 x 10 in.; pp. 148.

A study of the design of various types of sliding gates used in hydraulic work.

WORLD METRIC STANDARDIZATION: An Urgent Issue—A Volume of Testimony Urging World-Wide Adoption of the Metric Units of Weights and Measures—Meter-Liter-Gram. Compiled by Audrey Drury, in Collaboration with Clifton Hildebrand, W. Mortimer Crocker, Harry Allcock, M. I. E. E., and other members of the World Metric Standardization Council. San Francisco: World Metric Standardization Council, 681 Market St. Cloth; 6 x 9 in.; pp. 524. $5.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Possibilities in Rural Engineering

Sir—On behalf of the American Society of Agricultural Engineers I want to assure you that we appreciate the constructive editorial, "Possibilities in Rural Engineering," appearing in the May 11, 1922, issue of *Engineering News-Record*.

Your picture of the possibilities in this field is not overdrawn in the least. It is constructive effort of this sort that will direct to agricultural engineering the attention that it merits. Engineers should interest themselves in the possibilities in this field, because they are unlimited. Agriculture has been slow to adopt modern engineering methods and equipment, but engineering is bound to do for agriculture what it has done for manufacturing and transportation, though the process will be somewhat slower. Unless the younger generation of farmers trained largely in our state agricultural colleges apply modern business methods and engineering on a much more extensive scale to farming than has been done in the past, the time is coming when we are going to see corporation farming or the consolidation of farms into single business units and operated like our factories or groups of factories are operated at the present time. There is a great need for the application of the principles of efficiency engineering and scientific management to the business of farming, and it will be the engineer pretty largely who will revolutionize this, the most important industry, as well as the most fundamental.

RAYMOND OLNEY,
Secretary, American Society of Agricultural Engineers.
St. Joseph, Mich., June 5.

Foundation Pressures in Multiple-Arch Dams

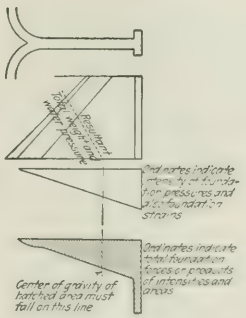
Sir—I have read the letter printed in *Engineering News-Record* of April 13 by "Enquirer" relative to the foundation pressures in a multiple-arch dam. Several years ago the writer raised practically this same question in a discussion of L. R. Jorgenson's article "Multiple-Arch Dams on Rush Creek, California," published in Transactions, American Society of Civil Engineers (Vol. LXXXI, p. 850), but no answer resulted from the author of that article.

As pointed out by "Enquirer," different assumptions will give variations of over 100 per cent in the foundation pressures. Such variation is hardly permissible in a structure in which all the active loads are determinable or at least are assumed within very narrow limits.

Though exception may be taken to the method of design advocated by "Enquirer" on the ground that the formula $f = \frac{P}{A} \pm \frac{Mc}{I}$ assumes the foundation on elastic material with strains proportional to stresses, it is probably the most reasonable assumption to make in the absence of more definite data.

For the purpose of getting the foundation pressures it is reasonable to assume one entire buttress and two half arches acting as a unit and the above formula may be applied if no tension results. If tension results, the formula becomes inapplicable and resort must be had to cut and try methods. The resulting foundation pressures would then be such as to satisfy the two conditions shown in the accompanying sketch on the assumption that no appreciable tension can exist between the structure and the foundation. For sections above the foundation, tension may exist to the extent of a portion of the weight [illegible]. For sections considerably above the foundation the above formula again becomes applicable, provided provision is made to take such tension.

If no pressure, or very light pressures, result under the



arch barrel, considerable shearing and bending stresses may occur in the arch and buttress. The shearing stress may run from 40 to 70 lb. per square inch, requiring the use of large quantities of reinforcing steel in the lower upstream portions of the buttresses. It may also be necessary to provide steel to take care of tension stresses due to bending. In many cases it will undoubtedly be found cheaper to extend the buttresses further downstream. This will equalize the foundation pressure resulting in more uniform foundation settlement (if not on rock foundation), and will avoid any large shearing and bending stresses.

Dams are structures of too great menace to be designed in the rather haphazard way that some buildings are designed. Yet the writer feels that some dams that have been designed and built in the past ten years have not received the careful and rational analysis of stress conditions which their importance demands. Some of the designs are only qualitative rather than quantitative, the principal theory of design being simply the words "arch action."

It is hoped that "Enquirer's" question will produce sufficient discussion to settle the points brought up.

San Francisco, Cal., May 26. L. H. NISHKIAN, Consulting Engineer.

Sir—In *Engineering News-Record*, April 13, p. 623, an engineer signed "Enquirer" desires information on the method of calculating the foundation pressures in a multiple-arch dam, or in any other structure of irregular foundation area.

"Enquirer" is no doubt correct if he assumes that in a multiple-arch dam, the arches and buttresses are acting together as a monolithic structure, particularly if the junction of arches and buttresses is heavily reinforced. Any movement of appreciable size between arches and buttresses naturally would produce a crack and leakage might occur.

The difference between the results for the maximum pressure at the foundation of the 80 ft. high buttress (8 tons per square foot by the "middle third" theory, and 19 tons per square foot by the method used by "Enquirer" is rather startling and needs, no doubt, further investigation.

The application of the general formula for eccentric loading (compression combined with bending) $f = P/A \pm Mc/I$, as suggested by "Enquirer" is correct in the general form. However, the moment of inertia, I, is to be calculated for the neutral axis of the area under stress, and not for the axis through the center of gravity of the foundation area, which "Enquirer" apparently has done.

The writer has given the general solution of the problem under consideration in his recent paper "Gravity and Arch Action in Curved Dams," (Transactions, Am. Soc. C. E. Vol. LXXXIV, (1921) p. 44.) The formulas derived in this paper were shown with regard to finding the foundation pressures for irregular foundation areas, such as occur, for instance, in the case of curved dams. The same equations ("cylinder hoof" or "monolith" theory) will also furnish correct results for the stresses in any horizontal section through a multiple-arch dam, by considering arches and buttresses as acting together monolithically.

It would lead too far to give here again the whole derivation of the formulas of the "monolith" theory. However, for ready reference the final equations are given below and the various steps for calculating the "monolith" pressures, with reference to the accompanying figure, which corresponds to the one shown by "Enquirer," are as follows:

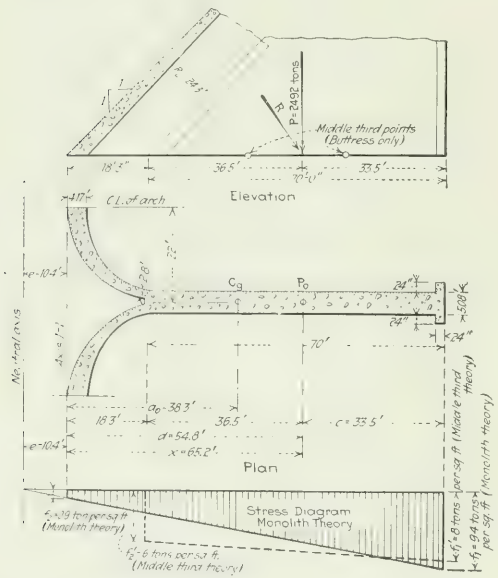
(1) Combine all the loads (water pressure and weight of dam, etc.,) which act above the horizontal section to be investigated, and find the point of intersection of the resultant R with the section. This furnishes the distances, c, and

d, of P_o from the downstream and upstream ends respectively, of the "monolith" above the section. The vertical component of R, may be called P.

(2) Figure the area A of the section, (arches plus buttress, etc.) and its center of gravity, C_g, also the distance a_o of C_g from the up-stream end of the section.

(3) Calculate the moment of inertia I_1 of the area A with regard to the upstream tangent *1—1*.

(4) Calculate the static moment S_1 of the area A with regard to the axis *1—1*.



(5) Figure the distance e, of the neutral axis from the axis *1—1* by the equation

$$e = \frac{I_1 - d\,S_1}{S_1 + A\,(d - 2a)}$$

Then, the disance x of P_o from the neutral axis is $x = d + e$.

(6) Calculate the section modulus S of the area A from the relation $S = S_1 + Ae$ and find the maximum compression stress f_1 at the downstream end of the buttress by the equation

$$f_1 = \frac{P(e + X)}{S} \text{ tons per square foot.}$$

The pressure at the upstream side, f_2, is proportional to the distance from the neutral axis. All dimensions are in feet and the weights in tons.

It should be noted, that this method of calculating the pressures is no more reliable if tension occurs at the upstream side (e negative), which for practical designs ought to be excluded anyway.

The writer would have been pleased to investigate as an example the dam referred to by "Enquirer." However, only the foundation area is shown by his figure, and neither the size and direction of the resultant, nor its point of intersection with the base are given.

These quantities nevertheless, may be estimated approximately. Thus, it was mentioned, that according to the "middle-third" theory the pressure at the toe was about 8 tons per square foot, and 6 tons at the heel. The average pressure is therefore 7 tons. The area of the rectangular foundation (buttress only) is $5.08 \times 70 = 356$ sq.ft. and, consequently, the vertical component of the resultant appears to be about $7 \times 356 = 2{,}492$ tons. From the condition that the pressure at the toe and the heel were 8 tons and 6 tons, respectively, it can be calculated that the resultant intersects the base about 10.1 ft. from the lower middle-third point, that is, about 1.5 ft. downstream from the center of the base.

Assuming this to be approximately correct, the conditions are represented by the accompanying figure.

By applying the equations of the monolith theory, referred to previously, there is,

$P = 2{,}492$ tons.

$A = 540$ sq.ft. (arches plus buttress plus counterforts.)

(A was estimated from figure.)

$c = 33.5$ ft.

$d = 54.8$ ft.

$a_o = 38.3$ ft.

$I_1 = 1{,}222{,}000$

$S_1 = 20{,}640$

The moment of inertia I_1 of the area A with regard to the axis *1—1*, is easily calculated, for instance, by dividing A into a number of small parts, whence I_1 equals approximately the sum of such parts multiplied by the square of the distances of the centers of gravity of the respective parts from the axis *1—1*.

In a similar manner S_1 is found by summation of the products of such small parts and the distance of the respective centers of gravity from the axis *1—1*.

Then

$$e = \frac{1{,}222{,}000 - 54.8 \times 20{,}640}{20{,}640 + 540\,(54.8 - 2 \times 38.3)} = 10.4\ ft.$$

$$x = 54.8 + 10.4 = 65.2 \text{ ft.}$$

$$S = 20{,}640 + 540 \times 10.4 = 26{,}150.$$

$$f_1 = \frac{2492\,(33.5 + 65.2)}{26{,}150} = 9.4 \text{ tons per sq.ft.}$$

$f_2 = 0.9$ tons per square foot (taken from stress diagram.)

The corresponding results by the middle-third theory are 8 and 6 tons per sq.ft. at the downstream and upstream face of the buttress respectively. The values were plotted on the stress diagram of the accompanying figure whereby the shaded diagram shows the stresses as obtained by the monolith theory, and the dotted lines give the stresses calculated by the method of the middle-third theory.

Thus it is seen that a difference of nearly 20 per cent exists between the values of the maximum stresses as calculated by the two methods. The difference is still more marked at higher elevations, since the area of the buttress decreases rapidly, while the area of the arches decreases rather slowly. However, the conditions are not quite as serious as the calculations of "Enquirer" appeared to indicate.

It is further of interest to note that the neutral axis is considerably outside the area of the base, and that therefore a large increase of load would have to occur before any tension would develop at the upstream side.

FRED A. NOETZLI,
Chief Engineer, Beckman & Linden Eng. Corp.
San Francisco, Cal., April 24.

Yellow Fire Hydrants in Philadelphia

After much study Philadelphia is making a trial of yellow paint on its fire hydrants in place of the dark green or brown color heretofore used. Yellow was adopted after consultation by the Water Bureau with representatives of the fire and police departments, automobilists, teamsters and others. It was concluded that yellow would be satisfactory because it can be seen easily at night and in fog or rainy weather. It was also concluded that yellow would be sufficiently conspicuous to be seen by drivers of automobiles and motor trucks, thus reducing the number of breaks in fire hydrants by these machines, there being an average of a hydrant a day broken by motor driven and other vehicles.

NEWS OF THE WEEK

New York, June 15, 1922

Ford Muscle Shoals Offer Wins Committee Favor

Majority of House Military Affairs Committee Favors Proposal—Minority Groups Dissent

(Washington Correspondence)

The recommendations of a majority of the members of the Committee on Military Affairs of the House of Representatives in the matter of the Henry Ford proposal for the Muscle Shoals property of the government are embodied in a bill introduced June 5 by Representative McKenzie, the acting chairman of the committee. The title of the bill reads "To authorize and direct the Secretary of War to sell to Henry Ford Nitrate Plant No. 1 at Sheffield, Ala.; Nitrate Plant No. 2 at Muscle Shoals, Ala.; Waco quarry, near Russellville, Ala.; and to lease to the corporation to be incorporated by him dam numbered two and dam numbered three, including power stations when constructed as provided herein, and for other purposes."

The McKenzie bill recommends the acceptance of Henry Ford's offer, as revised on May 31, less the steam plant at Gorgas and with a provision that the "company shall be obligated during the lease period to manufacture nitrogen and other commercial fertilizers, mixed or unmixed, with or without filler, according to demand . . . The annual production of these fertilizers shall have the nitrogen content of at least 40,000 tons of fixed nitrogen." A profit of 8 per cent is allowed.

A majority of eight members of the committee favors the unqualified acceptance of Mr. Ford's offer as amended on May 31, and will submit its bill later. A minority of two is opposed to the Ford offer both as made and amended.

Two other bills already have been introduced proposing the acceptance of the Ford offer. One was introduced by Representative Wright, of Georgia, and the other by Representative Almon, of Alabama.

Dinner for Smith and Merriman

A dinner has been arranged to be held at the Hotel Pennsylvania, New York City, June 27, at 7:30 p.m., to give friends and associates of J. Waldo Smith and Thaddeus Merriman an opportunity to express their appreciation of the 17 years service of the former as chief engineer of the New York City Board of Water Supply and to celebrate the promotion of the latter to the post of chief engineer. The committee on arrangements consists of [illegible] Ridgway, chairman, and Jules Brouchaud, William W. Brush, William L. Chapman, John H. Cook, Clarence A. Crane, Walter J. Drummond, Alfred D. Flinn, John F. Galvin, Walter E. Spear, W. J. Bohrendorf, John P. Hogan, Crawford M. Holland, Nelson P. Lewis, John F. Sanborn, Merritt H. Smith, and Arthur S. Tuttle.

American Association of Engineers Convention Passes Stabilizing Measures

Dues Unchanged—Supreme Court Established—Employment Service Extended—Radical Amendments Rejected

(Engineering News-Record Staff Report)

MORE than 100 delegates bearing 40 proxies made up the official gathering of the American Association of Engineers, June 5, 6 and 7 at Salt Lake City. Two sessions were taken up in consideration of resolutions and constitutional amendments, some of which would have radically changed the organization machinery and in the opinion of many led to disintegration. The positive vote in favor of a stable, unified organization was particularly noted in the rejection of proposed amendments to establish departments for special groups and to form district compensation and minimum salary-fixing committees. Dues remain as at present except that the $3 fee for students was reduced to $1. Distribution of dues is changed so that chapters collecting their own dues and maintaining paid assistants in accordance with rules formulated by the board are to retain 60 per cent as they do now while those which do not maintain these functions will get but 40 per cent. Dues of all members are now collectable April 1. Heretofore they fell due on the anniversary of affiliation.

Perhaps the most stabilizing amendment passed related to the formation of a judiciary committee which will act as a supreme court in the hearing of all cases, especially those involving ethics. It will be the final court following a review of a case by the existing practice committee.

An extended, national employment service was authorized to be worked out by the board of directors as soon as finances will permit.

Support was given (1) a bill in Congress praying for relief to the Hawaiian labor shortage, (2) the Sterling federal employees reclassification bill and (3) the Smith-McNary revolving-fund land-reclamation bill.

Chapters were urged by resolution to induce members to join civic societies and to seek appointment on committees relating to engineering.

Entertainment of the delegates included a full-day trip by automobile over paved roads to the Strawberry Reclamation Project, the Olmstead hydro-electric development and the Utah Lake pumping station. The Ogden Chapter drove the delegates from Ogden to Salt Lake after an inspection of the newly completed road through Ogden Canyon on the way to the city well-water system in an upper mountain valley. By special dispensation of the Mormon church the delegates were permitted to examine the 60-year old perfectly-preserved roof trusses of the tabernacle which has an inside width of 150 ft. and length of 250 ft.

Society Functioning

The address of the outgoing president, H. O. Garman, reflected the keynote of the convention's prime action—retention of moderation in the form of administration. Though the swing from a strong centralized government to local-chapter control with its accompanying large distribution of funds had been all but disastrous, Mr. Garman expressed the opinion that the experiment had been worth the cost, as the association had profited by the harmful effects of both extremes. Now, he asserted, all are willing to settle on a middle ground, allocating to local chapters matters of local importance, and giving to headquarters [illegible] problems.

Mr. Garman's recommendations for the greater development and service of the association are as follows:

1. National headquarters must furnish the [illegible] and leadership.
2. These [illegible] must be carried to the chapters by programs of publicity and traveling secretaries.
3. Dues should not be lowered and a larger portion should go to head-

Many Attend Springfield City Planning Conference

(Engineering News-Record Staff Report)

Many city and consulting engineers were among the two hundred-odd persons who attended the fourteenth National Conference on City Planning, at Springfield, Mass., June 5 to 7. The program was notable for its few and well chosen topics and the full utilization of the ample time afforded for discussion. Besides the papers, several of which are abstracted elsewhere in this issue, discussions on zoning were carried on at table during breakfast, lunch and dinner each day.

Lawson Purdy and Flavell Shurtleff were re-elected as president and secretary of the conference. The 1923 meeting will be held at Baltimore, Md.

Portland Cement Association Meeting at Atlantic City

At the same time that the American Society for Testing Materials is meeting in Atlantic City, the Portland Cement Association is to have a regular meeting, not at the same hotel, but at the Hotel Traymore. On June 27 there will be papers of general interest to concrete users, a [illegible] and Dean [illegible] Appreciation of the Cement Industry" by W. R. Ellicott, of the [illegible] and "Quality Control in Cement Manufacture" by Richard K. Meade, a consulting engineer of Baltimore.

quarters to be used to stimulate and rejuvenate chapters.

4. Headquarters should care for federal legislation and administration and the chapters attend to state, county and municipal affairs.

5. A self-supporting employment service should be developed with offices located where there are large concentrations of engineers.

These features were accepted later as the report of the executive committee.

Committee Reports

Finances — Financial affairs of the association were reflected in the report of the treasurer, H. W. Clausen. Of an income of $218,176.84, the chapters received $113,067.98; *Professional Engineer*, $25,422.96; and headquarters $90,107.81, leaving a deficit of $10,421.75. The net worth of the association dropped from $43,000 to $33,000 during the year. The auditing committee reported the net worth of the chapters as more than $22,000 as of Dec. 31, 1921. He recommended a freer hand be given to the board of directors as changes come faster than can be met by annual convention by-laws or constitutional procedure.

Secretary's Report—The present condition of the organization was summed up by the secretary, C. E. Drayer. Three great needs exist: Seasoned leaders, statement of a program in such definite terms as to revitalize to action officers and members and establishment of a flesh-and-blood contact between all units of the organization. Of the 22,253 members on the roll May 15, 27.4 per cent were in arrears, for more than the constitutional limit of 90 days. During the year more than 3,100 members qualified for membership. Coincident with recent improved business conditions collections have improved. Departmental service has been crippled because of lack of funds.

Practice — The practice committee, headed by H. W. Clausen, has passed on 40 cases, 20 during the past year. It acts as a superior court but for the ultimate machinery in corrective measures a supreme court far removed from engineering policies is needed. An amendment was passed meeting this recommendation.

Chapter Activities — The committee on chapter activities, A. K. McDaniels, chairman, is organized with a personnel picked from the various districts and co-operates with the director. Advice and assistance in carrying on activities are given by personal contact. The principles followed are to give every member work to do and to encourage interest in civic affairs.

Employment — One in three members of the association has applied for positions during the past year. Data concerning address changes showed that, as an average, every engineer changes his address once in two years. K. H. Talbot, chairman of the employment committee, recommended that $1 of the dues be alloted to employment service. More than 1,100 men were placed by the chapters and 1,629 by headquarters. Several chapter representatives stated that not all placements had been reported. Oregon placed more than 370 men but had not reported to headquarters. By resolution the board was authorized to organize the employment service to give the best service possible with the funds available.

Political Activities — The committee on political activities, Harold Almert, chairman, recommended that representative engineers in each of the 12 districts get acquainted with their congressmen before the necessity arose of appearing before them in regard to legislative matters. That no active part be taken in presidential campaigns other than to interview all candidates urging that engineers be appointed to engineering positions was a recommendation approved.

Classification of Engineering Schools —Tentative minimum requirements for a "recognized technical engineering school" were brought in but no action was taken. The committee was continued. It was proposed that 15 standard units of preparatory high school work be required for entrance, and 12 quarters of 12 weeks each and attendance for 6,000 hours for graduation.

Proposed Educational Department— The committee on an educational department was continued and ordered to prepare specifications for engineering positions, outlining how preparation may be made to fill the positions.

Practice and Fees — Little support has been found among practising engineers by the committee on practice and fees for a more complete analysis of fee charges but there has been a demand for a brief report covering important features of practice which can be printed on a single sheet to inclose in a letter to prospective clients. Langdon Pearse, chairman, reported a schedule that had been adjusted to a simple basis with the purpose of supplying a minimum fee.

Legislation — Dan W. Patton, chairman of the committee on legislation, reported 19 states with license laws functioning reasonably well with but two or three exceptions. His recommendation to reduce the present association model law to a set of principles from which bills could be written to fit local requirements was adopted.

Chapter Functioning

Chapter functioning from fourteen different angles, handled by as many delegates, was the subject of a helpful session presided over by A. K. McDaniels. Some of the points made were as follows:

The principles of chapter success were set forth as being human interest, combat, life and service. More tangibly, said G. R. Fansett, "get contact with other civic organizations, set new members to work, select broadgage officials, crucify the man who uses the organization from selfish motives and control publicity by referring all matter to a second or third party for censorship and impressions."

On standard constitutions it was suggested that provision be made for removal of non-functioning officers. W. S. Boyle reported the novel experience of a successful operation for five years of the Indianapolis Chapter with no constitution or by-laws. Everybody is responsible; officials have no legal obligations.

Mr. Boyle detailed the workings of an engineer's program of local civic responsibility wherein eleven committees report on as many subjects among which are sewage, flood protection, street lighting, traffic arteries, street parking, local transportation, smoke protection, water softening and building code. A word of caution to keep out of the field of other organizations was given.

Chapter bulletins and news letters of varied forms were in evidence from the small four-page loose-leaf sheets for insertion in pocket size note books to the 16-page standard magazine size such as the *Pacific Engineer* issued at San Francisco for a group of seven chapters, 1,500 copies of which cost $150. The sheets must have, said A. J. Capron of San Francisco, a broad, tolerant, non-technical, editorial policy; and be attractive, dignified and brief.

Will P. Blair, Cleveland, asserted that the constitution should include the fact that the organization promotes and encourages engineering efficiency. Such expression would go a long way, in his opinion, toward combating the suspicions of employees and of the casually informed engineer that selfishness was the only tenet of the association. By resolution the board was asked to embody the idea in a constitutional amendment next year.

Publicity and Public Affairs

On publicity and public affairs W. W. De Berard, Western Editor, *Engineering News-Record*, indicated that a broad knowledge of public affairs was the basis of a successful democracy, and that the engineer's responsibility was larger than he realized because of the dominant part engineering plays in modern civic life.

At this point the Ogden chapter was awarded the publicity banner for having secured the greatest number of column inches of space (1,599) in the newspapers during the year. M. D. Williams, president of the Ogden chapter, in accepting the award outlined the way in which the chapter had functioned in identifying itself on an equal footing with the Rotary, Kiwanis and similar organizations. A year ago an engineer in Ogden was a mechanic, today he is known as a technical man. No committees in which engineering is involved are named without including an engineer.

In conducting chapter meetings "satisfy the yearnings of individuality," said E. T. D. Meyers, of Richmond. In turn have every member preside at some meeting and urge him to take part at other times. W. A. Dungan, Chicago, explained the "Safety Valve" —an informal gathering where anyone may speak on any subject. At Mr. Meyers' suggestion a committee was authorized to seek an audience with the American Railway Engineering Association to explain the aims and efforts of A. A. E. in promoting loyalty and efficiency.

No cure save removal from office exists for neglectful non-functioning officers, said L. K. Sherman who suggested a headquarters receivership when necessary for revitalizing defunct or inactive chapters.

A. M. Knowles, New York, suggested the following to maintain member interest: Men should be made to understand obligations when they join; more information on work done should be given the membership.

In the opinion of most of the delegates the sphere of women in chapter activities is not in a women's auxiliary but in attendance at social func-

(*Continued on p.* 1015)

Many Subjects Considered by Federation Council

National and International Problems of Broad Scope Claim Attention of Executive Board

In addition to adopting the report of its committee on Registration of Engineers, as reported elsewhere in this issue, the Executive Board of the American Engineering Council of the Federated American Engineering Societies at its recent Pittsburgh meeting discussed several other matters of national and international scope. The employment service now maintained by the council in New York is to be turned over to the administration and control of the four founder societies, but the employment committee of the council is to continue its investigation as to the possibility of co-ordinating existing and local employment services with a national service.

The committee on Regional Activities reported progress toward a general plan for the affiliation of local or state organizations and recommended that whenever an investigation is to be conducted under the auspices of the council involving local investigation in a community that contains a society affiliated with the federation, the services of that society are to be utilized.

Water Power Problems

Plans were announced proposing solutions for national water power and forestry problems and after a long discussion of the water-power problem the board decided to lay the entire question before President Harding. This action, it was stated, was prompted by "the Federal Water Power Commission's lack of effective and permanent personnel." A national movement toward conservation of forests in which would be co-ordinated the efforts of engineers, the U. S. Forestry Service, the forest services of the states, universities, and technical schools, and other groups such as the farmers, the railroads, and lumberman is to be in charge of a reforestation committee of the council. President Cooley of the Council is to confer with Will H. Hays with a view to enlisting motion-picture co-operation for this movement.

The Board pledged its support to President Harding in his plan of government reorganization, and in the event that that plan is not adopted, determined to press independently a movement for the establishment of a Department of Public Works.

The council's committee on Work Periods in Continuous Industries reported progress in its investigation into the relative merits of three 8-hour shifts and two 12-hour shifts. The report was referred to the committee on Procedure, which will direct the work of preparing it for publication and report at the next meeting of the board. It was reported that progress is being made in an investigation to determine methods of converting steel plants, as to their engineering aspects, from two to three shifts. The proposals of Frank A. Vanderlip, the New York banker, for reconstruction in Europe was brought before the board and referred to the committee on Procedure.

The board decided to co-operate with other agencies in finding a solution for the national problem of flood control involving the establishment of a national hydraulic laboratory. Co-operation is to be continued with the several organizations interested in the types of government contracts and a study was directed looking to a form of universal contract agreement for railroad construction. Plans were considered also looking to the expansion of the development of electrical energy.

It developed at the board meeting that committees are at work on the general policy of affiliation of American engineers with the engineering bodies of other nations. A movement headed by Sir Robert Hadfield is said to be on foot in London to form a union of engineers which shall include all English-speaking peoples.

Progress was reported as to the study of the business cycle with the assistance of [illegible] engineering groups and in co-operation with the Department of Commerce. The data gathered in this work are being compiled in Washington where they will be available to further the plans of the President's Committee on Unemployment in a study of cyclical depressions.

Other matters considered by the board were [illegible] awards in [illegible] patent legislation, an international engineering congress, aerial research, engineering representation on the Coal Strike Commission, foreign relations, and wasted in the agricultural industry.

The Engineer in Public Life

FRANKLIN THOMAS

Following the adoption of a charter provision for a city-manager form of government, Franklin Thomas, professor of civil engineering at the California Institute of Technology, was elected a member and vice-chairman of the Board of Directors of the City of Pasadena, Cal. His public activities also include membership on the City Planning Commission, and this year he was chosen first vice-president of the Pasadena Chamber of Commerce.



Prof. Thomas was born in Red Oak, Iowa, in 1885 and was graduated from the University of Iowa in 1908, after which he spent a year as a graduate student at McGill University. After several years on railroad work, beginning on the C., B. & Q., he became construction foreman for E. A. Wallberg, contractor, of Montreal, on a 10,000-hp. hydro-electric plant. For two years he served as instructor, department of engineering, at the University of Michigan and left that position to become designer for the Alabama Power Co. at Birmingham on the Muscle Shoals development. He returned to university work in 1913, becoming a professor of civil engineering at Throop Institute, recently renamed the California Institute of Technology. Prof. Thomas' work has included flood control and hydrographic investigations.

Apply for More Power at Niagara

American Superpower Corp. Seeks Preliminary Permit for 12,000 Sec.-Ft.

The American Superpower Corp. has applied to the Federal Power Commission for a preliminary permit covering the use of 12,000 sec.-ft. or one-half the additional diversion of water in the Niagara river recommended by the Board of Engineers. The application was filed with the understanding that no action be taken on it until the additional diversion may have been arranged. It is thought that the application was made solely for legal purposes in connection with the existing controversy between the federal government and the state of New York in the matter of the waterpower act.

Construction Proposed

The application proposes the construction of a transmission line from Lewiston, in Niagara county, to Yonkers, where connection will be made with lines supplying New York city. The estimated cost is $27,457,000. The power canal from La Salle to Lewiston is to be made available for water transportation and, in addition, a waterway is to be made possible "from the upper Niagara river to the lower Niagara river, the state of New York having granted this route to applicant in order that private interests might be induced to accomplish the construction of a ship canal on the American side around Niagara Falls, for which both the state and federal governments have made frequent surveys, but without undertaking such project."

The applicant estimates that $34,188,000 will be required for the construction of the works necessary for the generation of 450,000 hp., under a head of 301 ft. at 88 per cent efficiency. The power house would be equipped with nine units of 50,000 hp. each, to be stepped up to 110,000 volts for local distribution and to 220,000 volts for transmission to New York. The power taken from the line at intermediate points would be stepped down to the required voltage. The transmission line to New York would consist of four circuits, each capable of carrying 75,000 kilowatts at 220,000 volts, three-phase at 60 cycles. There would be two independent lines on a right-of-way 350 ft. wide.

Publications on Subways and Engineers in War Available

There is still available for distribution a limited supply of the following publications noted in this journal March 2, p. 370: "American Engineers Behind the Battle Lines in France" (98 pages, 9 x 12 in.) a collection of articles by [illegible] correspondent with the A. E. F. during the war; and "Building Subways in New York," (78 pages, 9 x 12 in.) a series of articles by [illegible].

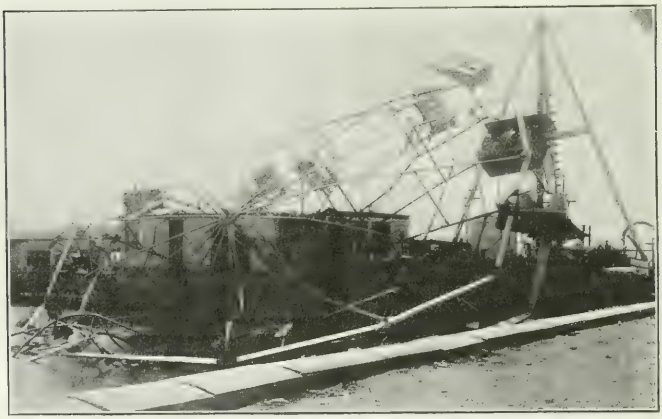
Both publications are illustrated and are bound in stiff-board covers with cloth back. They will be mailed to [illegible] readers on receipt of [illegible] per copy to cover postage and handling charges.

Ferris Wheel Blown Down; Seven Passengers Killed

Squall of 90 to 100 Miles Velocity Overturns Supporting Tower

A violent squall on the afternoon of June 11 blew down a small Ferris wheel at Clason Point Park, New York City. The sixteen cars of the wheel were filled with passengers, some 60 or 70 in all, and seven of these were killed or fatally injured. The accident was caused by the overturning of the leeward trunnion-support tower by the wind pressure; the wheel itself shows no indication of failure and was only little distorted in the fall.

Extensive destruction was wrought by the same squall at other points along Long Island Sound, in upper New York City and in northeastern New Jersey. Throughout the general storm area, extending over the eastern part of New York State and New England, squalls and gales with intense rainfall occurred at many points; trees and buildings were blown down and local floods occurred.



WRECKED CLASON POINT FERRIS WHEEL; LOOKING SOUTHWEST

The Clason Point wheel, built in 1910, was a combination steel and wood wheel of 63-ft. diameter journaled on a 6-in. steel shaft in bearing blocks bolted on pyramidal wooden towers about 40 ft. high. The plans for the structure were drawn by L. F. J. Weiher and A. L. B. Evrolas, architects, New York City. The wheel consisted of two side frames about 7 ft apart connected by the center shaft and the shafts from which the cars were hung. Each comprised a segmental rim built up of 4 x 8¾-in. sticks sawed to the circle and spliced with steel plates, 16 spokes of 3 x 2½ x $\frac{7}{16}$ tees, two intermediate rings of 1¾-in. tees, and thin diagonal sway rods in the transverse plane of each spoke. Each of the two towers, which were 12 ft. apart, was built of a three-post inner frame having a 10 x 12 plumb post and 8 x 8 batter posts reaching out 19 ft., and an 8 x 8 back-leg with about the same reach, all resting on 10 x 12 sills and anchored to small concrete piers under the main posts.

After the wrecking of the wheel it was found that the west or landward tower was undisturbed and its trunnion bearing block and cap were still in place, while the east tower was down to the east, to which side the wheel had also been blown. In the view herewith, looking southwest, the near edge is the top of the wheel, while the far or higher edge was the lower side before the wheel was blown down; the shaft end showing at the level of the roof of the house-boat was the west end, seated in the bearing on the undisturbed west tower in the background.

According to P. J. Reville, superintendent of buildings for Bronx Borough, New York City, who has jurisdiction over the Clason Point region, the wheel was inspected a month ago, as part of his bureau's regular spring inspection of amusement structures. It was reported in good condition. Examination since the failure has not shown specific defects and the broken sticks of the overturned east tower are not decayed, he states; some of the concrete anchor blocks are lifted and tilted, however, including the pier under the back leg of the surviving west tower.

Estimates of the overturning forces, based on a 25-lb. wind pressure in the squall and an exposed area of 600 to 800 sq.ft., indicate an overturning moment at the base of the leeward tower sufficient to produce a compression of about 40,000 lb. in the back-leg and a corresponding tension in the front leg. The sufficiency of the structure to resist high wind pressure is under investigation.

Wind velocities ranging from 60 to 100 m.p.h. are reported for the squall. The New York station of the U. S. Weather Bureau recorded a maximum 5-min. movement of 75 m.p.h., and the observatory in Central Park, about 6 mi. farther north and at much lower height above ground, 42 m.p.h. At Mount Vernon, Dr. J. W. Redway, cooperative observer of the Weather Bureau, recorded a 5-min. movement of 70 m.p.h., but estimates the maximum at 90 m.p.h. or more, corresponding to a pressure of about 30 lb. per sq. ft. At his station an abrupt jump of the barometer occurred during the squall, amounting to 1-5 in. within half a minute or less.

Am. Soc. C. E. Casts First Ballot for Official Nominees

The first ballot for official nominees of the Am. Soc. C. E. was canvassed June 1. Eliminating those who received less than 5 per cent of the votes cast, under the constitution of the society, the following are eligible for consideration in the second ballot which will be canvassed Aug. 15. The vote received by each candidate in the first ballot is noted after his name.

For president: C. F. Loweth, 1,423; John F. Coleman, 294; Andrew M. Hunt, 258.

For vice-president, Zone 2: George S. Davison, 322; R. Khuen, Jr., 93; S. T. Wagner, 58; John F. Coleman, 54; C. P. Fortney, 49; W. M. Gardner, 49; L. L. Hidinger, 44.

For vice-president, Zone 3: Anson Marston, 402; Charles H. Paul, 51.

For director, District 3: G. G. Honness, 28; Glenn D. Holmes, 23; Charles A. Poole, 21; Bruce L. Cushing, 17.

For director, District 5: E. B. Whitman, 75; H. K. Bishop, 13.

For director, District 7: George H. Fenkell, 162.

For director, District 8: A. S. Baldwin, 159.

For director, District 9: R. N. Begien, 73; James Moreland Johnson, 19; Charles H. Paul, 7.

For director, District 12: J. C. Ralston, 49; George C. Mason, 40; Eugene Carroll, 17.

Expect Further Railroad Wage Cut

News dispatches from Chicago foreshadow further railroad wage reductions by the Railroad Labor Board amounting to $40,000,000 and affecting 355,000 additional railway employees. These will include clerks, signal men, marine employees, coal passers, oilers, water tankers, freight handlers, and other common labor included in the station employee group.

Carpenters Barred by Building Unions Despite Gompers' Plea

The Building Trades Department of the American Federation of Labor has rejected a proposal by Samuel Gompers that steps be taken to reunite the Brotherhood of Carpenters and Joiners with the other building trades unions in the department. The building trades convention endorsed the National Board for Jurisdictional Awards which was responsible for the decision against the carpenters that led to their withdrawal from the department a year ago.

A.G.C. to Issue $400,000 5 Per Cent Certificates

In order to insure the carrying forward of its program of development, the executive board of the Associated General Contractors of America has authorized the issuance of $400,000 worth of 5 per cent interest bearing certificates, interest being payable semi-annually—June 1 and December 1. The certificates are to be retired within five years, will be issued in denominations of $100 and $500 and will constitute a prior lien on the dues and assets of the A.G.C. The sale of certificates will be handled by the executive board, advisory board and president's council of the A.G.C.

A. A. E. Convention

(*Concluded from p.* 1012)

tions and outings. An understanding of the organization by the women promotes attendance, it was found.

The incoming president, A. N. Johnson, summed up the aims of the organization as follows:

"Until the formation of the A. A. E., the engineering profession as a whole was represented by no single organization, the welfare of the individual was a matter for individual concern, the engineer's responsibility to his profession was unstressed, that of his profession to the public welfare unrealized. To supply these fundamental needs has been, and will continue to be, the motive that actuates the association.

New President of A. A. E.



A. N. JOHNSON

"Never before has the association been confronted with a greater opportunity to render service. Each member must be imbued with the spirit of service to his fellows and to his community, for in no other way can the individual benefit by the association, or the association be of benefit to the profession."

Because of the singleness of purpose of employment between A. A. E. and the Federated American Engineering Societies there should be little difficulty in working out a plan of mutual benefit, asserted Mr. Johnson. Both cooperation in university extension work and the promotion of public undertakings A. A. E. is peculiarly well organized to foster is his belief. "It must be the constant endeavor on the part of those charged with the guidance of the policies of the association," he continued, "to let no opportunity escape to join in every effort that makes for the greater usefulness of our profession. The day of petty jealousy has passed. Let us keep ever before us our ideals, to make the engineer of greater worth to himself and his profession that we may make its contribution towards the common good the greatest of all professions."

Professor Rockwell, of Tufts, To Be Rutgers Engineering Dean

After almost twenty years connection with the faculty of the engineering school of Tufts College, Mass., Prof. Edward H. Rockwell will leave in June to accept the position of dean of engineering at Rutgers College, New Brunswick, N. J. During the past four years Prof. Rockwell has been head of the department of civil and structural engineering at Tufts.

Professor Rockwell was graduated from Worcester Polytechnic Institute in 1890 with the degree of B.S., receiving a degree of C.E. from that institution last year. For twelve years prior to his going to Tufts, he was engaged in practice of civil engineering in Chicago, Worcester and Boston. Besides his professional duties, he has acted as consulting engineer on state, county and private work. He was elected instructor of civil engineering at Tufts in 1902, assistant professor in 1903 and professor of structural engineering in 1906. In 1918, he was placed in charge of both the civil and structural engineering departments.

He is a member and past president of the Boston Chapter of the American Association of Engineers, a member of the council of the Society for the Promotion of Engineering Education, a member of the American Society of Civil Engineers, of the American Association of University Professors and of the Council of the Affiliated Technical Societies of Boston.

Increasing interest in engineering at Rutgers has caused that college to call upon Professor Rockwell to carry forward its plans.

Would Investigate Diversion of Lake Michigan Water

(*Washington Correspondence*)

An exhaustive investigation of the whole question of the diversion of water from Lake Michigan was assured, it is believed, when the Committee on Rivers and Harbors reported favorably on May 23 on the resolution requesting the Secretary of War to furnish facts as to the effect of the diversion upon the depths of the harbors and channels of the Great Lakes and as to the damage that will result by the discharge of the waters, after they have been polluted by the sewage of Chicago, through the Illinois River. The committee calls the attention of the House to the fact that the channel of the Illinois River is insufficient to receive the volume of water which it is proposed to pass through it. Information is requested also as to the effect of the project upon the lands adjacent to the Illinois River and the health of the people living near that stream.

Vote Money for Chicago Bridges

Bond issues of $3,100,000 for bridges and viaducts and $2,000,000 for extension of the street lighting system were approved by the voters of Chicago on June 5. The bridge bonds are needed for the completion of the Madison St. bridge and Roosevelt Road bridge and viaduct. Work on these projects has been stopped for some time owing to lack of funds, leaving them in such condition as to obstruct and inconvenience traffic seriously.

Congress Approves 3-Year Federal Road Program

Annual Appropriations of $50,000,000 Provided—Creation of Deficit is Authorized

(*Washington Correspondence*)

State highway officials and all others directly interested in highway construction seem to be pleased with the highway legislation which now has been approved by each House of Congress. The fact that the conferees provided for a three-year program carrying $50,000,000 annually, increased the maximum of federal contribution, and gave the Secretary of Agriculture the right to make contracts prior to the actual appropriation of next year's funds, more than offsets the reduction of $15,000,000 in the appropriation for the next fiscal year.

There is some fear that a maximum of $16,250 per mile for the federal contribution will discourage the construction of certain roads particularly in mountainous or swampy sections where construction is difficult. With the increasing need for wider and thicker surfacing, the opinion of most federal and state highway officials is that the maximum should be raised instead of lowered.

There are 14 states that will have used up their federal-aid allotments at varying times during the course of the fiscal year beginning July 1. To meet that situation without the actual appropriation of funds the conferees established a precedent by authorizing the Secretary of Agriculture to create a deficit by obligating the federal government to meet payments on road contracts when the money is available. Under this arrangement, the $50,000,000 authorized for the fiscal year beginning July 1, will not have to be appropriated until near the close of that year.

Authorizes Barge Line Between St. Louis and New Orleans

After a thorough study of the situation, the Secretary of War has authorized Edward F. Goltra, of St. Louis, to operate a barge line between St. Louis and New Orleans on the Mississippi River. For several years the Government has been conducing an experiment in transportation on the Mississippi and Warrior Rivers. The Secretary of War is anxious that nothing interfere with the working out of that experiment, but finally gave the necessary permission to Mr. Goltra in the belief that there is ample tonnage to support both lines.

Chevalier Promoted to Colonel in Engineer Reserve

Willard T. Chevalier, who served with the 11th Engineers in France during the World War with the rank of captain, major and lieutenant-colonel, has been commissioned colonel in the Officers Reserve Corps. Col. Chevalier, who joined the staff of *Engineering News-Record* as associate editor early this year, becomes commanding officer of the 302d Engineers, succeeding Col. William Barclay Parsons, promoted to the position of deputy chief engineer of G. H. Q. Engineer Headquarters.

New Engineering Building for Michigan Students

The Michigan Alumnus announces that plans have been approved and contracts prepared for the new engineering shops and laboratory for the University of Michigan. This building, for which approximately $750,000 has been appropriated, will be approximately 190 x 223 ft.

The building was designed by Smith, Hinchman & Grylls, Detroit architects.

Plan New Series of Road Tests at Pittsburg, Cal.

The California Highway Commission, jointly with the U. S. Bureau of Public Roads, and with the co-operation of the Columbia Steel Co. in the use of its property, is to continue to completion the Pittsburg highway tests started last spring by the company to investigate the strength of different types of concrete highways, with particular reference to the effect of reinforcing steel. At the conclusion of the tests already instituted, the commission and the federal bureau expect to start an entirely new series of tests on the same ground, which has been offered for the purpose by the steel company.

Brick Used for First Time on State Highway in Indiana

Contract for the construction of the first brick road in Indiana to be built under the direction of the state highway department was recently let at a cost of $219,916.78. Indiana was one of the last states in the union to establish a highway department, and while many miles of brick roads have been constructed in the past by the various counties, the contract just let is the first action of this kind by the state.

The section to be paved with brick is 6.897 miles long and extends from Putnamville to a point 1½ miles east of Mt. Meridian. It is a part of the old National Road which runs entirely across the state, and is the principal traffic route between Indianapolis and Terre Haute.

Decision of the state highway department to use vitrified brick on this road is in accordance with the recent announcement by Gov. W. T. McCray that brick roads would be included in this year's program. The bid for brick is $111,916.78 more than the low bid for concrete on this section. The design calls for a 5-in. concrete base, 3-in. vertical-fiber brick and asphalt filler. The work will be done by the Carpenter Construction Co., of Terre Haute.

Civil Service Examinations

UNITED STATES

For the United States civil service examinations listed below apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the Civil Service Commission.

Vacancies in the Bureau of Public Roads.

Junior Civil Engineer, $1,200 a year.

Junior Highway Bridge Engineer, $1,200 to $1,600 a year.

Examination June 21.

Highway Bridge Engineer, $1,800 to $2,100.

Applications to close June 27.

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Annual Convention, Portsmouth, N. H., June 21-22.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, University of Pittsburgh; Annual Convention, University of Illinois, June 20-23.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual Meeting, Atlantic City, N. J., June 26-30.

NEW ENGLAND WATER WORKS ASSOCIATION, Boston; Annual Convention, New Bedford, Mass., Sept. 12-15.

The Seattle branches of the American Society of Civil Engineers and the American Association of Engineers listened recently to a discussion upon scientific methods of making concrete delivered by Prof. Durf A. Abrams of the Lewis Institute, Chicago. Prof. Abrams is making a tour of the western states.

Personal Notes

JOHN R. VAN SICKLE, for the past five years associate professor of civil engineering at the Mississippi Agriculture and Mechanical College, resigned June 1 to take up work as designer for the Virginia Bridge & Iron Co., Roanoke, Va.

ROBERT S. PARSONS, since 1920 general manager of the Erie R.R., has been elected vice-president in charge of operations of that company.

L. D. BLAUVELT, consulting engineer, Denver, Col., has been appointed chief engineer of the Moffat Tunnel Commission which is to carry out the public project for a six-mile railway tunnel in Colorado, as described in *Engineering News-Record* of May 18, p. 836.

C. M. HATHAWAY, district engineer of the Illinois State Division of Highways, has been appointed engineer of construction to succeed B. H. Piepmeier, resigned to become state highway engineer of Missouri.

F. S. ALTMAN has been appointed district engineer for the Portland Cement Association with headquarters at Minneapolis, Minn. Mr. Altman has been with the Portland Cement Association as engineer of the Kansas territory since his return from France where he served as captain in the 23rd Engineers. Before the war Mr. Altman was city engineer of Atchison, Kansas.

E. R. SHEPARD, who has been prominently connected with the electrolysis work of the U. S. Bureau of Standards, has resigned to continue the same line of work independently at Washington, D. C.

CHARLES ENZIAN has opened a consulting engineering office in Philadelphia where he will engage in general consulting engineering practice, specializing in examinations, analyses and reports of undeveloped and developed coal properties for operating companies, financiers and land owners.

FRANCIS A. DEVER, assistant engineer for the Duluth, Missabe & Northern R.R., has been awarded the Strathcona Memorial Fellowship in transportation at Yale University for the next academic year. Mr. Dever was graduated from the college of engineering and architecture, University of Minnesota, in 1920.

PROF. JACOB O. JONES, who has been associate professor in the department of mechanics at the University of Kansas, has accepted the position of associate professor of hydraulics in the college of engineering and architecture of the University of Minnesota. In addition to regular instruction work, Prof. Jones will devote special attention to research and laboratory investigations in experimental hydraulics.

W. R. KETTENRING, office engineer of the Chicago & Northwestern Ry., has been appointed auditor of capital expenditures to succeed the late A. S. Morris. Mr. Kettenring is a graduate of Cornell College, Iowa, and has been in the engineering department of the C. & N. W. Ry. since 1902.

STANLEY H. WRIGHT, who has been associated for a number of years with J. W. Ledoux, consulting engineer, Philadelphia, has joined the engineering staff of the Gilbert C. White Co., consulting engineers, Durham, N. C. Mr. Wright will be engaged in the design and construction of waterworks and his headquarters will be at Hendersonville, N. C.

PROF. ARTHUR J. WOOD, until recently professor of railway mechanical engineering, Pennsylvania State College, has been appointed head of the department of mechanical engineering to succeed Prof. E. A. Fessenden who has gone to Rensselaer Polytechnic Institute. Prof. Wood has been in the department of mechanical engineering in the Pennsylvania State College since 1904. Recently he has had direct charge of the engineering experiment station.

HENRY P. CAMPBELL, senior assistant city engineer of Indianapolis, resigned recently to enter a private engineering firm. He was appointed at the beginning of the present city administration. In addition to his work as assistant to John L. Elliott, city engineer, he also was in charge of track-elevation work. The board of public works accepted the resignation, which became effective June 10, and named MELNOTT N. BEEBE, street engineer, to fill the place, at the same time promoting WILLIAM LACEY, an assistant engineer, to the position of street engineer. Both Mr. Beebe and Mr. Lacey have been in the department for several years. Mr. Lacey's old place will not be filled at the present time.

C. G. TROWBRIDGE, former city engineer of Decatur, Ga., has resigned to engage in engineering work with a local investment company.

BUSINESS NOTES

HORACE M. BRINGHURST, former sales engineer for the General Iron Works Co., Cincinnati, Ohio, has been made sales engineer in the Kansas City office of the Paul J. Kalman Co., Inc., Chicago, Ill., fabricators of reinforcing steel.

THE MARCK ENGINEERING & CONTRACTING COMPANY, an organization which has for the past three years been operating in the West Indies with offices at Santo Domingo, has opened offices in Brooklyn, N. Y. The company expects to facilitate movement of American materials and machinery for work in Latin America through the addition of its Brooklyn office.

JOHN M. BAILEY, who for more than twenty years has been secretary of the Pittsburgh Testing Laboratory, has been elected vice-president and secretary of the Standard Inspection Co., a building-inspection organization with offices in Pittsburgh. Previous to his association with the Pittsburgh Testing Laboratory Mr. Bailey was with the Burden Iron Works, Troy, N. Y., and the Portland Rolling Mill Co., Portland, Me.

THE AIR REDUCTION SALES CO., handling welding and cutting apparatus and supplies, announces the following change in personnel: A. R. Ludlow, former vice-president in charge of sales, is now first vice-president; M. W. Randall, former secretary, is vice-president and secretary; Herman Van Fleet, former chief engineer, is now vice-president and operating manager; Dr. F. J. Metzger is vice-president in charge of research and development.

THOMAS B. HUDSON has resigned his position with the Whiting-Turner Construction Co., Baltimore, Md., and has opened offices in Baltimore and Washington, where he will represent the McFarland-Meade Co. of Philadelphia, manufacturers of steel sash, fireproof doors and windows, ornamental steel stairs and sheet-metal products.

J. M. KRYL, president of the Kryl Bridge and Crane Works, Chicago, and W. H. EICHELMAN, until recently chief engineer of the Hamler Boiler & Tank Co., have established a partnership for the fabrication of steel. The location of the new firm is Chicago.

THE NEW JERSEY CONCRETE PRODUCTS CORP., announces the acquisition of the factory of the [illegible] Cast Concrete Co. near Dover, N. J., and the extension of its own facilities to supply in addition to precast structural concrete and ornamental stone, other concrete products such as building tile, face and common brick. The factory of the corporation is at Dover, N. J., and its executive office in New York City.

JOHN F. SCHURCH has been elected a vice-president of Manning, Maxwell & Moore, Inc., and has taken charge of the company's western sales. His headquarters will be in the company's Chicago office. Mr. Schurch was graduated from the University of Minnesota in 1893 and since his graduation has held successive positions with the Minneapolis, St. Paul & Sault Ste Marie R.R., the Railway Materials Co. of Chicago, and with the T. H. Symington Co. as vice-president.

OBITUARY

CHARLES A. WILLARD, building contractor, died at his home in Long Beach, Cal., May 2, age 62 years.

P. H. CONNOLLY, city engineer of Racine, Wis., died at his home in that city recently. Mr. Connolly was a graduate of the University of Wisconsin and a member of the Engineering Society of Wisconsin, the Western Society of Engineers, and the American Society for Municipal Improvement.

ALVIN E. GRAVELLE, civil engineer, Los Angeles, Cal., died April 28. As engineer with the Wisconsin Bridge & Iron Co. about 1900 he designed the fixed-trunnion bascule bridge over the Milwaukee River at Grand Ave., Milwaukee, Wis. (*Engineering News*, July 3 and 31, 1902, pp. 19 and 81). Later he was associated with John Geist, consulting engineer, at Milwaukee, in the design of the Broadway bascule bridge over the same river. He then went to the American Bridge Co., leaving a few years later to become assistant bridge engineer at Cleveland, Ohio.

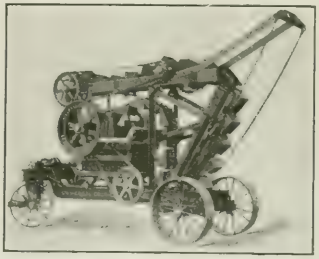
COL. RICARD O'SULLIVAN BURKE, for many years engineer of harbor work for the city of Chicago, died May 11 at the age of 84. He was born in Ireland in 1838 and came to this country in 1857. He served in the U. S. Army during the Civil War, becoming a captain of engineers and being mustered out with the rank of colonel. In 1887 he entered the engineering department of Chicago, being in charge of water-pipe extensions. Later he became superintendent of sewers for about two years, but then returned to the engineering department as engineer in charge of harbor work, which position he held until his retirement in 1917. Col. Burke was a member of the Western Society of Engineers.

EQUIPMENT AND MATERIALS

Cast Steel Portable Rock Crusher

A new portable rock crushing plant [illegible] has been produced by the Universal Crusher Co., Cedar Rapids, Iowa. The feed of the crusher is said to be smoother and [illegible] than the former equipment. With a [illegible] crusher operating the new plant [illegible] ton.

This outfit is made in all sizes for road work, the crusher openings ranging from 10x16 in. to 15x36 in. Another feature is the improved truck frame with double gooseneck made continuous with the I-beam sides and se-



curely trussed. The I-beams are 8 to 12 in., according to the size of the plant.

High Speed Locomotive Crane

Clutch design which simplifies the mechanism and permits quick operation is the special feature of a locomotive crane recently put on the market by the Moore Brothers Crane Co., Chicago. In the accompanying view this crane is shown handling a grab bucket but it is adapted also for use with a 1-yd. drag-line bucket. A patented gear-shift device enables one



clutch to do the work of three separate clutches, and this one clutch provides for swinging and propelling the machine and luffing the boom. The only other clutch used is for the drum. In this way a reduction in number of shafts, gears, levers and bearings is obtained. A 35-ft. V-shaped boom is used and the machine is mounted on traction wheels. Its weight is about 14 tons with tank and bunker empty.

Out-of-the-Ordinary Trade Publications

"How To Build a Better Home" is a handsome and useful pamphlet published by the COPPER AND BRASS RESEARCH ASSOCIATION, New York City. Besides pointing out the values of non-rusting metals for the home builder the pamphlet contains an instructive discussion, with pictures, of residence construction.

[illegible] one tool as good a technical [illegible] of slate as it is adapted to and used in electrical work [illegible] is furnished in a 40-page pamphlet entitled "Slate For Electrical Uses" published by the STRUCTURAL SLATE CO., Pen Argyl, Pa. The tabulations of the properties of slate are particularly useful.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Normal Price Level Illusory, Says Noted Economist

Professor Irving Fisher Believes Essence of Normality Is Price Stability, Not a Particular Level

A significant view of coming price conditions and their relation to past experience is expressed below by Irving Fisher, professor of political economy, Yale University, world famous as an authority on financial trends. His statement is a reply to the following letter addressed to him by the editor of "Business Side of Construction:"

"There is so much interest in what the "new normal" for prices should be that Engineering News-Record *would like to treat the matter in its Business Side of Construction. Your views will be most welcome and will help us reach a useful conclusion."*

"Since the war, prices have been compared with 1913 or 1914, and nearly all index numbers are based upon a pre-war year. Many are of the opinion that the new normal will be about 50 per cent above the 1913 price level. On the other hand not a few believe that the present 1913 base should be maintained, and that prices will gradually move down to it again over a period of years."

"Will there be a new normal? If so, what will it be?"

"In reply to yours of June 2 I would say that I think the 'new normal' for prices is a delusion and a snare. I have collected and charted all the index numbers of price movements from the earliest time, which I have been able to gather together. This history of prices shows that there never has been any 'normal.' The price level today in France is about thirty times what it was a thousand years ago, according to the somewhat shaky data which we have. We have good data, however, for England, beginning in 1782. Prices fell between 1782 and 1789, rose between 1889 and 1909, about doubling, fell between 1809 and 1849 (with many oscillations in between) to below what they were in 1789, rose between 1849 and 1873 about 50 per cent, fell between 1873 and 1896 about 25 per cent, rose between 1896 and 1914 about 35 per cent, rose much more rapidly between 1914 and 1920 to over three-fold, and have fallen about 50 per cent since that time. That is, throughout history the price level has constantly changed. Or, in other words, the purchasing power of the dollar or other monetary unit, has constantly changed in the inverse ratio. Exactly the same thing is true in the United States for the 120 years for which we have index numbers of prices."

"But there is always the illusion that a few years ago there was a "normal" which we want to reach again. This was true after the Civil War. It was true in the Bryan campaign in 1896 when the cry of Bryan and his followers was to give us back the "Dollar of the Daddies." Before the war the whole world was excited over the "High Cost of Living" which assumed that the price level was "abnormally high." There was vague talk about going back to the price level of ten years before. After the war it was natural to consider the war as the disturbing element and the pre-war price level as "normal." Hence the cry for "Back to Normalcy" and a deflated price level. Deflation has been partly accomplished, with the result of the most disastrous depression of trade the country has ever had. In every situation people look longingly back to the "good old times" of a few years before which they can remember. Recently the oscillations of prices have been so rapid that some people still look longingly back to the pre-war price level, while others look longingly back to the price level of 1920. The danger is that there will therefore be two parties, one for inflation and one for further deflation. As Reginald McKenna, formerly Chancellor of the Exchequer of Great Britain and now President of the London Joint City and Midland Bank, the largest bank in the world, has so well said there is not and never has been any normal and, in the long run, one normal is as good as another, while the constant effort to cure inflation by deflation and deflation by inflation threatens us with an alternation of evils, and both are equally bad. Central Europe is cursed with inflation just as England and the United States are cursed with deflation today. What we want is a stable price level and once we have got it, whether it is high or low, it should be regarded as "normal." This must be obtained by some kind of legislation similar either to such as I proposed in my "Stabilizing the Dollar" proposed, in accordance with that plan, in Congress by Representative Dallinger's bill of Massachusetts and by the bill of Representative Goldsborough of Maryland, or by the plan of Professor Cassel or any other plan that will work. Without some plan we are sure to continue oscillating. No one can do more than guess as to what the future holds in store. My own guess is that, in the immediate future, unless stabilization is achieved by appropriate legislation, we shall find prices rise for the next couple of years or so. After the peak has been reached and the credit extension again strained in the United States while gold is being drawn away to Europe there is a prospect of a long gruelling fall of prices. Beyond this I would not even try to guess."

"I hope I have made it clear that while I believe that one 'normal' is just as good as another, some normal is of vast importance. The essence of normality in the price level is not a particular level of prices but constancy. An inconstant price level plays havoc—rising prices, making all the evils associated with the phrase the 'high cost of living' and falling prices, all those associated with the phrase the 'depression of trade,' although several kinds of other evils besides 'high cost of living' and 'depression of trade' are involved. These alternations cost the world billions of dollars a year in waste motion, discontent and injustice and some day we must surely put a stop to them."

Cement Up in the West

The recent rise in cement prices at the Northampton, Pa., and Hudson, N. Y., mills has been followed by a similar advance in several of the production centers of the Middle West and at one in the South.

The rise, attributed to higher coal prices, amounts to 10c. per bbl. at the mills in Buffington, Ind., Universal, Pa., Steelton, Minn., and 15c. at Fordwick, Va.

The mill change is reflected in an increase of 19c. in Toledo, 20c. in Detroit, and 10c. per bbl., f.o.b. 12 other Mid-Western cities, including Chicago. New York quotations remain as reported last week.

Foreign Construction Being Done by New York Firms

Six more important foreign construction projects are here added to the list, as published in the *Engineering News-Record* on April 20, of New York contractors, all of whom are building in Central and South America. Total values of the contracts amount to $29,500,000, the two largest to Dwight P. Robinson & Co., Inc., for $15,000,000; and Ulen Constr. Corp., for $10,000,000. Following are details of jobs:

Name and Address Of Contractor New York City	Kind of Work	Where Work Is Located	Cost	When Started	Expected completion	Name of Owner
Stone & Webster 120 Bway.	Office Building	Buenos Ayres	$200,000	April, 1922	Feb., 1923	All American Cables Inc. New York City
Ulen Co., 120 Bway.	Railroad, including stations and terminals	Bolivia	10,000,000	Aug., 1921	1927	Bolivian Gov't.
Dwight P. Robinson & Co., Inc., 125 E. 46th St.	Embassy Building	Rio de Janeira, S. A.	300,000	Jan., 1922	Sept., 1922	U. S. Gov't.
Dwight P. Robinson & Co., Inc., 125 E. 46th St.	Irrigation work including 5 dams	Northeastern Brazil	15,000,000	1921	1925	Brazilian Gov't
R. W. Hebard & Co., Inc., 40 Rector St.	200 Kilometers of modern highway	Republic of Panama	4,000,000	April, 1921	1925	PanamanianGov't.
R. W. Hebard & Co., Inc., 40 Rector St.	Group of Concrete Buildings	Santa Elena Ecuador	100,000	July, 1921	June, 1922	All American Cables Inc., New York City

Largest May Public Bond Sales Since 1892

Municipal bonds sold in May throughout the United States totaled $101,113,982, which is $36,000,000 less than in April, but nearly $38,000,000 heavier than in May, 1921. In fact, according to the *Commercial and Financial Chronicle*, this May's sales exceeded the May figures for the last thirty years.

Municipalities emitting permanent bonds numbered 587 during May, 1922, as against 339 for April, 1922, and 326 for May, 1921. The number of separate issues made during May, 1922, were 782 as compared with 607 for April, 1922, and 419 for May, 1921.

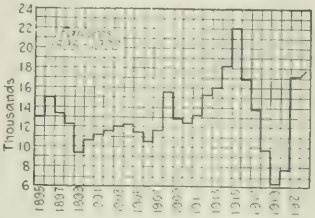
Among the more important new issues during May, 1922, were the following: Baltimore, $8,332,000 5s at 107.805, a basis of about 4.3 per cent; Boston, $4,223,000 4s at 100.71, a basis of about 3.95 per cent; Norfolk, Va., $3,165,000 5s at 103.569, a basis of about 4.56 per cent; Cleveland, O., $3,593,000 4½s at 103.13, a basis of about 4.38 per cent; Buffalo, N. Y., $2,230,000 4½s at 103.575, a basis of about 4.10 per cent and Columbus, O., $1,755,000 5s at 105.789, a basis of about 4.39 per cent.

The accompanying list of thirty-five representative issues shows thirty-two sold above par and three at par; the yields ranging from 4.20 to 5.23 per cent. The rates varied from 4½ to 6 per cent. All those drawing 6 per cent were west of the Mississippi, while the 4½s and 4¾s were nearly all in the New England and Middle Atlantic states.

Failures Last Week and Since 1895

While the 440 failures reported for the week of June 10 show an increase over the 407 defaults for the previous week, that may be due, at least in part, to the fact that this week, without a holiday, contained one more business day than did last week. The present level, however, is much higher than last year, when only 300 failures were reported to R. G. Dun & Co. for the corresponding week.

The current week's failures involving $5,000 in each instance totaled 243, or a percentage of 55.2 of the aggregate number. Last week, with 244, or only one more default with liabilities over $5,000, the percentage was distinctly higher, being 60.0, while a year ago the corresponding figures were 167 insolvencies and 55.6 per cent.



Canada's total failures this week were 55, a decided decrease from the 70 of the previous week, but still higher than a year ago, when the total figure was 32. Of the current Canadian defaults, 29 had liabilities of $5,000 or more in each case, compared with 35 last week.

REPRESENTATIVE BOND SALES OF MAY AND JUNE, 1922

County	Purpose	Amount	Maturity	Rate Per Cent	Basis	Sold For	Dated	Purchased by
Butler, Mo	Road	$300,000		5	.....	102.86	.....	Kauffman, Smith, Emert & Co. and Wm. R. Compton Co., St. Louis, Mo.
Douglas, Minn	Drainage	6,200	1937	6	5.23	108	May 1, 1922	Minneapolis Trust Co., Minneapolis, Minn
Floyd, Ind	Road	35,040		5		103.93		Fletcher Savings & Trust Co., Indianapolis, Ind.
Hamilton, Ind	Concrete road	48,000		4½		100		Citizens State Bank of Noblesville
Hancock, Ohio	Road	71,000	1923–32	5½	4.41	103.10	May 1, 1922	Prudden & Co., Toledo, Ohio
Kosciusko, Ind	Road	16,860	1923–32	5	4.65	101.98	Apr. 3, 1922	Meyer-Kiser Bank of Indianapolis, Ind
Lac Qui Parle, Minn	Ditch	166,600	1928–42	5½		101.47	July 15, 1922	Minnesota Loan & Trust Co., Northwestern Trust Co. and Lane, Piper & Jaffray, Inc.
	Ditch	3,650	1923–32					
Little Rock Creek Palmdale Irr. Dist. Los Angeles Co., Cal...	Ditch	660,000	1925–60	6		100		The California Bank, Citizens Nat. Bank, Stevens, Page & Sterling, Sheldon & Lancaster, Ramsdell & Lasher and John O. Knight & Co., all of Los Angeles
Lyon, Nev.	Highway	41,500	1934	6		101.27	Apr. 15, 1922	Palmer Bond & Mortgage Co., Salt Lake City.
Marion, Ind.	Track elevation	250,000	1923–37	5	4.21	105.86		
	Home	150,000	1923–37	5	4.30	104.70	May 25, 1922	Union Trust Co. of Indianapolis.
	Bridge	35,000	1923–32	5	4.29	103.42		
Montgomery, Ohio....	Highway extension	17,500	1922–42	5	4.948	102.42	May 1, 1922	A. C. Allyn & Co., Chicago.
		11,050	1923–32	5½	4.95	102.82		
New Castle, Del	Highway	150,000	1926–36	4½	4.40	101.26	June 1, 1922	Guaranty Co. of New York.
	Bridge	55,000	1966–67	4½	4.40	101.26	June 1, 1922	
	Bridge	50,000	1938–44	4½	4.40	101.26	June 1, 1922	
Nobles, Minn	Ditch	75,000	1928–42	4½		101.36	June 1, 1922	Lane, Piper & Jaffray, Inc., and Drake, Ballard Co.
St. Joseph, Ind	Highway	23,500	1923–32	5	4.62	101.90	May 15, 1922	J. F. Wild & Co., State Bank.
		25,000	1923–32	5	4.62	101.905	May 15, 1922	J. F. Wild & Co., State Bank.
		49,000	1923–32	5	4.61	101.93	May 15, 1922	Fletcher Savings & Trust Co.
		31,000	1923–32	5	4.62	101.91	May 15, 1922	Fletcher Savings & Trust Co.
Seneca, Ohio.....	Highway	45,000	1923–31	5½		102.12	May 1, 1922	Breed, Elliott & Harrison, Cincinnati; Prudden & Co., Toledo.
		18,000	1923–31	5½		102.12	June 1, 1922	
		81,000	1923–31	5½	5.17	102.63	June 1, 1922	Richards, Parish & Lamson
Tippecanoe, Ind	Highway	18,700	1923	5	4.60	101.99	Apr. 15, 1922	Fletcher Savings & Trust Co., Indianapolis, Ind.
Municipality								
Beaver, Pa	Gen. improvement	$50,000		5		107.16	May 29, 1922	Ft. McIntosh Nat. Bank, Beaver, Pa
Birmingham, Ala	Pub. improvement	88,500	1932	5		102.14	June 1, 1922	Steiner Bros. & Co., Birmingham, Ala
Cadillac, Mich	Sewage disp.	65,000	1926–34	5		100	July 1, 1922	Mrs. W. W. Mitchell, Cadillac, Mich
Dearborn, Mich	Street imp't.	55,000	1942	4½	4.48	100.25	June 1, 1922	First National Co., Dearborn, Mich
Ithaca, N. Y	Pavement	4[illegible]	1923–40	4½		101.10	June 1, 1922	Clark, Williams & Co. and C. W. Whitis & Co.
	Sewer	200,000	1924–45					
	Pavement	50,000	1941					
Evansville, Ind	Park	175,000	1924–29	5	4.69	101.91	Apr. 1, 1922	City National Bank, Evansville, Ind.
	Pub. impv't.	125,000	1924–29	5	4.68	101.97	Apr. 1, 1922	
	Waterworks	140,000	1924	5	4.42	104.18	June 1, 1922	
Grand Rapids, Mich	Sewer	20,000	1937	5	4.93	100.61	Apr. 15, 1922	Kalman Wood & Co., Minneapolis, Minn.
Harrisonburg, Va...	Water	150,000	1927–51	5	4.98	100.089	May 27, 1922	Wm. R. Compton Co., St. Louis, Mo.; Graham & Co., New York City
Indianapolis, Ind.	Highway connecting link	36,500	1923	5		102.94	May 29, 1922	Meyer-Kiser Bank of Indianapolis, Ind.
Lima, Ohio	Intercepting and outfall sewer	50,000	1923–42	5	4.58	104.113	May 1, 1922	Taylor, Ewart & Co., Inc., & P. Lyons & Co., Inc., Sioux City, Iowa
Middletown, N. Y	School	320,000	1924–60	5	4.70	104.344	June 1, 1922	Ward Securities Co. of Milwaukee
Milwaukee, Wis	School	500,000	[illegible]	4	4.10	103.041	June 1, 1922	E. H. Rollins & Sons, New York City; Eastman, Dillon & Co.; Wm. A. Read & Co., New York City; Harris, Forbes & Co., New York City; Hornblower & Weeks, Boston; Higbie & Co., Detroit; Equitable Trust Co. all of New York City
	Elec. lights	200,000	[illegible]	4	4.10	103.041	June 1, 1922	
	Park	[illegible]	[illegible]	4	4.06	105.041	June 1, 1922	
	Street	[illegible]	[illegible]	4	4.36	105.041	June 1, 1922	
	Bridge	600,000	[illegible]	4	4.24	105.041	June 1, 1922	
	Harbor impr'v't.	500,000	1942	4	4.10	103.041	June 1, 1922	
	Sewer	[illegible]	1942	4	4.10	105.041	June 1, 1922	
New London, Conn	Public improv't	[illegible]	[illegible]	4½	4.20	102.31	June 1, 1922	Woodmen Trust Co., New London, Conn.
Niagara Falls, N. Y	City Hall Bldg.	[illegible]	[illegible]	5½		104.27	June 1, 1922	Sherwood & Merrifield, New York City
Omaha, Neb	Street impr'v't	[illegible]	1942	4½	4.45	100.69	June 1, 1922	National City Co., Chase Securities Corporation and Continental Trust & Savings Bank, Chicago
Portland, Ore	Special impr'v't	317,954	1932	6		105.300		
						104.40	May 20, 1922	Coffin & Burr, Inc., Boston
						104.70		H. L. Allen & Co., New York City
						104.248		
						104.32		Ann Lawrence & Co., Inc., New York City
						104.3		Graham, Parsons & Co., Philadelphia
Puyallup, Wash.	Water	[illegible]	[illegible]	[illegible]	[illegible]	101.07	May 31, 1922	Harris, Forbes & Co., New York City
Salem, N. J.	Waterworks	45,000	[illegible]	6	5.23	102.28	June 15, 1922	R. L. Day, Boyd & Co., Boston, Mass.
Schenectady, N. Y..	Public improv't	[illegible]	[illegible]	4½	4.15	101.678	June 1, 1922	National City Co., New York City
	Sewers	[illegible]	[illegible]					
	Public impr'v't.	[illegible]	[illegible]					
	School	[illegible]	[illegible]					

Freight Loadings Increase

Reports of the Car Service Division, American Railway Association, show that in the week ended May 20, 1922, 792,459 cars were loaded with revenue freight. This is 15,100 cars in excess of the loading in the previous week, and is the best record made in any week since April 1st. Compared with the preceding year, the total loading increased 21,468 cars. Comparison with the 1920 performance, however, shows a decrease of 69,615 cars.

SURPLUS AND SHORTAGE STATEMENT—MAY 15 TO 23, 1922

Districts	Flat Cars Surplus	Flat Cars Shortage	All Box Cars Surplus	All Box Cars Shortage	All Coal Cars Surplus	All Coal Cars Shortage	Total All Cars Surplus	Total All Cars Shortage
Eastern	847	...	12,577	..	72,606	...	90,448	...
Allegheny	472	...	10,895	...	101,311	...	116,279	...
Pocahontas	11	..	822	..	409	...	2,332	...
Southern	2,062	18	6,106	374	2,834	66	15,230	460
Northwestern	857	..	23,658	..	2,370	...	33,576	10
Central western	428	97	18,864	5	25,624	...	58,600	102
Southwestern	675	58	6,612	144	3,537	...	13,169	202
Total	5,352	173	79,534	523	208,691	66	329,634	774
Canadian roads	1,430		22,385		1,135	...	31,850	
Grand total	6,782	173	101,919	523	209,826	66	361,484	774
May 15, 1922	6,511	86	108,865	252	219,766	449	377,764	816

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of June 1; the next, on July 6.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	+$2.68	$3.50	$4.00	$2.48	+$2.86	$3.50	$3.10	$3.60	$3.75
Structural rivets, 100 lb.	+3.00	4.25	5.50	3.10	3.90	4.45	4.50	3.75	6.50
Reinforcing bars, ¾ in. up, 100 lb.	+2.58	3.50	3.50	2.38	+2.76	3.52½	2.55	3.60	+2.90
Steel pipe, black, 2½ to 6 in. lap, discount	61%	61.15%	45%	59½%	61.9–5%	44%	49.1%	53%	30.00
Cast-iron pipe, 6 in. and over, ton	48.80@49.80	+48.50	48.30	44.10	50.50	57.00	51.00	52.00	50.00
Concreting Material:									
Cement without bags, bbl.	2.40@2.50	2.34	2.25	+2.07	+2.34	2.90	2.83	2.94	2.48
Gravel, ¾ in., cu.yd.	1.75	1.85	2.25	1.80	1.50	1.75	2.25	1.25	1.50
Sand, cu.yd.	1.00	1.15	2.25	1.80	1.00	0.75	1.50	1.25	1.25
Crushed stone, ¾ in., cu.yd.	1.75	1.90	2.73	1.60	2.25	3.50	2.25	3.00	+2.00
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	49.00	38.00	34.50	45.00	+40.00	+49.00	27.00	21.50	47.00
Lime, finishing, hydrated, ton	15.80@16.80	22.50	25.00	18.00	29.00	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	2.75@3.18	1.75	2.50	1.40	1.40	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000.	23.50	10.00	11.15	11.00	16@17	12.00	15.00	14.00	16.00
Hollow building tile, 4x12x12, per block	Not used	.075	.115	.0707	.082	.08	....	.12	.09
Hollow partition tile 4x12x12, per block	.1112	.0707	.115	.0657	....	.08	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal.	−.86	−.92	1.09	−.96	−.98	−1.10	1.04	.86	+1.07
Common Labor:									
Common labor, union, hour	.75	.35	.....	.80	.....	.50@.55	.56½	.50@.60	....
Common labor, non-union, hour	.44@.60	.20	.25	.72½	.35@.50	.35@.50	.47½@.50	.....	.20@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or − signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.10 for Kelly Island and $1.55 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks.

Montreal quotes on fir instead of pine. Sand, stone, gravel and lump lime per ton. Lime and tile are delivered; cement, sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.13 cents). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $30; 6-in., $110.

Changes Since Last Week

Linseed oil is the only material of the sixteen listed above to decline. Steel, lumber, and cement continue to stiffen. Cast-iron pipe is up $2.25 per ton in Atlanta, while crushed stone has risen sharply in Montreal.

Structural shapes quoted at $2.68 as against $2.58 in New York warehouses and at $2.86 as compared with $2.76 per 100 lb. in Minneapolis, one week ago. Structural rivets and reinforcing bars up 10c. in New York. Bars are also up in Minneapolis, and up 15c. in Montreal. Pittsburgh price of $1.60 per 100 lb. on steel shapes and reinforcing bars giving away to quotations of $1.70@$1.75, the higher figure applying principally to bars.

Cast-iron pipe quoted at $48.50 as against $46.25 per ton, f.o.b. Atlanta.

Cement up 10c. per bbl. in Chicago and Minneapolis, following advance at mills, as described elsewhere in this section. Crushed stone 40c. higher per ton in Montreal.

Douglas fir up $1 in Minneapolis, and heavily advanced in Denver.

Raw linseed oil down 2c. in New York, Atlanta, Chicago and Minneapolis, and 8c. per gal. in Denver.

A total of 380 mills reporting to the National Lumber Manufacturer's Association for the week ending June 3, shows 220,903,463 ft. of lumber cut; 230,351,754 ft. shipped and orders for 220,069,897 ft. b.m. Production stands at 5 per cent and orders at 2½ per cent below normal while shipments are just at normal. Lumber stocks are growing smaller at the mills owing to recent heavy demands, and the labor supply is reported only "fair" or "easy."

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. McGRAW, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN *Editor*

Volume 88 — NEW YORK, JUNE 22, 1922 — Number 25

Shingles Again Indicted

ONCE more a fire of the conflagration type has swept through a wooden house district, this time at Arverne, Long Island. Once more the charge is made that responsibility rests on the wood-shingle roofs. W. E. Mallalieu, head of the National Board of Fire Underwriters, says, "The Arverne fire is what is known as a wooden shingle roof conflagration . . . It is probable that if there had been no wooden shingle roof, the original fire would never have spread as it did." By a coincidence the issue of shingle roofs is raised on another page by R. S. Moulton, of the National Fire Protection Association, who refers to some earlier conflagrations in support of his argument. Both utterances, like most of what has been written previously on shingle-roof dangers, fail to offer any proof that wooden house colonies are not subject to substantially the same conflagration danger with or without shingle roofs, and without such proof they miss the convincing effect which they aim at. Wood-sheathed houses in the path of a blast of flame and heat are bound to become ignited and take part in the advance of a conflagration, and while it is obvious that incombustible roof coverings reduce the area of inflammable materials directly exposed to heat attack, it has never yet been shown that they would materially reduce the probable spread of a general fire. Yet Mr. Mallalieu charges the shingle roof with being the responsible cause of conflagrations in wood-house districts, saying that they have occurred "because of the wide use of such shingles for roof coverings." Only recently we commented on the absence of proof and convincing effect that has characterized much of the anti-shingle propaganda in the past. Means can be found, we believe, for providing such proof. Were the case against the shingle convincingly established, the way would be open for a definite step forward in the fire-prevention movement; and such a forward step is much to be desired.

Whither Going?

WHITHER is the Federated American Engineering Societies going? It was organized to enter into non-technical matters of public importance, and in so doing relieve its constituent members of these activities, yet at the Pittsburgh meeting of the council it refused to take membership in the American Construction Council. A short time previous, on the other hand, it had moved to help in arranging an International Engineering Congress in Philadelphia in 1926. The former is not a technical activity; the latter is. The Federation, through its council, refuses to support that for which it is organized, but promotes that for which it is not organized. The reason for refusing to join the Construction Council is beyond our comprehension. It is because the Federation "should be co-ordinate and not subordinate" to quote one speaker, or in the words of another, "if we do this [join the new organization] we shall be on the same stage with the A. F. of L. or the National Building Trades Employers Association." So the council voted to co-operate with but not to take membership in the new body. We think there is needed in the council a clearer view of its purpose and a greater sense of responsibility for carrying out that which the constituent bodies have delegated to it. There may have been a feeling that the Construction Council movement interested too limited a group of engineers to justify the Federation's participation. That might have been a good excuse, but that reason was not mentioned in the Pittsburgh discussion.

Licensing Indecision

TYPICAL of the mental attitude of many engineers is the report of the Committee on Registration of the American Engineering Council, presented in *Engineering News-Record* last week. The committee appears not to see any positive reasons for licensing but is willing to bow to an accomplished fact. It will admit that there are reasons why such legislation "may properly cover engineers and architects charged with responsibility for public works," but it is agreed that those reasons do not apply to mining engineers. As to other engineers it cannot agree. So with engineers in general. Not only do those who profess opinions on the subject disagree among themselves but many, also, cannot even lead their own minds to definite conclusions on the issue as now drawn. They feel that even now arguments have not been presented with such clear-cut precision that they are left only the alternative of support or opposition. We fear that this indecision is traceable to an opinion that much of the argument in support of licensing has been invoked to justify a position already occupied on other than strictly rational grounds. We do not question here the soundness of that argument. We point out only that so far it has failed to convince a numerous and worth-while section of the profession that engineers should be licensed by the state. And that section, by the way, is far more numerous and worth-while than might be imagined in view of the highly organized minority in favor of licensing. We suspect that where the opposition has not been similarly organized the question has been going by default. Quite aside from the merits of licensing, we believe that this is not a healthy situation. The issue is too important. Licensing will have its effect upon every engineer, and each individual engineer owes it to himself and his profession to think the subject through to a definite conclusion.

Grading Portland Cement

SOONER or later we are coming to grading cement. The present standard portland cement specification is a great step forward from the dozen different standards of some years ago but all that it does is to pre-

scribe certain universally accepted minima in place of many different minima. It perpetuates the fallacy that all portland cement is alike, or at least equally acceptable, provided it is just so good in a number of particulars. As Mr. Bates points out, in the extract reprinted on p. 1046 of this issue, cement for different uses requires different properties. At the present time there is difficulty in specifying cement qualities that will indicate those properties, and more than that tests of concrete have not been devised which unmistakably relate cement quality to concrete behavior. In consequence the single standard is today justified and desirable. The art of testing is improving, however, and these difficulties will be overcome There are some commercial reasons why one and only one cement standard should prevail but they must in time bow to superior demands of the user.

Toward a Uniform Concrete

SO PRONOUNCED has been the opposition to the Joint Committee's clause permitting the specifying of concrete by strength and so valid have been the arguments against it that there is small chance of its being incorporated in the final report of the committee. Nevertheless, with normal improvements in the making and testing of concrete a strength specification is bound to be required in time. Methods which will guarantee a uniform concrete and tests which will definitely determine that such a concrete has been produced are being studied all the time and human experience shows that when a sufficient number of men work simultaneously and independently on the same problem that problem is eventually solved. A step toward the solution of the problem of uniform production of concrete is promised in the method outlined by Mr. Bertin, of the White Construction Co., on another page. The variable moisture content of sand has been a stumbling block in proportioning ever since the importance of the water content has been appreciated. The suggested method bids fair to make it negligible, provided it can be shown that the saturated content of a given sand is constant, and provided further that enough tests prove beyond doubt that the optimum amount of water can be computed from the characteristics of the aggregate. It is to be hoped, therefore, that the contemplated tests will be comprehensive and prompt.

Dangerous "Amusement Devices"

JUST about thirty years the Chicago World's Fair gave birth to the mechanical "amusement device," which since then has come to infest every private park in the country and some public parks. During that time a record of accidents and fatalities has been piled up against these machines which characterizes them as not merely a public nuisance but a public menace. Last week a degenerate descendant of the Chicago Fair family, a small Ferris wheel, blew down in a wind storm, adding seven or eight more to the list of victims of amusement devices. It is time to put an end to this bad record. Two courses are open. If the thrill-making machines built for the alleged diversion of the working man and his family are held to satisfy a real need, they must be placed under such control, and charged with such accountability, as will assure safety. To do this, competent engineering certification of their adequacy in construction and in operation is the minimum requirement. This is the one course; could it be followed effectively and continuously, a reasonable assurance of safety might be attained. The other course is more radical but certain in its operation: Wipe out the amusement devices entirely. Under present conditions the public safety is constantly at risk while the various contraptions intended to give their patrons a new sensation continue to exist. Depending for their attraction on a spice of fictitious danger, they are so built and managed that this danger only too often becomes real. With the rarest exceptions they are incompetently designed, cheaply built, and operated by roustabout attendants. Only through a miracle can they be permanently safe; and sad experience shows that this particular miracle does not often happen. Both structural safety and operating safety are in question. Frequent competent engineering certification of the structures would reasonably assure the former. Safe operation is a more difficult problem, and nothing less than requiring skilled, licensed operators to be in charge of such devices at all times would do. We have little faith that such drastic requirements could be enforced even in cities with efficient administrative machinery. And of course those amusement machines which are located outside of cities, as many of them are, would altogether escape control unless it were exercised by the state. Complete abolition of amusement machines is the only dependable guarantee against their dangers.

Time for Performance

FOLLOWING the controversies which marked both the original and the adjourned sessions of its annual meeting, the American Road Builders Association has reached the point where promises of an alert, business-like administration, in keeping with the importance of highway development as a leading American industry, are not sufficient. The indications are clear that a substantial amount of actual performance will henceforth be demanded. Much fault has been found, in the past, with the management of the organization as exercised through the secretaryship, but in spite of this widespread dissatisfaction the former incumbent was returned to office by a vote of the directors at this year's annual meeting—not a hopeful sign. In the opinion of many the real solution lay in a thorough housecleaning —applied both to methods and to personnel. This has not been done, but there are indications that an effort will be made to improve conditions this year. It is difficult, however, to reconcile this view with the action of the directorate in casting a majority ballot which can be construed in no other way than as an indorsement of the old secretaryship.

The main hope lies in the assumption of a large portion of control over the association's policies by the executive committee. One of the big issues is the management of the Good Roads Show. So severely was the conduct of the show at Chicago this year criticized that it might be worth while trying the innovation of employing a competent, paid manager and providing him with headquarters in Chicago at least three months before the opening of the show. Such a manager could be guided as to policies by a committee representing both the active members of the association and the manufacturers. If the feeling among exhibitors is rightly sensed, they are willing, this year, to make a final trial

of participating in an exhibit in co-operation with the American Road Builders Association. It is certain, however, the the experiment will not be repeated unless the conditions of past years show a marked improvement.

With a break in the deadlock in the selection of a president effected by the choice, last week, of Thomas J. Wasser and the charge of an illegal election of directors sustained, the way is clear for constructive work instead of internal dissension. The feeling now is to let bygones be bygones. Nevertheless, the end of the year will bring forth a demand for proof that the present administration has been a decided improvement over its predecessors.

To Put Labor's Best Foot Forward

IT IS the type of leadership displayed by John Donlin, president of the Building Trades Department of the American Federation of Labor, at Cincinnati recently that will win for labor the solid support of the general public. In his annual report he laid down the principle that the aims and methods of labor organizations cannot contravene the interests of the public. Specifically he proposed (1) that the authority to call strikes be taken away from the local unions and be lodged in the central organization, (2) that unscrupulous labor leaders be deposed, (3) that periodic conferences be held between the presidents of all building labor international unions in order to deal with important issues involving procedure in the building trades, and (4) that laws and rules that are "wasteful, devoid of reason and unjustifiable" be eliminated.

We have no doubt that the adoption of these suggestions would work a reformation in the building-trades unions. It stands to reason that among a group of men big enough to have been elected presidents of their international unions enough sound leadership will be found to reject, once given the needed authority, methods and procedures which are unfair to the public and a hindrance, in the long run, to labor's attainment of its own aims. The fighting type, that knows no reason, finds its way into the higher ranks. On the other hand, that there is a goodly group of the other persuasion is shown by these proposals of Mr. Donlin and by the wholeheartedness with which the Building Trades Department has worked in the National Board for Jurisdictional Awards—that singularly brilliant example of what can be done in labor questions by a man-fashion, honest approach by all parties at interest.

Should Mr. Donlin carry his association with him in his suggestions his group will take a strategic position in the construction situation. With invincible force they could then demand that other elements in construction square their practices with the interests of the public—the dealers, for example, who have gouged on materials, the bankers who have demanded extraordinary premiums.

It is much to hope for. However, Mr. Donlin has more than once set labor's best foot forward. If his associates will join with him in demanding centralized strike control, the elimination of crooked leaders, the co-ordination of the internationals on policies that square with public interest, and the elimination of wasteful practices, results of incalculable gain to the public—and incidentally to the A. F. of L.—would quickly follow.

The State at Fault

WITH great regret we record on another page an accident that on every account should not have been allowed to happen. The collapse of the Marlin bridge by washout of an abutment gives no room for apology for its inadequate construction. As an academic question of engineering, the case may be subject to argument on both sides. Rivers are treacherous, and scour action cannot always be provided against at a reasonable cost; accidents will happen, and the vagaries of floods are beyond prediction; foundations ten feet deeper might have been destroyed just as easily, and the extra burden on the taxpayer's pocket would have been a sheer waste. Reasoning of this kind may be urged in defense of the particular construction, but the unanswerable fact is that the people who depended on the bridge expected and believed it to be enduring, and had faith enough to stand on the bridge even in time of flood—they were carried down in its collapse. The public knows, and engineers know, that properly applied engineering skill could have prevented the failure.

Where impartial engineering supervision is absent, such accidents are likely to occur. They may occur even where the most conscientious and disinterested engineering skill has been applied, but long experience shows that they are most common, in fact alarmingly common, under circumstances where the engineering design, or important engineering decisions, are left to a contractor whose pocketbook benefits by building cheaply. In permitting the construction of this particular bridge without adequate, impartial engineering control, the State of Texas is at fault.

Country-wide experience points clearly to the remedy for these conditions. The remedy is to place all bridge construction in a state under the control of the state highway authorities, and to organize a competent bridge division in the highway department. State upon state has demonstrated that such control at once raises the level of highway bridge construction and removes a menace that until then resisted all attempts at betterment. So long as local bridge contracting remains in the hands of political officials the results are evil in so large a proportion of cases that the public is never safe and never well served; but the consistent record of a generation shows that the evil conditions are changed when the state highway bridge authorities are placed in control.

Texas needs to reform its bridge-building system as many other states have done. It is not the only state, however, in which the antiquated and unsafe system of bridge construction in sole charge of local officials prevails. The Marlin failure is an object lesson whose instructive value is not confined to Texas. Wherever the old system is still relied upon, the people should be told and should realize that they are in danger, that public safety is not adequately provided for, and that a change of system is needed.

Bringing about the change lies within the control of the people of the state themselves. Legislatures should act to provide for state supervision of bridge building. Until they do, it is the state that is at fault, and the state should properly bear the blame for resulting failures. This should be brought home to the people of Texas and of other states that need to learn the lesson.

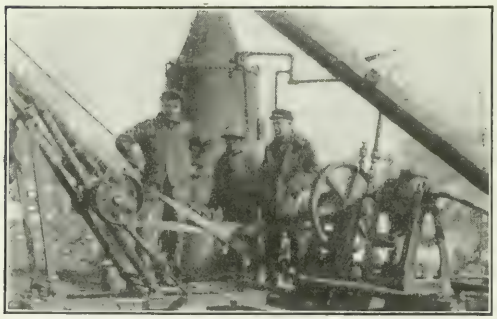
Exploratory Boring Needed as Guide to Design and Construction of Public Works

Subsurface Surveys Save Money and Prevent Mistakes—Boring Methods and Drill-Rig Types Discussed —Preservation of Records Vital

By James F. Sanborn
Consulting Engineer, New York City

Mr. Sanborn was formerly department engineer on the Catskill aqueduct and took an active part in the extensive geological investigations which invariably preceded the location and design of the dams, tunnels and other structures built by the New York Board of Water Supply.—Editor.

ENGINEERS planning large works should know the nature and quality of the underground mass supporting heavy structures, information upon which the design, cost and very existence of these structures depend. The systematic survey of that portion of the earth below the visible surface is frequently of even more importance in considering large structures than the topographical surveys upon which engineers have learned to rely in the preparation and conduct of construction work. The proper method of securing under-



THE POWERFUL MINNESOTA CHURN BUCK, SHOWN BELTED TO DIAMOND DRILL FOR INCLINED HOLE

ground data, however, is not always followed by those responsible for large expenditures and the tendency of many engineers to take chances that their assumptions are correct has often been followed by delays, revisions of plans and additional expense far beyond the original estimate.

In our large cities heavy steel-frame buildings and bridges of long span with great loads concentrated upon footings of small area, subway tunnels through water-bearing sand beneath rivers, aqueducts in rock carrying water under great pressure to the distributing mains, all require a definite knowledge, respectively, of the excellence of the material carrying the loads of columns and bridge piers, the depth of cover above the compressed-air tunnel roof, and the certainty that no failure of the rock through which the aqueduct tunnel is driven will result in serious loss of water brought from a far source.

The purpose of borings is, first, to determine the practicability of the site, perhaps one of several to be chosen for a structure, and after the best is proved, to gain the information required to assist in designing the particular type of construction and in estimating the cost of necessary excavations. Wash samples of glacial drift and rock samples in the form of cores seldom furnish, by themselves, enough information of the nature of the ground mass. A knowledge of the behavior of the drill as it is operated, the circulation or loss of water used in drilling, and subsequent tests applied to the hole after completion must all be studied to secure definite information on which to base designs for large works.

Boring Records—It has not been possible for most engineers to have a wide experience in underground exploration, nor is it easy to get much information on the subject of borings and geological structure. In such work those skilled in making and interpreting boring data should be consulted whenever possible. As an aid to those seeking information in New York City the Municipal Engineers of New York reviewed all available data on borings and geology relating to the city's public works in order that the information constantly going through the hands of the city's engineers might be preserved. A permanent collection of all reliable records of borings and a collection of rock cores and samples representing the numerous geological formations from Yonkers to Staten Island has been arranged and is housed in a room set apart for the purpose in the Municipal Building, and is available at all times for reference and study.

It is a mistake to assume that borings have but a temporary value and are useful only for the purpose for which they were made. In the investigations undertaken by the New York Board of Water Supply for the location of the 18-mile city tunnel of the Catskill aqueduct the geologists made excellent use of certain rock cores from borings made by the Dock Department many years ago and preserved by General McClellan, who insisted on saving the records and cores. Some of his associates with less imagination wished to throw the old stuff away. These very cores gave the important preliminary information which guided subsequent exploration and threw light upon the rock structure under the East River.

Borings are made for many purposes and the interpretation required varies with the needs of each case. Such works as bridge piers, building foundations, dams, caissons, docks, subways, tunnels for sewers or aqueducts and harbor dredging offer opportunities for the effective use of borings. It seems well to describe three particular cases: (1) a long tunnel in rock; (2) the site of a dam on glacial drift; and (3) a tunnel under a river. In each case the explorations were carefully and thoroughly made, were accompanied by exhaustive tests of various kinds, and furnish good examples of the best practice in work of this kind.

City Aqueduct Borings—A tunnel 18 miles in length and from 200 to 700 ft. underground, the longest con-

tinuous tunnel in the world, has been driven for the Catskill aqueduct pressure tunnel in New York City, starting in Yonkers and running to Brooklyn. As this tunnel operates under a head of several hundred feet of water the explorations were unusually thorough in order that the tunnel might be everywhere located in rock so sound that it would not yield and permit leakage in service. Numerous borings were made to define the bedrock profile along the tunnel line and to explore for bad ground in order that dubious stretches might be avoided in the location.

Devasego Dam Site—A problem in underground exploration with a number of unusual features was studied by the New York Board of Water Supply at a proposed dam site on Schoharie Creek at Devasego Falls. The site appeared at first to be the most favorable one on the stream, but after the borings and certain porosity experiments had been completed, the site was proved to have certain disadvantages which, with other considerations relating to the catchment area, determined the selection of another location for the dam. The borings were largely in glacial drift in part filled with boulders and hard clay, which made for difficult boring work, and extended to bedrock from which diamond drill cores were taken. Wash samples of the glacial drift were caught, and every 10 ft. or oftener a dry sample or undisturbed core of the glacial drift was taken, which proved of great value in estimating the porosity of the material. The glacial drift was in places so hard that an unusual amount of dynamite was required at times to gain an advance. The large number of sticks of dynamite used was taken as some measure of the impervious character of the ground.



SETUP FOR WASHING AND DRIVING CASING

At angle of 60 deg. in preparation for diamond drill boring.

An unexpected bend of this old gorge almost at right angles to the course of the valley illustrates well the need of careful work in distributing the borings to establish the position of such an underground feature, which may have a serious bearing on the location of the dam foundations. At the site explored a ridge of glacial drift, extending out into the main valley from the west, formerly dammed the entire valley, forming a lake to the south. The modern stream has cut through this soft ground ridge at Devasego Falls. Borings show the drift there to be 100 ft. deep. The proposition of the engineers was to take advantage of the natural barrier of glacial drift which crosses the valley, build a short dam to close the gap made in the glacial ridge by the modern stream and thus restore the lake which formerly existed to the south of the ridge.

As the depth of water in the reservoir confined by the earth ridge would be nearly 100 ft., the main question was to determine by the borings the degree of porosity of the material in the ridge. Lines of holes were drilled along the center of the proposed dam site and along the crest and toe of the ridge, as well as across the ridge. The glacial ridge is known as a "kame deposit" and was formed close to the glacial ice during a melting stage, in part by material transported, sorted and laid down by the water from the melting of the ice mass and in part of residual till frozen into the ice, compressed by it and dropped as the ice disappeared.

It can be readily appreciated that the mixed material resulting from the activities of the water and ice might be in places quite porous, and elsewhere quite impervious, as was found to be the fact on examination of the dry samples taken at frequent intervals in the borings. The sandy, porous material and the dense impervious portions of the ridge were found to lie in no regular relation one to the other, so that it was at first hoped that there were no continuous strata of porous material extending through the ridge. A close inspection and classification of the dry samples taken from the borings seemed to show that the upper part of the ridge above the level of the floor of the valley was sufficiently impervious to act as a dike, while the material below that level was classified as easily penetrated by water. This conclusion was largely borne out by the records of loss of water during the operation of drilling at about the elevation of the valley floor and by the position of the ground-water table under the ridge, which was flat and below the general elevation of Schoharie Creek. As a confirmation of the belief that great quantities of water would escape under the ridge from a reservoir making use of the kame deposit as a dam porosity experiments were made in some of the drill holes by pumping water down the holes and noting the effect upon the water table in neighboring holes. In certain cases the water introduced went away as fast as it could be pumped in, without considerable result in raising the ground water level, which was regarded as further evidence of the porous condition of parts of the glacial ridge.



RIVER SETUP DIAMOND DRILL MOUNTED ON SCOW

The dam is now being built about 3 miles down stream from Devasego Falls.

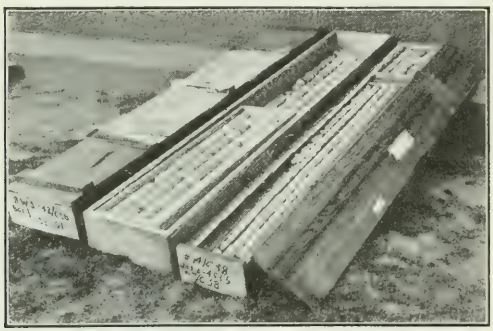
Hudson River Borings—About the most difficult boring work for an important structure near New York City was that undertaken to explore the bedrock of the Hudson River valley near Cornwall, N. Y., for the pressure tunnel of the Catskill aqueduct which crosses the river at Storm King mountain. The maximum depth of bedrock there is still unknown, although about two years were spent in efforts to sink casing from floating equipment in the middle of the river to develop the bedrock profile above the tunnel line. The greatest depth reached by the casing was 768 ft. but at that point the hole had to be abandoned without getting any diamond drill core from bedrock. Inclined diamond drill holes were meantime started from the deep shafts on either

shore, which demonstrated that the gorge did not extend below an elevation 960 ft. below the water surface. (See *Engineering Record*, Jan. 15, 1910, p. 68.)

A survey of the holes at the Hudson River was made to determine the inclination at 50-ft. intervals by means of glass vials etched with acid. The vial partly filled with dilute acid was placed in a tube, inserted to the desired depth in the hole, and allowed to remain until the line of the surface of the acid was etched on the glass. On being withdrawn, the angle between the axis of the vial and the etched line was measured against a calibrated dial.

A small compass, floating in a bath of hot gelatin, which solidifies on cooling, is sometimes used to determine the direction of inclined holes.

In order to check the depth of the holes below the river surface by measuring the hydrostatic head at the bottoms of the holes a recording pressure gage was used. This gage consisted of a cell with a steel diaghragm filled with mercury and a glass column through which



PERMANENT STORAGE OF CORES FOR BORING RECORDS
A 6-ft. core box, showing double layer of cores by use of trays; the core is marked by surgeon's tape, preserved by a covering of varnish.

the mercury rose and overflowed into a receptacle, the amount of mercury so overflowing being in proportion to the pressure on the steel diaphragm.

Boring Methods—The methods employed in boring work depend upon the information sought and vary from the sounding-bar or rod driven by hand to the heavy and complicated machinery necessary to handle deep holes. Four general types of machine are used for making exploratory borings for public works: (1) Wash rigs; (2) diamond drills; (3) shot drills; (4) well drills. In addition we may mention (5) the rotary and (6) the California well rig for making deep borings or test wells in soft ground. Wash drills are used to explore the soft ground above bedrock, while bedrock is explored by methods 2, 3 and 4. The drilling problem in most cases is to determine the bedrock profile, to take samples of the glacial drift or soft ground overlying the rock and to secure cores of the bedrock in order to determine its character.

Two separate drilling operations are necessary; First, carrying the casing to bedrock to support the walls of the hole in soft glacial sands and, second, taking cores in bedrock. For work of exploration the drilling rigs used are generally light, as the holes for most structures are not often deep. Drilling contractors commonly have one type of rig which they use and to which their men are accustomed so that the kind of machines used depend upon which contractor gets the work. For ordinary depth of overburden—50 or 75 ft.—the churn drilling and driving of casing can be done with the drum of the diamond drill. For greater depths, resort may be had to some form of well-drilling rig, sometimes mounted on a wagon, and provided with a boiler pump and gear for raising and dropping a string of drilling tools handling a sand bucket and for driving casing by means of a weight.

Gasoline engines are used somewhat for test-boring work where about 10 hp. is sufficient. They may be provided with a belt pulley for driving the shot or diamond drill, and a nigger-head on a flywheel for driving casing. Gasoline equipment is not satisfactory in cold weather on account of difficulty with the water supply, and more power is needed in penetrating great depths with casing than the above-described rig can furnish.

Minnesota Rig—A satisfactory type of plant adapted for penetrating 200 to 300 ft. of glacial drift with casing is the Minnesota type churn buck, shown in the pictures. Steam is provided from a boiler of about 10 hp. which may be mounted on a wagon.

The powerful steam engine of oscillating type with a 10 x 12-in. cylinder is geared to the spool which is used in driving casing. The up-and-down motion with the wash pipe or churn-drill rods and for operating the drive weight is secured through letting the rope slide back and forth tight and loose, on the spool of the engine. The engine is also belted for operating the diamond drill.

A three-legged derrick with 26-ft. poles is used, giving 22 ft. hoist in the clear. A hollow cast-iron drive block weighing about 300 lb., with a 3-in. diameter hole through the center for a guide, is used for pounding down casing. In drawing up the casing when shooting on boulders encountered in sinking the engine is well adapted to "rapping back" or delivering a powerful upward blow for withdrawing or raising the pipe. Altogether, it is a very flexible and powerful rig.

A pump of large capacity is used for supplying the plentiful volume of water under high pressure so necessary in washing down casing below the 100-ft. depth. The outfit is used as a wash rig for operating wash rods and driving casing through earth until rock is reached. In operation the engine is kept running always in the same direction while the rope for raising the rods or drive weight is operated by hand by tightening or loosening two or three coils on the drum. This machine is strong enough to part a new 1½-in. diameter Manila rope. For driving casing through earth more than 100 ft. deep it is a device of sufficient power for the rapid handling of the work.

Wash Rigs—Hand-operated wash rigs are effective in putting down relatively shallow holes and where there are no boulders and the going is easy, as in uniform clay or sand, wash holes are sometimes put down by hand to depths of 200 ft. in sand. The advantage of the hand rig is that it is light and easily moved from one setup to the next, and can be taken anywhere, in woods or over hills, or where room is lacking in city work, without much expense. For preliminary work such light rigs are useful, but the results secured are of limited value. Wash borings intended to prove bedrock are likely to be unreliable, and power rigs must be employed when beds of gravel, hardpan and boulders are struck; a liberal use of dynamite to break up such obstacles is desirable.

Diamond Drills—For rapid drilling in rock to take

samples and give accurate data on the formation there is no device superior to the diamond-drilling machine. There are a number of types, the choice depending upon the depth of hole and size of core desired.

The diamond bit is in the form of an annular ring of soft steel, in which the stones are set, and the bit is screwed into a core barrel, flush with the outside. A hollow line of rods actuated by the rotating mechanism spins the core barrel and diamond bit, and feeds it forward as the diamonds wear away the rock. Water for cooling the bit and washing up the cuttings is forced by a pump down the line of drilling rods, which are thick and well made.

For explorations aiming to save the maximum amount



ARRANGEMENT OF CORES IN BOXES

of core the double core barrel has been devised to prevent revolving and the grinding action of the core.

The cost of core borings is usually four or five times as much per foot as the cost in ordinary glacial drift or other soft ground.

Shot Drills—There are several makes of drills suited for taking rock cores of sizes larger than the largest diamond drill bit in use; for plunger elevators deep holes in rock up to 20 in. in diameter are not uncommon. For use in weak rock which does not yield a satisfactory core by the diamond bit the shot drill often gives good results.

The shot drill has an annular steel cutter or bit attached to a core barrel 5 to 10 ft. long and turned by a string of rods actuated by a rotating power-driven mechanism. Chilled steel shot are fed down the hole and lodge beneath the rotating bit, which rubs them around on the bottom of the hole. These shot are hard enough to scratch glass. They vary in size from the finest dust to the size of No. 6 shot. If they are crushed, the cutting power is increased. The particles become embedded in the soft steel of the rotating bit and form an effective grinding tool. Water is fed down through the drill rods, as with the diamond drill, to wash up the rock cuttings, but the water pressure must be carefully adjusted to such a velocity that the shot are not carried away from the point of attack.

Earth Borings Inspection—The following directions may be given to one entrusted with the inspection of borings in earth, and have been used on public work:

The main object is to determine the pervious or impervious character of the material penetrated or its bearing value under load.

Record the character of material washed up; never report material as "hardpan" as this is too indefinite a term.

Record the discoloration of the water as indicating material being penetrated, especially the presence of clay which might not otherwise be indicated.

Watch for and record pockets of sand or gravel without any cementing material. In reporting sand be sure it is not gravel that has been ground fine by the action of the drill.

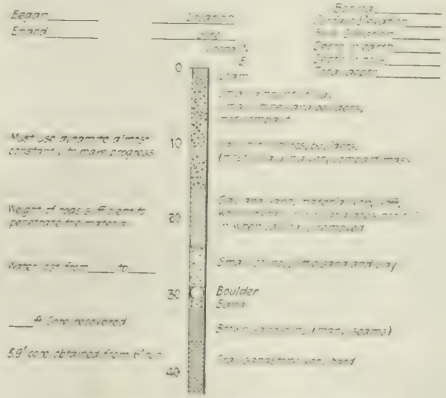
In reporting materials give some qualifications as to their compactness.

Observe the mechanical operations of drilling, noting delays and the time necessary to penetrate a stratum, omitting delays caused by other conditions than the character of the material.

Report expedients used to make progress, including the location requiring use of dynamite, with amount of same.

Watch carefully and report concisely the action of water in all boring operations. Should the water forced down the wash pipe fail to come to the surface again, the hole should be recorded as "losing water." This would tend to signify that the material is water-bearing or porous, or it may be a seam or cavity such as may exist in rock. Should the water stay at the top of the pipe it would tend to show the impervious nature of the underlying material. The water may flow out of the top of the casing, indicating that a stream of water has been encountered with a greater head than that in the pipe.

In reporting "sand and gravel," give some idea as to the proportional amounts, size, and whether or not the formation includes boulders. In the event of large boulders being encountered which cannot be "shot out" and which require the use of the diamond drill to pass through, make



TYPICAL FORM OF RECORD SHEET

sure that the location and size of the boulder is accurately determined.

Samples should be taken which will represent the character of materials for each 10 ft. penetrated, and oftener if the condition changes. The dry method of sampling is to be preferred and should be strictly adhered to for the borings at embankment sites and other places where the material arouses any suspicion of porosity. Samples should be placed in the bottles provided and labeled at once; marking the character of the samples (wet or dry) must not be neglected; label should show depth of material and boring designation. When a wet sample is permitted it should be taken only after the receptacle in which the wash water is caught is filled and all matter in suspension precipitated. A note should give the capacity of the receptacle and the progress of the boring made while it was being filled. Tests of various kinds, for bearing value of the earth, if required, may be made during the progress of the work. A correct idea of the condition may be gained by an experienced boring operator.

Rock Boring Inspection—The following instructions apply to borings in rock:

Record depth to and elevation of rock. Rock must be penetrated at least 20 ft. and attention is called to the possible error of calling boulders bottom.

Record all observed characters of the rock, all seams and the behavior of water.

Report the comparative rates of speed of penetration through various types of rock. Racing of drill might indicate soft rock and should be noted.

Record each length of core recovered and length of corresponding run of core barrel as the proportional amounts will give indication of the hardness of the rock, attention not being given to any possible breaking up of core by the operations of drill or movement of particles.

Records of recovered core are to be made as to whether

any of these breaks were caused mechanically or by seams.

Arrange core in boxes as shown in accompanying sketch. This work must be done regularly and boxes placed for future reference in the storage building provided. Label box with boring designation.

Preservation of Records — Mark total run of recovered core on division strips of each board. Use more than one box if necessary and give proper boring designation and number.

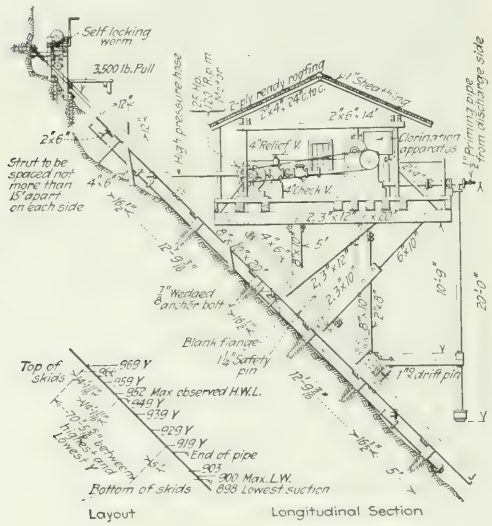
Core should be placed in the bottom of core box, as shown in sketch, as soon as it is obtained. At A place the top piece of core, labeled with hole number and depth. Then place the remainder consecutively as shown. The core at C follows that at B, while that at E follows D. The next layer is filled with core in the same manner. The core placed corresponding to A will follow core at F. After the box is filled, it should be nailed up at once for storing. In every case all pieces of core obtained from boulders and not properly relating to the core in question, should be gathered up and placed in a box made for that purpose.

For each boring the following information should be given:

Boring	Co-ordinate North	Co-ordinate East	Surface Elev.	Rock Elev.	Depth in Earth	Depth in Rock	Total Depth

Pumping Plant on Incline Moved to Suit Water Level

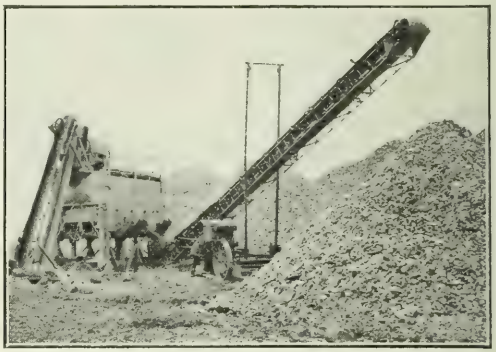
IN PROVIDING a water supply for the construction camp at the Don Pedro Dam in California it was necessary to make the intake adjustable to a considerable range in water level. Records of the flow in the Tuolumne River, from which the supply is drawn, show that at this point the water level has varied as much as 52 ft. As the water supply in question would be in use for more than one season, it was decided to put the pumping plant on a platform that could be moved up and down an incline as the water level varied, as shown by the illustration. Four-inch delivery pipes laid between the rails of the incline were provided with Ys for connecting with the pumping plant and were located 10 ft. apart vertically.



MOVABLE PUMPING PLANT ON INCLINE

Field-Stone Crushing Plant for Roadwork

BY CRUSHING, screening and storing rock obtained from adjacent fields, the Highways Improvement Co. of South Bend, Ind., during the winter of 1921-22, was able to get rock at a little less than it could be shipped in; was able to keep its organization together, and was able to help the farmers get rid of objectionable stone. The equipment, as illustrated, consisted of an Austin portable screening and crushing plant run by a 25-hp. steam tractor; an 18-in. x 60-ft. gasoline-driven portable belt conveyor, and a 5-ton pitless scale. The contract was for six miles of penetration macadam road near South Bend.



PLANT CRUSHES STONE FROM FARMERS' FIELDS

A survey was made of the farms along the road and it was decided that it would be possible to get enough stone from the fields to pay to put in the portable plant. The plant was set up at the middle point of the road and stone was hauled in by the farmers from within a radius of four miles. About 60 per cent of the material was taken directly from the fields to the crusher, but sometimes when the wagons all arrived at nearly the same time they were required to stock-pile the material. Most of the stone was igneous rock, basalt, granite, niggerheads, etc.

The plant reduced the stone to four sizes as follows: screenings, ¼ in. to dust; fine chips, ¼ in. to ¾ in.; coarse chips, ¾ in. to 1¼ in., and large chips, 1¼ to 4 in. As the rock was very hard the large sizes predominated. In fact the partition between the bins for the third and fourth sizes was entirely removed so that both of these sizes flowed directly to the conveyor from the screen. A 70,000-ton storage pile was built up from Jan. 10 to April 5.

The view and information are furnished by the Barber-Greene Co., whose belt conveyor was used.

Ohio Cities Cannot Divert Water Revenues

The Ohio Supreme Court has unanimously affirmed a decision of a lower court (Roetenger *v.* City of Cincinnati) upholding Section 3959 of the Ohio General Code which limits the use of the earnings of municipally owned water-works to operation, maintenance, extensions and debt charges. Cincinnati desired to transfer $500,000 of water-works revenue in relief of general taxation and of its embarrassing financial situation.

Some Engineering Aspects of New York Traffic

Counts Show Fifth Avenue Intensity—Influence of New Routes—Type and Condition of Paving Are Important

FROM a paper on "Traffic Handling," before the New York Section, Am. Soc. C. E., by Amos Schaeffer, consulting engineer to the borough president of Manhattan, the following extracts covering figures on traffic intensity and proposed measures of relieving congestion are taken:

Facilities must be provided not for the average movement of traffic over a period of 8 or 10 hours, but for a shorter interval of greatest intensity, which usually occurs between 9 and 10 a.m., and between 5 and 6 p.m. Fifteen minutes has been assumed in the past as a sufficiently short period to measure intensity.

Fifth Ave. Counts—On Dec. 21, 1910, the 15-min. period of maximum traffic on Fifth Ave. between 41st and 42nd Sts. occurred between 3:30 and 3:45 p.m., when 505 vehicles passed through the block in both directions. This is very closely 7 per cent of the total traffic in 10 hours. Fifth Ave. has a roadway width of 55 ft., permitting the movement of six lanes of traffic provided no vehicles are parked along the curb. As soon as moving traffic requires the space, no parking should be permitted. The movement of six lanes of traffic gives an intensity of 5.6 vehicles per minute per lane.

On Aug. 25, 1911, there was a maximum traffic of 256 vehicles in 15 min. between 4:45 and 5 p.m., equivalent to 2.9 vehicles per lane of traffic per minute. This great decrease in traffic is probably due to the season of the year when it was taken. The former count was in December when Christmas shopping was at its height, while the latter was made in August, when many people were away.

On April 2, 1919, the intensity was 6.19 vehicles per lane of traffic per minute. In October of the same year it was 6.96, and in April, 1920, it was 6.45. If it be assumed that there is a line of parked vehicles along each curb, which happens to be the case at times, these figures will become 9.29, 10.47 and 9.67. Several years ago it would have been asserted that no roadway could accommodate this intensity.

New Route's Influence—Traffic counts were made in April and October, 1919, in the vicinity of Fifth Ave. and 42nd St. to determine what effect the opening of the Park Ave. viaduct would have on the movement of traffic in the vicinity. These observations were made to determine the movement of northbound and southbound traffic at Fifth Ave. and 42nd St.; on Madison Ave. between 41st and 42nd Sts., and between 42nd and 43rd Sts.; on 34th St. between Fifth and Park Aves.; on Park Ave. from 34th to 35th Sts., and on the Park Ave. viaduct. The April count was made just before the viaduct was opened and that in October about six months after. Some interesting facts were developed in these counts. For instance, the total traffic on Fifth Ave. for a period of 11 hours in April was 18,617 vehicles; in October it was 17,782, a decrease of about 4 per cent. On the other hand, the maximum hourly traffic had increased from 2,165 in April to 2,511 in October.

Madison Ave. between 41st and 42nd Sts. accommodated 9,489 vehicles in April, and in October 7,710, a decrease of about 18 per cent. Thirty-fourth St., between Fifth and Madison Aves. carried 4,182 vehicles in April, and in October 4,105. Between Madison and Park Ave., however, there was an increase from 1886 vehicles in April to 5,728 in October, an increase of 3,842 vehicles, or 200 per cent. The traffic on Park Ave. from 34th to 35th Sts. increased during the same period from 5,365 vehicles to 14,376 vehicles, or 9,011 vehicles, which is equivalent to 168 per cent. The Park Ave. viaduct was not open in April but in October it carried 13,086 vehicles. The maximum hourly count was 2,098 vehicles which gives an intensity of 8.74 vehicles per lane of traffic per minute. This is a greater intensity than occurs on any of the other thoroughfares under discussion, if the intensity is based on the full width of the roadways and nothing is deducted for parking space.

The deductions to be made from these observations is that traffic immediately availed itself of the Park Ave. viaduct and the roadway around the westerly side of the Grand Central Station. There is no interference from crosstown traffic between 40th and 45th Sts., and consequently there is more freedom of movement than on any of the other thoroughfares. While it seemed to have caused but little reduction in traffic on Fifth Ave. there was considerable reduction on Madison Ave. It also appears that it must have attracted considerable traffic from other thoroughfares. The phenomenal increase in traffic on 34th St. between Madison and Park Aves. and on Park Ave. seems to indicate that a new thoroughfare for traffic has developed on Madison Ave. from 23rd to 34th Sts., through 34th St. and Park Ave., over the Park Ave. Viaduct and up Park Ave. This course certainly avoids the great point of congestion at 42nd St. and Fifth Ave.

Suggested Remedies—Studies have also been made for eliminating the grade crossing at 42nd St. and Fifth Ave. There is sufficient clearance over the subway at Fifth Ave. to depress 42nd St., so that both the surface cars and vehicular and pedestrian traffic may be carried under Fifth Ave.

It has been the practice in Manhattan for a number of years to replace curb intersections having a radius of 6 ft. by a radius of 12 ft. This permits traffic making a right turn to hug the curb closely and keep out of the way of traffic moving in the opposite direction. With a 6-ft. radius automobiles are thrown well into the way of traffic in the opposite direction. A passenger car can turn in a radius of about 20 ft. A 12-ft. curb radius plus the width of the car makes about 17 ft., so that a car after having turned a corner is not more than 3 ft. from the curb. These changes are made in connection with the repaving of streets.

Car Tracks and Paving—The effect of surface car tracks and pavements on traffic is clearly indicated in traffic observations made in 1915, on Center St. between Duane and Pearl Sts. and on Fourth Ave. between 20th and 21st Sts.; both of these streets have car tracks. On Center St. the pavement consisted of rough granite blocks and the observations indicate that vehicular traffic used the car tracks, at least to as great an extent as the pavement outside of the tracks. On Fourth Ave., on the other hand, where the pavement was a high-class granite block, vehicles used the pavement in preference to the car tracks. Two deductions may be made from these observations, namely, that vehicles will not use the car tracks unless the pavement in the roadway is bad and that therefore surface car tracks are an impediment to traffic and reduce the effective width of the roadway for vehicular traffic.

There are, generally speaking, but two kinds of pavements in use in the Borough of Manhattan, sheet asphalt and granite block. Sheet asphalt is used where a noiseless and cheaper pavement is desired for traffic of light tonnage and granite block is laid for the use of both of heavy tonnage and intensive traffic. The specifications under which granite blocks are laid at present produce a pavement which is not objectionable for the use of pleasure automobiles. The objection as to noise also disappears, as more vehicles are equipped with rubber tires. It may be predicted, therefore, that the use of granite block for pavements will increase and will be acceptable to all kinds of traffic.

Tire Widths and Vehicle Loads—A Correction

In the communication from S. Whinery on the relation between wide tires and excessive vehicle loads (*Engineering News-Record*, June 1, p. 923) two typographical errors occurred. In the sketch the width of the bearing area given as 15 in. should be 17 in. and in the text the figure "12.2 per cent" given as the increase in circular bearing area on sub-foundation should be 122 per cent.

FROM JOB AND OFFICE

Hints That Cut Costs and Time — *For Contractor and Average Engineer*

Truck Drives Piles and Backfills Trench

IN BUILDING 72 and 84-in. segmental block sewers at Wichita Falls, Tex., a motor truck was successfully utilized to backfill trench and drive piles when it was not busy hauling material. For backfilling, a winch was installed to pull a two-man scraper. The equipment,



MOTOR TRUCK EQUIPPED TO DRIVE PILES

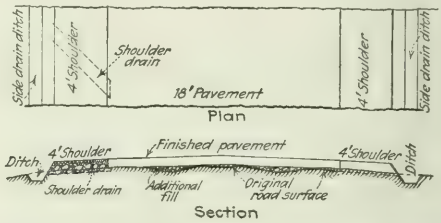
besides the winch, for piledriving, is indicated by the illustration. The contractor was C. H. Foley, Wichita Falls, and Julian Montgomery, now of the firm of Montgomery & Ward, consulting engineers, was city engineer.

A Cheap Form of Road Drain

BY JOSEPH BLICKENSDERFER
Engineer, Department of Roads and Bridges, Salt Lake County, Utah

IN THE case of a road with a grade exceeding 2 per cent the following method of subgrade drainage is effective and cheap in construction cost: At intervals of 25 ft. along the roadway small trenches should be dug about the width of two ordinary shovels and to a depth of about 2 in. below the finished subgrade, so that water collecting at the edge of the pavement will readily drop into these trenches and be carried off. In the bottom of these trenches boulders and rocks from 4 to 6 in. in size should be laid and filled in with smaller material, as the trench is filled, to within about 2 in. from the surface of the pavement. Then additional material to finish the shoulders should be put on and thoroughly rolled with a heavy roller.

For the purpose of getting the drain to function



SECTION AND PLAN OF INEXPENSIVE ROAD DRAIN

properly its center line should be at an angle of 45 deg. with that of the longitudinal axis of the road and a slope of at least 6 in. in 10 ft. should be given to the drain. The cost of this construction will be found very low where proper material is available. A plan and cross section of this type of construction is shown.

Analysis of Formwork for Concrete Members in Steel Building

BY RICHARD P. WALLIS
The Lundoff Bicknell Co., General Contractors, Cleveland, Ohio

IN A LARGE building with many concrete members it is possible to reduce mental and physical labor incident to the sketching of formwork details by the compilation of charts showing all possible sizes and arrangements of structural members and the necessary dimensions of forms to fit each case. In this way endless repetition of calculations is eliminated and the process is simplified to one of making an analysis of the particular conditions existing with any one member and then applying the proper dimensions for the parts as obtained from the charts.

The accompanying charts were prepared and used by the writer with considerable success in sketching the forms for the fireproofing of the beams and columns of the 21-story office building recently erected in Cleveland for the B. F. Keith interests. In this case the framework was of structural steel, fireproofed with 2 in. of concrete. The floor construction was principally of metal domes and concrete joists with some monolithic slabs. The formwork for the slab and beam sides was of $\frac{7}{8}$-in., and the beam bottoms of $1\frac{3}{4}$-in. material. Columns were formed from $1\frac{3}{4}$-in. material.

In the preparation of the beam sketches it was found that the depth of the steel below the top of the slab and the thickness of the floor construction were the governing factors. As indicated by the sketches, charts were worked out for the following requirements: Width of beam bottoms, depth of beam sides, size of notches in beam sides caused by other beams framing into them and notches in column forms where floor beams frame into the column.

Beam Size, In.	Weight Per Ft., Lb.	Full Width, In.	½ Width, In.
8	18.0	8	4
10	25.0	8¼	4⅛
12	31.5	9	4½
15	42.0	9½	4¾
15	60.0	10	5
18	55.0	10	5
20	65.0	10½	5¼
20	80.0	11	5½
24	80.0	11	5½

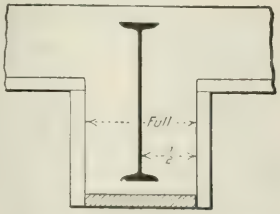


CHART I. WIDTH OF BEAM BOTTOMS

Beam Size, In.	Depth of Steel (In.)	
	—4	—2
8	15¼	13¼
10	17¼	15¼
12	19¼	17¼
15	22¼	20¼
18	25¼	23¼
20	27¼	25¼
24	31¼	29¼

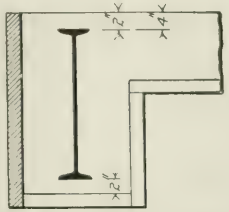


CHART III. DEPTH OF SIDE TO TOP OF SLAB

Beam Size, In.	Total slab thickness in inches												
	4	5	6	7	8	9	10	11	12	13	14	15	
8	10¼	9¾	8½	7¾	6¼	5¼	4½	4	3¼	2¼	2½	1¼	¾
10	12¼	11	10½	9¾	8½	7¼	6½	6	5¼	4¼	4¾	3½	1¼
12	14¼	13¼	12¼	11¼	10¼	9¾	8½	8	7¼	6¼	6	5¼	4¾
15	17¼	16¼	15½	14¾	13¼	12¼	11¼	11	10¼	9¼	9	8½	7¾
18	20¼	19¼	18½	17¼	16¼	15¼	14¾	14	13¼	12¼	12¼	11½	10¾
20	22¼	21¼	20½	19¾	18½	17¼	16½	16	15¼	14¼	14¾	13½	12¾
24	26¼	25¼	24½	23¾	22½	21¼	20½	20	19¼	18¼	18	17½	16¾

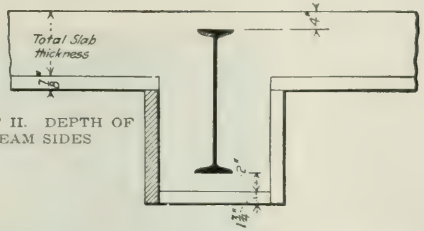


CHART II. DEPTH OF BEAM SIDES

Beam Size, In.	Depth of Steel (Inches)	
	—4	—2
8	13¼ — x	11¼ — x
10	15¼ — x	13¼ — x
12	17¼ — x	15¼ — x
15	20¼ — x	18¼ — x
18	23¼ — x	21¼ — x

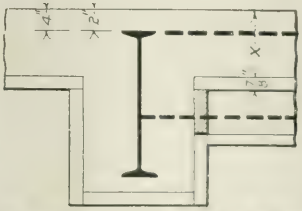


CHART IV. DEPTH OF NOTCH TO UNDERSIDE OF FLOOR

Beam Size, In.	Depth of Steel (In.)	
	—4	—2
8	14	12
10	16	14
12	18	16
15	21	19
18	24	22

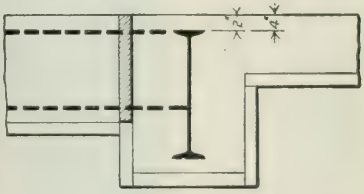


CHART V. DEPTH OF NOTCH TO TOP OF SLAB

In this particular instance the size of the steel beams and columns governed the dimensions of the forms but the principle of reducing all possible conditions of construction to tabular form and taking off the required dimensions from these charts applies equally well to any reinforced-concrete structure.

The sketches should be made in duplicate on cross-section paper (the original to go to the carpenter and the carbon to be kept in the office) and need be diagrammatic only. It is not necessary to make the sketches to scale though it would be helpful if it were practical to do so. The sketch should show a cross-section of the completed form properly oriented, indicating how the various parts are membered up, and an outline of each part carefully dimensioned so that the carpenter need waste no time in laying out the form work.

The use of these charts makes possible a considerable saving in the time required for this work and insures additional accuracy in the sketches [illegible] owing to the elimination of the repetition of a large number of individual calculations.

(In Inches)

Beam Size, In	10½ in., Floor & Joist		12-in. Slab		6-in. Slab	
	—4	—2	—3	—2	—4	—2
8	2[illegible]	[illegible]	1[illegible]	[illegible]	7½	5½
10	4½	2[illegible]	3[illegible]	1[illegible]	9[illegible]	7½
12	6½	4[illegible]	5½	3½	11[illegible]	9½
15 (42 lb.)	[illegible]	[illegible]	[illegible]	6½	14½	12½
15 (60 lb.)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
18	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
20 (65 lb.)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
20 (80 lb.)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
24	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

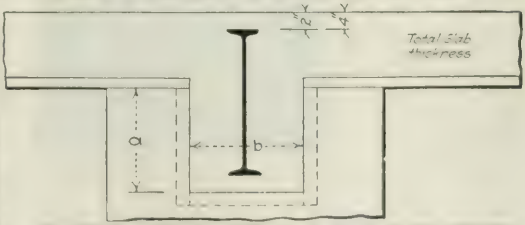


CHART VI. SIZE OF NOTCHES IN COLUMN (IN INCHES)

Paving Costs for Different Types

Average costs per square yard of various types of paving for country roads have been compiled by the U. S. Bureau of Public Roads. The figures cover 68,000,000 sq.yd. of paving constructed with federal aid in all parts of the United States during the period 1916-1921. The costs per square yard are as follows: Sand-clay, 18c.; gravel, 46c.; plain and surface-treated macadam, 95c.; bituminous macadam, $2.10; bituminous concrete, $2.50; plain cement concrete, $2.57; reinforced-cement concrete, $2.74; and brick, $4.10. These figures cover only the cost of the paving; they do not include the cost of grading, and officials point out that it must not be assumed that roads of the several types can be constructed in any locality at these figures. For example, the cost of bituminous concrete varied from $1.70 in the New England states to $3.13 in the group of states including Kentucky, Tennessee, Mississippi, and Alabama.

Derricks Lashed to Building Columns in Restricted Operating Area

LACK of sufficient operating space in which to follow the usual method of foundation excavation led the contractors on the construction of a seven-story building being erected on 43d St. between Madison and Park Aves., New York City, to adopt rather unusual means for anchoring the stiff-leg derricks necessary for handling excavated material.

The building under construction is one which will be occupied exclusively by Charles & Co., now occupying part of the building adjacent to that being constructed. The ground area to be occupied by the building has a frontage on 43d St. of 42 ft., a depth of 100.5 ft. on the west side perpendicular to 43d St. and a width of 24.7 ft. at the rear end. In order to provide room for a basement and sub-basement it has been necessary to excavate approximately 3,300 cu.yd. of solid rock. As the building is being constructed in one of the most congested portions of the city, the amount of plant that could be erected in the street was limited. Not enough room was available for erecting stiff-leg derricks in the ordinary fashion so the contractors undercut the foundations of the adjoining buildings sufficiently to provide safe bearing for heavy timbers upon which the stiff-leg derricks were to be placed. These timbers were usually 14 in. square and they were placed three ply on about 18-ft. centers.



DETAIL OF TIES FROM DERRICK MAST TO COLUMN

As these timbers were placed at approximately the finished first floor elevation, the usual cribbing necessary for supporting excavating plants was done away with, allowing free access at all times to the entire area to be excavated.

In place of anchoring the derrick masts to dead-men the derricks were so set that the masts were directly opposite and about 8 ft. from the steel columns of an adjoining 20-story building. A rigid connection was made by an 8-in. channel and two sets of 8-in. angles from the top of the mast to the steel column. The column was punched for the purpose and the angles securely bolted both to the connecting channel and to the column. Two other anchorage points were made from each mast to the adjoining columns on either side by several strands of ¾-in. steel cable, the fastening to the column being made by a steel plate and an eye-bar.

With this derrick equipment it was possible to handle excavated material by the second derrick from the rear of the area being excavated to approximately the middle of the area whence the load would be picked up by the first derrick and transferred to trucks waiting in the street. The center of the first derrick was approximately 18 ft. and the center of the second derrick 35.5 ft., from the 43d Street building line.

Derrick 1 was equipped with a 60-ft. boom and a 35-ft. mast and derrick 2 with a boom about 75 ft. in length and a mast 35 ft. long.

The excavation work was done by Clarence L. Smith, Inc., New York City, and the Ruggles-Robinson Co., enginers and constructors, are contractors for the erection of the building.

FROM JOB AND OFFICE

Hints That Cut Costs and Time

Floating a Stranded Lumber Carrier

By E. A. Strunk, Jr.
Key West, Fla.

AN AIR compressor, a gasoline launch, some light derrick equipment and a modicum of ingenuity were largely responsible for the reclamation of 75 per cent of the 600,000 ft. b.m. lumber cargo carried by the American schooner "J. W. Somerville," which was stranded last October in the Gulf Straits between Key West and the coast of Cuba. The schooner was en route from St. Andrews Bay, Fla., to San Juan, Porto Rico, and was overturned during a West Indian hurricane. All members of the crew were lost. The vessel was later found and towed into the outer harbor of Key West and grounded on a sand and coral reef of about 18 ft. depth.

Four months later it was sold and the purchaser immediately contracted to have the vessel floated, the South Florida Contracting & Engineering Co. being given the job. The schooner was located five miles off Key West and had been forced by the heavy seas higher on to the reef.

The contractor rigged up a small barge with an air compressor and towed it to the wreck with a small launch. Previous investigation had disclosed the fact that heavy anchors and the anchor chain were caught on the rock, and weighed the schooner down so that their removal was necessary before the vessel could be floated. During March and April the anchors and chains were therefore removed, considerable time being consumed in that operation due to the fact that diving was possible only in calmest weather.

With anchors and chains removed air was pumped into the vessel until it floated. The schooner was then towed into land and a rock bin built on her keel. Into this rock bin were placed 100 tons of rock which gave a center of buoyancy permitting turning of the vessel by light derrick equipment. She was then towed into water of a 35-ft. depth and a 10-ton derrick barge hooked on turned her in a few minutes. Gasoline tugs then towed her to dockage in Key West.

Heavy seas and grinding on the rocks had torn away masts and housing but all of the lumber cargo stored below decks (approximately 475,000 ft. b.m.) remained intact though watersoaked, discolored and covered with mud and sand. The hull, of edge grain pine and oak, appeared but little damaged.

FROM JOB AND OFFICE

For Contractor and Average Engineer

Solving a Land-Subdivision Problem

By Edwin P. Arneson
San Antonio, Texas

AN UNUSUAL problem in land subdivision arose out of the decision of seven Mexican heirs to cut up a tract of land already long and narrow into seven still narrower strips, all of the same area. The fact that the proposed method of subdivision appeared freakish and as against public policy to the surveyor was beside the point, inasmuch as he was told that it was his services as a surveyor that were wanted, not his ideas of rural economy.

The land lay in the shape of a quadrilateral, about ten times as long as it was wide, and no two sides were parallel. It was the desire of each of the owners to have an equal front on the road along the east boundary, then to have rays departing therefrom on such

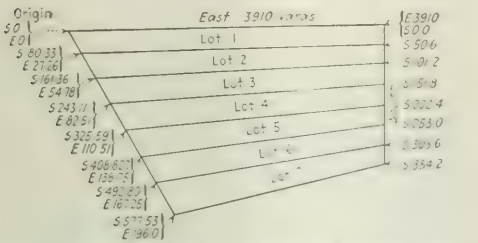


FIG. 1—CO-ORDINATES OF LOT CORNERS DETERMINED

courses as would make seven equal lots. The following solution of the problem is direct, exact and self-checking. There is nothing unusual in the mathematics of the method, but it is believed that the method itself is interesting and that it can be applied often with profit to the solution of a wide range of subdivision problems.

Briefly, if we solve the first lot, and then solve a quadrilateral equal in area to the first lot plus the second lot, we can then, by differences, find the characteristics of the second lot; and so on through all seven solutions. Though this method has the appearance of "the long way 'round," it has the advantage of working each computation on the same base. If then the differences check, first and second, we have avoided errors that might otherwise have nullified a whole series of computations.

Referring to Fig. 1, let

a=given front on road for one or more lots

A=given area of one or more lots, in acres (5,645 square varas=1 acre)

X=the latitude of west boundary line for corresponding A

Then: $5,645A = \frac{(a + x)(3910 - x)}{2} \tan \theta$

From which:

$$X = \frac{11,290A}{3910 - a} - \frac{3910a}{3910 - a}$$

By inserting in the last expression values for A and a corresponding to the number of equal lots desired to include in the computation we arrive at the data given in the accompanying table. From these data the co-ordinates of the various lot corners are determined. By simple computations the co-ordinates will give the courses and distances desired.

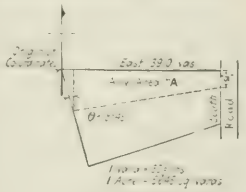


FIG. 2—DETAILS OF PROBLEM

Number of Portions of Lots	AREA: Acres	FACTORS USED IN FORMULA: "a" Southing or Latitude	(3910 - a)	(0.339) (a)	(11290) (A)	CO-ORDINATES, WEST LINE: Southing = "x"	Easting = tan θ (3910 - x)
1	45 22	50 6	197,846	17 15	510,533 8	80 33	27.26
2	90 44	101 2	395,692	34 30	1,021,067 6	161 36	54 78
3	135 66	151 8	593,538	51 46	1,531,601 4	243 11	82 51
4	180 88	202 4	791,384	68 61	2,042 135 2	325 59	110 51
5	216 10	253 0	989,230	85 77	2,552,669 0	408 82	138 75
6	271 32	303 6	1,187,076	102 92	3,063,202 8	492.80	167 25
7	316.53	354.2	1,384,922	120 07	3,573,736.6	577.53	196 0

Glass and Fire Tile Used as Aggregate in Concrete Building Foundation

By Frank F. Royal
Indian Head, Md.

WASTE glass and fire tile were used as aggregate for the concrete in a foundation for an addition to the existing office building occupied by the L. E. Smith Glass Co., Mt. Pleasant, Pa. It often happens that a glass tank built of brick and lined with fire tile breaks open and leaks or burns out with the extreme heat. In order to repair the tank the fires must be killed as the molten glass cannot be drained off. Once the glass has become cold a solid mass remains that has to be broken up with sledges, bars, picks, etc. As the glass clings to the fire tile the tile also has to be removed. Inasmuch as a quantity of this material was on hand, and because considerable difficulty would have been experienced in securing other suitable material, it was decided to use the broken glass and fire tile.

In the concrete, the lumps of glass and fire tile were broken to about 1½ in. in size. The concrete was mixed in the proportion of one part cement, two parts sand and five parts broken glass and fire tile. The wall had a thickness of 12 in. and was carried to a depth of 9 ft. The footings under the wall were composed of the same material. No reinforcing was used. After the forms were removed it was evident that the concrete used made a very substantial wall.

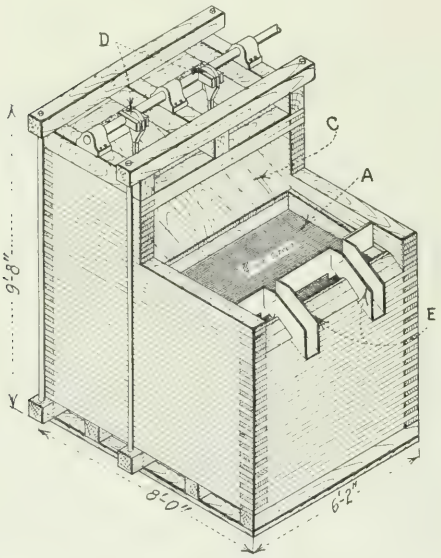
Another feature of the building was the imitation rock face finish. The walls above the foundation were built of 8-in. x 12-in. x 12-in. hollow tile and a rock facing of cement was applied directly on the blocks to match the old building, which was built of stone with a rock face finish. The cement rock facing was applied as follows:

A scratch coat of 1:2 mortar [illegible] was put on and before the cement set the joints were marked off to match the joints on the old building and then hack pointed. Before the scratch coat had thoroughly dried the rock facing was finished. The mixture of one part cement and one part sand with about 10 per cent of lime putty was applied with a small trowel

Shale Removed from Gravel by Jigging

GRAVEL containing shale has been successfully prepared for concrete-road construction by jigging out the soft and light stone, in experiments conducted by the Minnesota Pipe & Tile Co., with the aid of Prof. F. C. Lang and Prof. Davis of the University of Minnesota. Using the jig illustrated as designed by Prof. Davis, "practically every particle of shale was successfully removed" from a local gravel unfit for concrete roadwork because of its shale content.

Describing the jig in the Minnesota *Techno-Log*, Prof. Lang states that it is about 6 ft. wide, 8 ft.



JIG FOR REMOVING SHALE FROM GRAVEL

long, and 9 ft. 8 in. high. The space, *A* about 4 x 5 ft. has a ¾-in. screen at the bottom. Across the front is a weir about 4 in. above the screen bed. Approximately 4 in. from this a metal plate extends across the space with openings into spouts. The openings into the metal spouts *B* are about ½ in. above the top for weir across the front. At *C* is a platform sloping toward screen and at *D* are connecting rods which operate pistons.

When the jig is in operation, the bed is filled with gravel up to and somewhat above the elevation of the weir; it is filled with water up to the same level. The pistons, which are about 26 in. x 32 in. make about 154 2-in. strokes per minute. The effect is to keep the gravel jumping with the pulsation of the water, which causes the heavier stones to settle and the lighter particles or shale to come to the surface. Then if a constant stream of water is entering the jig and also a constant supply of gravel is being furnished on the sloping platform, it is entirely a matter of adjustment to have the shale and water flow out of the spouts and pebbles, and of course water, flow out under the plate and over the weir. Sand below ¾ in. goes through the screen and is removed from bottom of the hopper. The jig has a capacity of about five tons an hour.

FROM JOB AND OFFICE

Hints That Cut Costs and Time

Tank of 40,000-Gal. Capacity Supported by Timber Bents Moved on Flat Cars

A 40,000-gal. conical-bottom water tank was recently moved from its position along the lines of the Canadian National Railways at Resplendent, B. C., Canada, to Red Pass Junction, a distance of two miles, by an unusual method which proved successful.

The method used was as follows: Two steel flat cars were first heavily loaded with ballast and spurred out, one on each side of the tank, until the drawbars of the cars were just clear of the tank's riser pipe. The tank was then jacked up about 20 in., enough to allow the track to be connected under the riser pipe and also to give sufficient clearance between it and the top of the rail.

Two timber bents were then erected, one on each of the flat cars at the ends nearest the tank. The bents were placed just inside the tank columns and the whole structure was thus supported. Bents tied together at the top with two 8-in. by 8-in. timbers, notched over the tank and bolted, one on each side of the tank bottom. The weight was distributed on the bents by short posts placed on top of the bents just back of the columns, the top ends of the posts wedging against the bottom of the tank. The bents were well sway braced in both directions and bolstered on the cars with a 2-in. pin through the center, in order that the cars might be free to swing when passing through curves.

The cars were then coupled with chains and turn buckles, one on either side of the riser pipe, the turn buckles being used to adjust the chains when going around curves. A floor of 3-in. planks was laid in the bottom of the riser pipe and about 3½ yd. of gravel deposited in the heating chamber to act as ballast. Four sets of rope falls were used for guy lines extending from the top of the columns to the sides of the flat cars. These were fastened about 15 ft. from the end of the cars and crossed, as illustrated, in order that they might guy the tank in both directions.



TANK JACKED ON FLAT CARS

On reaching the destination, the cars were again spurred directly over the new tank foundation and the tank jacked into place. No sign of damage was detected in moving the tank.

The material contained in the foregoing article was taken from the *Water Tower*, published by the Chicago Bridge & Iron Works and the Horton Steel Works, Ltd., of Canada.

FROM JOB AND OFFICE

For Contractor and Average Engineer

Blower Removes Excess Fine Material From Sand For Road Work

By Allen P. Child
Kansas City, Mo.

A FIELD blower plant proved successful in preparing bank sand for concrete-road construction in Imperial County, Cal. The local sand contained about 15 or 20 per cent of a material which would pass a 100-mesh sieve as against the required 5 per cent. Instead of importing material from other localities a special plant was erected for blowing the fine particles from the sand.

The device was an ordinary conveyor which lifted the sand to a revolving screen. Material which would pass a ¼-in. mesh was discharged into a hopper under the screen and then through a narrow opening into a storage bin below. In falling from the hopper to the bin below this sheet of sand passed in front of a nozzle through which a current of air from a centrifugal



SAND SCREENING PLANT WITH BLOWER

blower passed. The velocity of the air at the nozzle was controlled by a pressure-regulator at the blower so that any desired percentage of material could be blown from the sand. The engine, which operated the conveyor and revolving screen operated the blower.

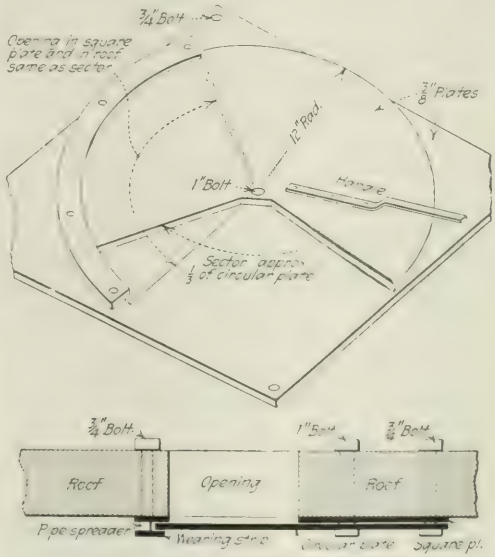
This system was economical where the sand did not require artificial drying.

An Inexpensive Overhead Bin Gate

By G. W. McAlpin
Huntington, West Va.

THE OVERHEAD bin gate shown in the accompanying sketch is being successfully used by various sand and gravel plants in this vicinity for admitting either sand or gravel from overhead bins into trucks. The gates are usually fitted into the roof of a tunnel through the bins. Trucks, passing through the tunnel, receive their loads.

The gate is made of a plate of ⅜-in. iron fitted against the roof of the tunnel, and held in place by four bolts.



BIN GATE FOR LOADING AGGREGATE

Gravel passes through an aperture in this plate, corresponding to a similar one through the top of the tunnel. A circular plate having a sector cut from it fits against this first plate and moves on a 1-in. bolt passing through its center. The sector fits the aperture in the ⅜-in. square plate and when turned by a handle opens the gate. A wearing strip bolted to ⅜-in. plate assists in holding the circular plate while the latter is being turned.

These gates have been made by local metal workers for about $10 each, considered a reasonable price. They are simple of design and easy of operation.

Stone Production During 1921

About 62,400,000 short tons of stone were quarried in the United States in 1921, according to the U. S. Geological Survey. This is more than 20 per cent less than the production in 1920. The estimated value of this stone is $92,500,000, a decrease of 30 per cent as compared with 1920. Procedures all over the country stated that both wages and prices had been reduced, and nearly all reported a decrease in the cost of production. High freight rates are said to have contributed largely to the general depression in the industry.

Heavy Steelwork in New Theater and Office Building

Steel Trusses and Long Concrete Cantilevers Support Balcony Floor—Steel Girders Carry Columns and Suspended Floor—High Pitch Roof Truss Over the Theater

TO PROVIDE large spaces unobstructed by columns in the first story of the 21-story Keith office building and theater at Cleveland, O., which floor is occupied mainly by the entrance hall and ticket lobby of the theater in the rear, heavy steel girder construction had to be introduced to support the superstructure columns over these spaces and also to carry the front wall across a broad doorway. No truss work is employed in the office building, but the theater has a long steel truss carrying the front of the balcony over the main floor. This truss, with two shorter side trusses, forms the seat for concrete cantilever girders which support the

Floor Girders—Lines of single and double plate girders carrying upper columns and walls over the open spaces on the lower floors are the main features of the office portion of the building. Otherwise the framing consists mainly of I-beams. Columns are of I-section, composed of a web plate and four angles, with two or more cover plates.

In the front or Euclid Ave. section are four double plate girders of 33 ft. span, at the third floor level (see Fig. 1). These girders extend across the lobby and main entrance, and each girder carries one intermediate line of columns for the upper stories. They

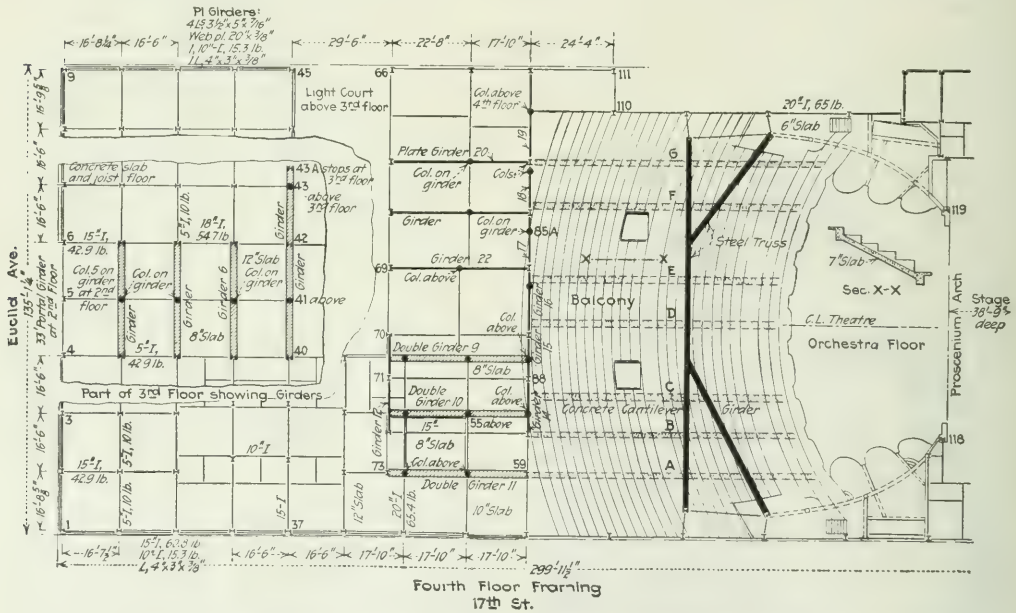


FIG. 1. FRAMING PLAN OF FOURTH AND THIRD FLOORS SHOWS TRUSSES AND GIRDERS IN THEATER AND OFFICE BUILDING

balcony floor. In the structural layout many difficult points were encountered in order to adapt the framing to special features of the architectural design. The general arrangement of the office building and theater are shown in Figs. 1 and 2.

The site, at Euclid Ave. and 17th St., is 300 x 135 ft. On the corner is the office building, L-shaped in plan, with fronts 135 ft. and 138 ft. long and a depth of 68 ft. Behind this building, partly under the 17th St. or 138-ft. wing and partly in the space formed by the L, are the grand hall or foyer, the lobby, promenade, balcony foyer and other adjuncts of the theater. Beyond this intermediate part of the structure is the theater proper 162 x 135 ft., with the 40-ft. stage and fly gallery occupying the rear. Foundation conditions are simple. Groups of concrete piles driven in sand carry the pedestals or footings for the steel columns.

are 51 in. deep, so that if placed in the second floor framing they would have been conspicuous obstructions in the ceiling of the lobby, thus preventing the desired appearance of spaciousness. For this reason it was necessary to place them at the third floor, and to suspend the second floor framing from them by hangers (see Fig. 2.) Details are given in Fig. 3.

Three double girders of 40½-ft. span in the fourth floor framing of the wing are required to carry the upper office floors over the grand hall and other large spaces for theater purposes (see Fig. 1). These girders, like those of the third floor, are not built up as box girders, but each consists of a pair of 60-in. single-web girders placed close together. Upon shoe plates riveted across the top flanges of each double girder are seated two intermediate columns. The construction of the fourth floor girders is shown in Fig. 4.

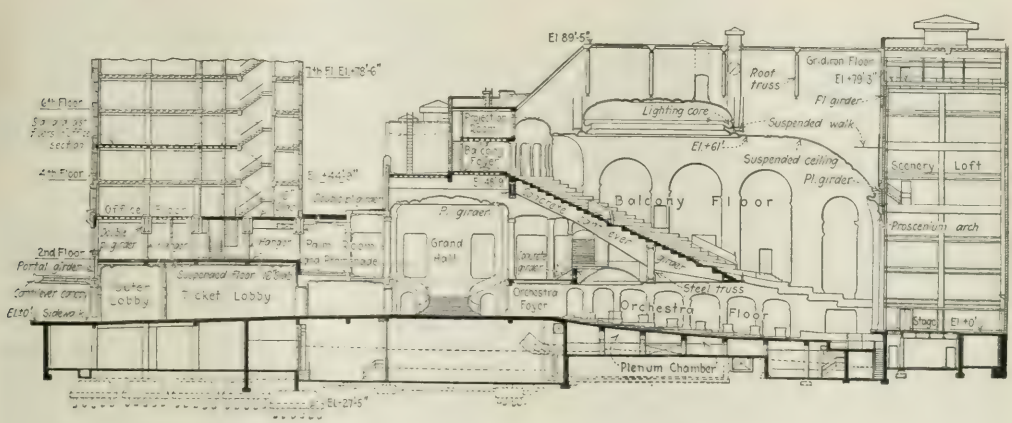


FIG. 2. SECTIONAL ELEVATION THROUGH OFFICES AND THEATER

The first of these girders (No. 11) has its webs framed on the flanges of two columns (59 and 73). In the others the arrangement is different, as shown in Fig. 1. At the inner end, the 60-in. double girder (No. 10) is seated upon an 80-in. girder 15 ft. 8 in. long (No. 12). At the outer end, the double girder is framed against the web of a 108-in. girder 15 ft. 8 in. long (No. 14). Two columns rest upon the double girder and a third, in line with them, is seated on the outer or wall girder, No. 14. These wall girders carry the intermediate columns over the entrances to the balcony.

For the relatively low structure in the space between the office building and the theater, single-web plate girders take the place of the double girders noted above. Each of these is framed between columns and carries a single column for the upper part of this intermediate structure (see Fig. 1).

Portal Girder—To permit of a wide entrance, a single-web portal girder of 33-ft. span and 7-ft. depth is placed at the second floor level in the Euclid Ave. front (see Figs. 1 and 2). This girder carries an intermediate column and the weight of the front wall. From the drawing, Fig. 3, it will be seen that each chord has four flange angles, forming a double channel section. A shelf angle on the outside supports architectural or decorative work. Angle brackets on the inside of the web carry an intermediate floor beam, the floor level being below the top chord of the girder. Hangers attached to the bottom chord support portal framing beneath the girder.

Wind Bracing—Substantial wind bracing is necessary in the office building owing to the height, narrowness and exposure. In most cases this bracing consists of large gusset plates above and below the spandrel

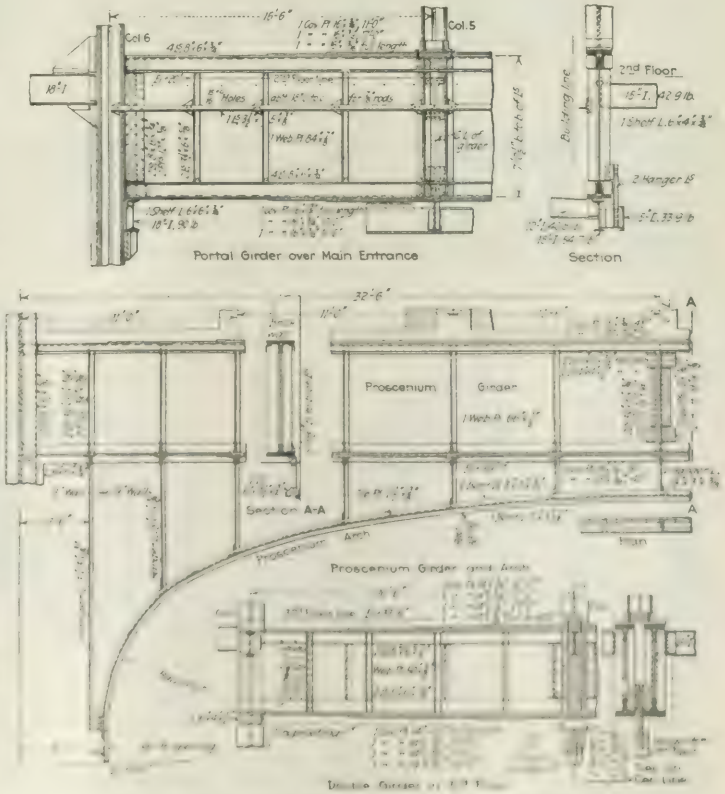


FIG. 3. GIRDERS IN THEATER AND STORE [illegible]

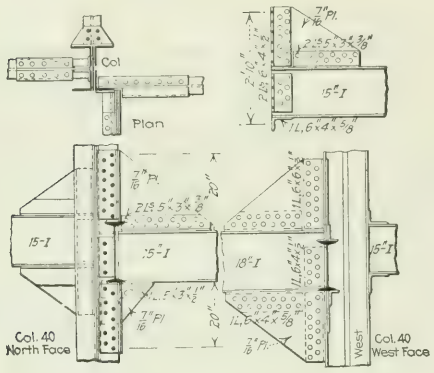


FIG. 5. WIND BRACING IN OFFICE BUILDING

beams, with angle connections to the flanges of beams and columns, as shown in Fig. 5. At some points these gussets are placed only above or below the beams, to conform to particular conditions and architectural requirements and to avoid all interference with openings.

are used in the lower stories, flat slabs 8 to 12-in. thick are used, according to the size of panel. The 12-in. slabs were required by the underwriters to separate the theater portion of the building from the office building. Floor loads are taken at 70 lb. per sq.ft. in the office floors, and 100 lb. for these portions which are subject to the heavy loading and movements of the usual theater crowds.

Structural Features of Theater

Steel trusses and concrete cantilever girders for the balcony, high pitched roof trusses and a long plate girder over the proscenium arch are prominent in the structural design of the theater. The general structural layout of both theater and offices is shown by Figs. 1, 2 and 6.

Steel Trusses—In order to carry the large balcony or upper floor without any supporting columns in the main floor, a steel riveted truss 106 ft. 3 in. c. to c. of bearings spans the entire width of the floor. Its ends are framed between interior columns at the line of the private boxes. It was necessary to make this truss very shallow in proportion to its span, so as to fit it between the ceiling over the main floor and the sloping floor of the balcony. With a depth of only 9 ft. 10 in. c. to c. of chords, therefore, its members are of very heavy construction, as will be seen by Fig. 7. Thus

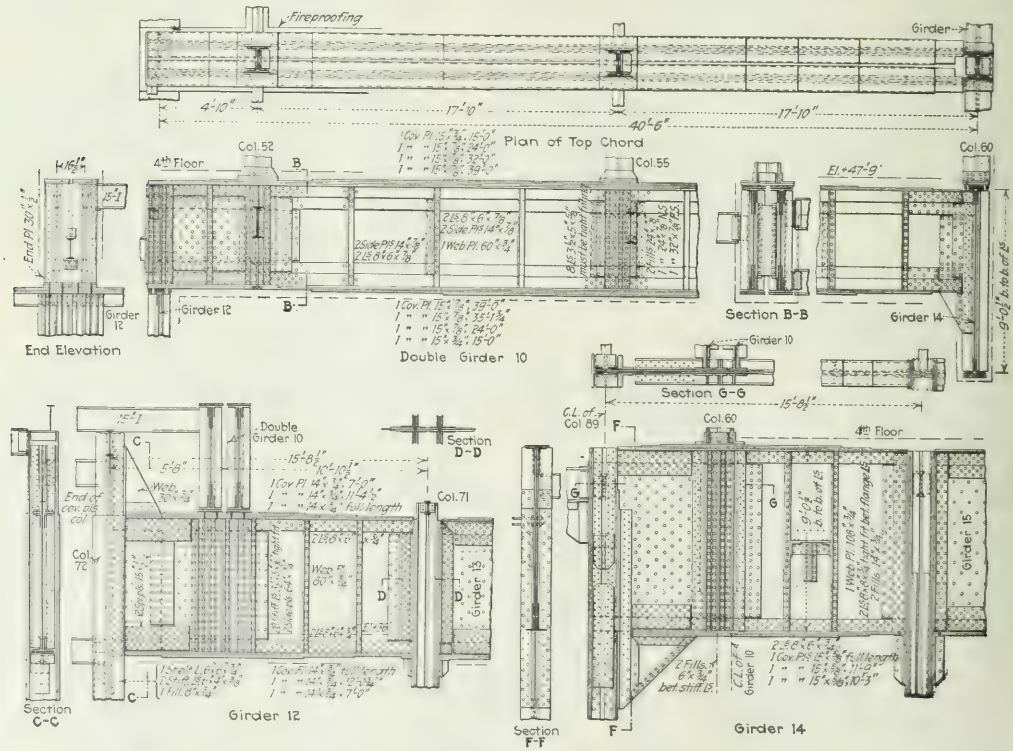


FIG. 4. HEAVY GIRDER FRAMING OF FOURTH FLOOR

Floors—In the upper stories for office purposes, where the framing is mainly of I-beams, there are concrete floors of the slab and joist type. Where girders the chords have an H section with four vertical cover plates along each side flange. With this arrangement it was possible to secure the necessary amount of

material more easily than would have been possible with chords of trough section.

Each of the main diagonals is of I-section, consisting of a horizontal web, four flange angles and two side cover plates. End connection plates were limited in size by the necessity of carrying corridors over the truss. Architectural conditions also prevented the connection plates to the columns being carried as far below the bottom chord as would ordinarily be considered advisable. The ends are reinforced, therefore, by plates extending as high as the floor elevation will permit.

Transportation and erection difficulties were increased by the requirement that each chord, with its connection plates, should be built up for its full length at the shops, no field splices being permitted. The 106-ft. bottom chord weighed about 45 tons and the 80-ft. top chord about 39 tons. These long members were shipped on flat cars and were hauled from the railway station to the site by teams of horses, each end of the girder being carried on a four-wheel truck. Before shipment, each truss was assembled complete at the shops as required.

To support the curved ends of the balcony, which project beyond the line of the main truss, two diagonal trusses are introduced, having their inner ends riveted to the main truss and their outer ends carried by columns of the interior framing (see Fig. 1). These diagonal trusses, one of which is shown in Fig. 8, are of similar design to the main truss, with each chord built up and handled as one piece. One truss is 49 ft. 8 in. long and 67 ft. 7 in. deep, and the other is 39 ft. 5 in. long and 5 ft. 6 in. deep.

End connection plates could not be allowed to extend below the bottom chord. For this reason, the supporting column is carried above the truss intersection to the floor line and a long rectangular plate is riveted to the column and truss, as shown. The 106-ft. main truss weighs about 116 tons complete and the two diagonal trusses weigh 18 and 14 tons respectively. All steel is cased with concrete 3 in. thick for the chords and 2 in. for the web members.

Concrete Cantilever Girders—To support the inclined floor of the balcony there are long concrete girders having their upper ends anchored to the steel framing

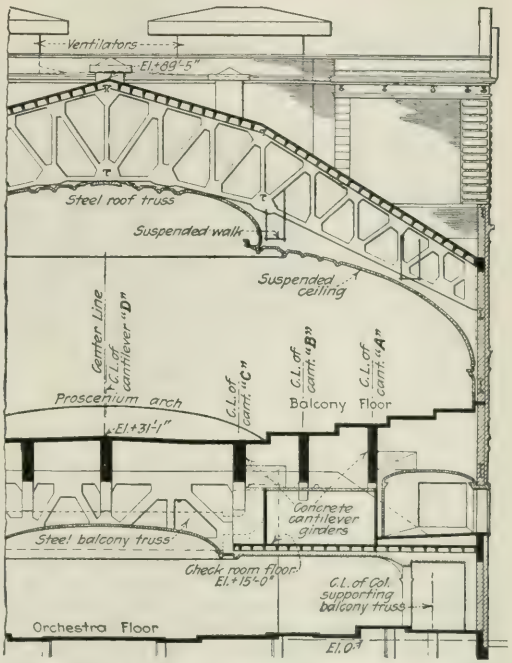


FIG. 6. PART CROSS-SECTION THROUGH THEATER

in the wall and their lower ends seated in the transverse steel truss, as shown in Figs. 1 and 2. Beyond this truss the girders have a cantilever projection of 27 to 30 ft. In order to provide seats for these girders in the truss, the posts are composed of two vertical members about 2 ft. apart.

Concrete was used for these girders as it reduced the cost and avoided complicated connections to the truss which would have been necessary with steel girders. Owing to the curved plan of the balcony front, the end girders would have had an excessive cantilever length. To meet this condition, two diagonal steel trusses were

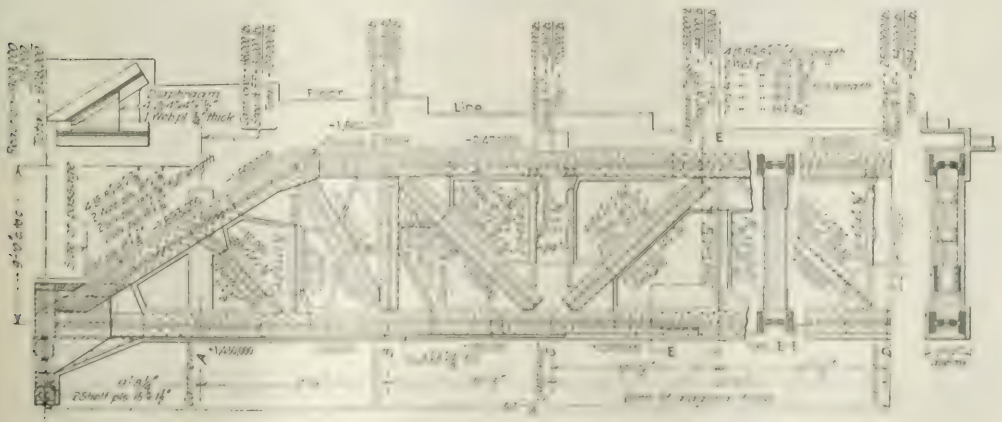


FIG. 7. LONG STEEL [illegible] FRONT OF BALCONY OF CLEVELAND O. THEATRE

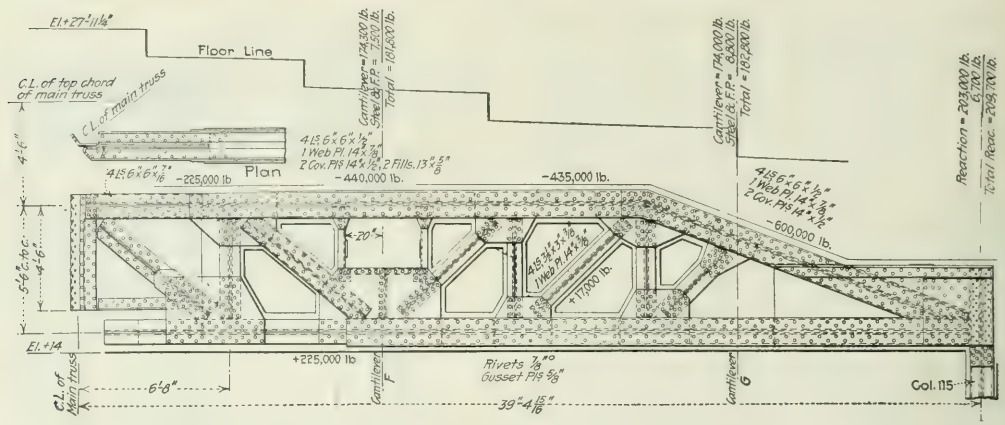


FIG. 8. DIAGONAL TRUSS OF BALCONY

provided to extend the seats for the longer girders, as noted above.

These concrete cantilever girders, Fig. 9, are from 4 ft. to 9 ft. deep and 18 to 24 in. wide. The upper surface is stepped to conform to the shape of the 3-in. floor slab, which was built monolithic with the girders. The risers of the steps, forming the joists, are of varying thickness, with a minimum of 5 in.

To meet the arrangement of stairways and passages giving access to the balcony floor at different levels, some of the corridors are reinforced concrete slabs suspended from the cantilever girders by steel hangers embedded in the concrete. At one point, however, such hangers would have been obstructive, and it was necessary to carry one side of the slab by a concrete girder of 55-ft. span. These arrangements are shown in Fig. 9, below.

The position of the trusses is shown in Fig 6 and the truss design is shown in Fig. 10. An unusual T-section is used for the top chord, composed of two 15-in. channels riveted back to back and a similar channel, with legs downward, riveted upon the top flange. The rise of the bottom chord is 20 ft. These trusses are spaced 18 ft. apart and are connected by sway bracing.

Proscenium Arch—Across the opening for the stage, the wall of the fly gallery or scenery loft is carried by a 66-in. plate girder of 65 ft. span (see Fig. 2), from which is suspended a curved angle member which outlines the proscenium arch. This arch rib gives an opening of 56 ft. and supports a brick spandrel, 9 in. and 13 in. thick. From the details of this girder in Fig. 3 it will be seen that the top chord has four flange angles, but their arrangement is different from that of the portal girder, also shown in Fig. 3. Another 65-ft.

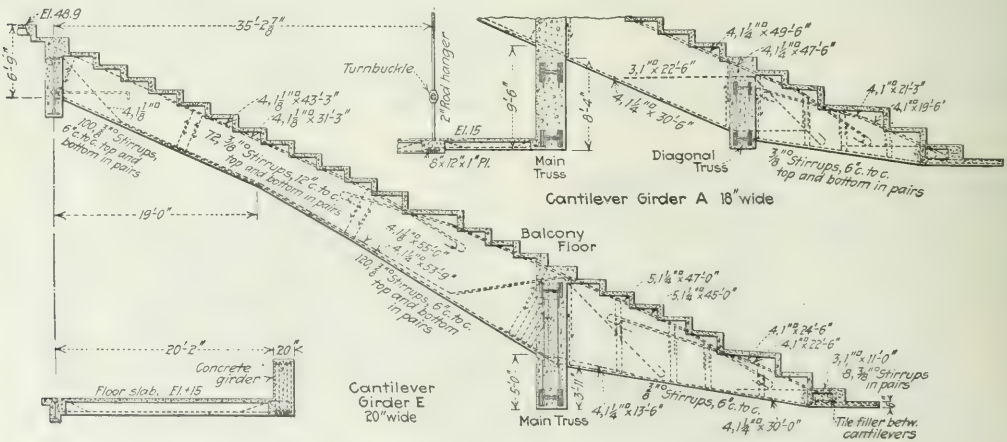


FIG. 9. INCLINED CONCRETE CANTILEVER GIRDERS

Roof Trusses—Steel roof trusses of 120-ft. 6-in. span with steeply inclined chords, are a feature of the theater. This design was worked out to meet the architectural requirements of low side walls and a lofty roof.

girder, 72 in. deep, is provided near the top of the wall of the fly gallery. This girder carries the gridiron framing.

The architects for this building are C. W. and Geo. L.

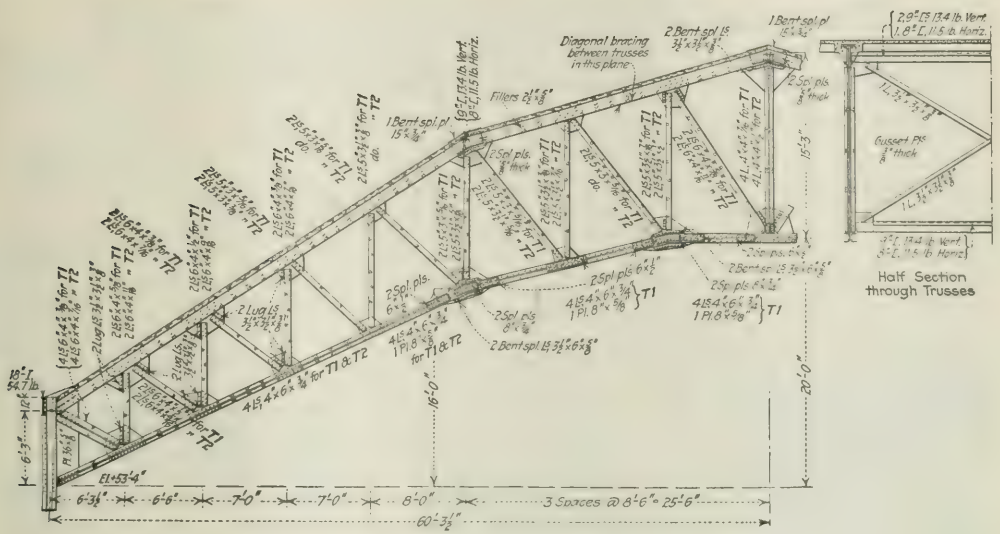


FIG. 10. HIGH PITCHED ROOF TRUSS OVER THEATER

Rapp, and the structural design was prepared by Lieberman & Hein, structural engineers, both of Chicago. The Lundoff-Bicknell Co. had the general contract, and the steel erection was done by the Bass Construction Co., both these being Cleveland firms.

Great City Planning Project on Pacific Coast Near Los Angeles

By Charles H. Cheney
City Planner, San Francisco, Cal.

THE largest single piece of city planning by private enterprise ever undertaken in this country for permanent development will be the new Palos Verdes Project in Los Angeles now being financed through nation-wide underwriting. We have the great examples of Washington, D. C., and possibly one or two other cities well planned in advance and built by public enterprise, and our great expositions have furnished stirring object lessons in what can be done by working to a carefully thought-out pre-arranged plan, for temporary dream cities. Now what city planners have long been urging for permanent city building seems likely of early accomplishment.

The Palos Verdes Project contemplates a new suburb which, although much larger, will be similar to Roland Park, Baltimore, Forest Hills, L. I., St. Francis Woods, San Francisco, etc., except that there will be a greater proportion of low-priced homes and home-sites. A marvelous piece of ground has been secured, containing 16,000 acres (25 square miles) and including almost 14 miles of ocean shore, at the southwest corner of the Los Angeles Metropolitan area, with Catalina Island opposite.

The underwriting calls for a total expenditure of $35,000,000, work to proceed [illegible] of $15,000,000 of this amount is available. Several million dollars has already been subscribed and it is expected that the $15,000,000 mark will be passed soon. Preliminary estimates of improvements include the following items:

Home building fund	$5,000,000
Streets and roads (125 miles concrete-paved)	6,000,000
Sewers	1,800,000
Water system	1,650,000
Cost of land	5,000,000
Ornamental plantings, art jury endowment	1,300,000
Hotels and clubs	2,000,000
Parks, schools and playgrounds	2,000,000
Three civic centers with business blocks	3,000,000
University	1,000,000
Transportation	4,000,000
Unapplied, taxes, etc.	2,250,000
Total	$35,000,000

The $5,000,000 home building fund is expected to finance the building of several thousand houses, arrangement for second mortgage loans being provided in the trust agreement and title already being held to the land. It is proposed to use part of this sum for the organization of co-partnership housing, similar to that in England, in order to furnish working men's homes in quantity on easy terms, and with maintenance and upkeep provided. No buildings can be built anywhere on the property unless the plans are approved by the art jury, which will be a permanent body, endowed with sufficient funds to do real work. Restrictions will be similar to those in force in Roland Park, Baltimore.

The staff appointed to develop the project includes Olmsted Brothers, Brookline, Mass., and the writer; H. T. Cory, consulting engineer, San Francisco, chief of engineering; Hunter Liggett, supply service; Myron Hunt, chairman art jury, and others.

All funds are held and administered by the Title Insurance & Trust Co. of Los Angeles as trustee.

Preliminary to the adoption of the general city plan a committee of the staff will this summer visit and check up on the principal city planning and housing schemes of the country in order to take advantage of as much previous experience as possible.

Power and Irrigation Development in Palestine

Complete Water Utilization for Agricultural and Industrial Service Projected—Long Dry Seasons Make Irrigation Necessary—Half a Million Horsepower Available—Large Part of Works Below Sea Level

AT JAFFA, on the Palestine shore of the Mediterranean, an electric power station with initial capacity of 1,000 kw. is under construction. Diesel engines will generate power from fuel oil. By the end of the present year the station will be completed and will be supplying electric current for the first needs of municipal and private service. Two other Diesel engine stations, at Haifa and at Jerusalem, are also to be built shortly and will feed into a transmission network to which the Jaffa station will be connected. At first these three stations will operate independently, but ultimately they will be merely reserve or peak-load elements of a large hydro-electric system centering in the valley of the River Jordan. These are the first units in the execution of a huge enterprise for which the Palestine government has granted concessions, embracing the utilization of substantially the entire water resources of the country. The main use is irrigation, by means of which great areas of irrigable lands may be brought up to a high level of production. The large heads available in the steep valleys will be utilized for power generation.

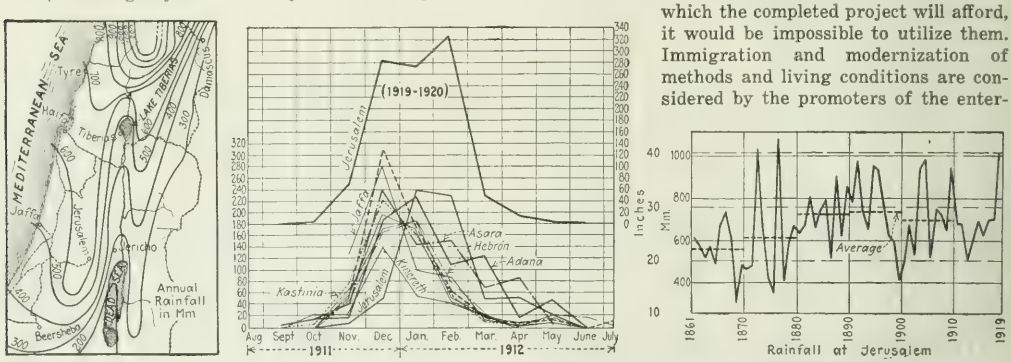


FIG. 1. RAINFALL DISTRIBUTION, MONTHLY AND ANNUAL VARIATIONS IN PALESTINE
Total annual precipitation fairly high, but dry summers make irrigation necessary for adequate development of agriculture.

Work on the first stage of the hydraulic power development is scheduled to begin in March, 1923. This involves the construction of a power plant on the Jordan about eight miles below its efflux from Lake Tiberias, construction of a supply canal from the lake, regulation of the lake level by a controlling dam at its outlet, and erection of a transmission line from the power station to Haifa and thence to Jaffa and Jerusalem, at a total cost of about $5,000,000. The ultimate development will require about twenty times this expenditure.

Two years of study have been devoted to the preliminaries of this project by Pinhas Rutenberg, civil engineer. His recommendations have been accepted by the Zionist interests and Baron Edmond de Rothschild as an essential foundation for the upbuilding of the country. The enterprise is of vast extent, covering practically the whole length of Palestine from north to south and the major portion of its width, from the Mediterranean to the eastern border of the Jordan valley. Not only its size, but also the conditions in the country at present make it impracticable to execute the whole project at once, but it will have to be constructed in successive stages, in a measure keeping pace with the upbuilding of the country.

The primitive character of living conditions, the small population, the crude agricultural methods employed, the waste character of large portions of the country, the lack of skilled labor, the inefficiency of local labor, and the virtual absence of any extensive industrial development are among the factors which determine this necessity. Even were it possible to provide immediately the superior productive facilities which the completed project will afford, it would be impossible to utilize them. Immigration and modernization of methods and living conditions are considered by the promoters of the enterprise to be prime essentials of the successful realization of the ultimate project. Already there is distinct evidence of the assimilation of modern methods of agriculture and construction. One striking example was furnished about a year ago, when American organizations interested in Palestine sent to the Jewish co-operative labor organizations there a gift of modern machinery and tools, such as plows, tractors, seeding machines, excavators, concrete mixers, road rollers and the like, to the amount of more than $100,000. This machinery was at once put to work in different parts of the country, with great success. Further, some of the recently founded agricultural colonies, among them Rishon-le-Zion, Petach-Tikvah, Rechoboth and Migdal have developed most successfully, and in their general aspects and prosperity give proof of the economic results of modern methods of work.

Recently, Mr. Rutenberg reports, he tried out Jewish labor under the most difficult conditions, in a part of the Jordan valley where malaria was prevalent, and secured most satisfactory results, both as regards efficiency and as regards the endurance of the workers. The benefits to be derived from the introduction of machinery should also reach the Arabs, who are expected to develop into good laborers.

A 70-year concession to the interests planning this development has been arranged by the Palestine government for the development of the country's complete

water resources. With the general powers have been coupled broad auxiliary powers, including the construction of electric railways, housing and manufacturing establishments. Rates and other conditions of operation of public-service elements of the development are to be under government regulation. The growth of the country will call for extensive housing construction, and material for this as well as other construction and production is largely lacking. Thus the erection of a cement mill, brick works and the like will be early requirements, and for this as well as transportation development the auxiliary powers are essential. The government is extending the project every encouragement because its successful execution will increase the general prosperity of the country. The recent decision of the government to electrify the Jerusalem Railway, as the first step in the electrification of all the Palestine lines, will have a close relation to the execution of the present enterprise, as power for the operation of the railway will be supplied by the transmission network.

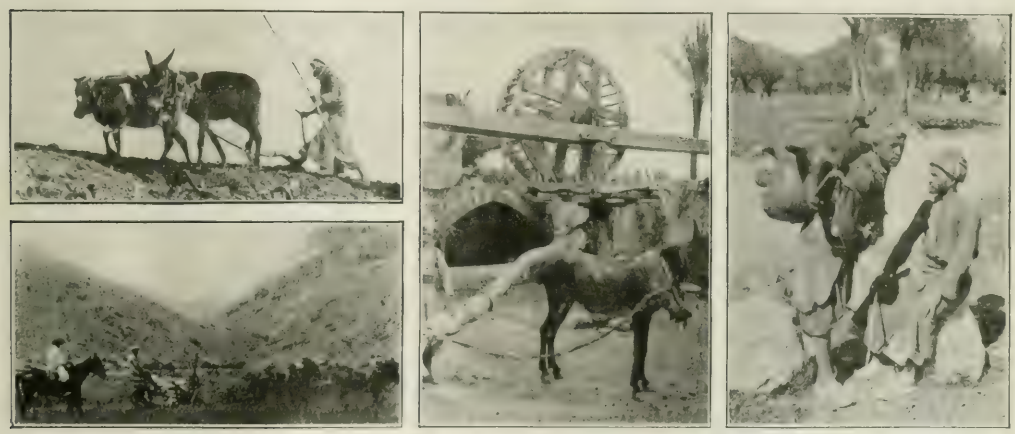


FIG. 2. PRIMITIVE METHODS PREVAIL IN AGRICULTURE AND WATER DISTRIBUTION
Old Wooden Plow and Modern Reaper—Irrigation wheel for garden—Domestic water supply by carrier.

Situation and Hydrology—Palestine is essentially a mountain and plateau country (see topographic sketch map Fig. 3). It represents an area of about 120 by 270 km., which at present has a population of only 700,000. The climate is semi-tropical and semi-arid. The country long ago was deforested, and the fertile soil has been washed away from the high ground. The valleys are fertile, but neglect has allowed them to become marshy and malarial. Sanitation by drainage will be an important item of engineering work in the development of the country.

There are highly fertile valleys around Jaffa, where, for example, orange growing is already so fully developed that a million cases of oranges per year are now exported to Europe. The region around Haifa promises great industrial development.

The highest ground is in the northern part of the country, where elevations of 7,000 to 9,000 ft. are reached in the Lebanon and Hermon mountains. Thence southward the larger part of the territory drains by way of the Jordan River to the Dead Sea, a sink 400 m. below sea level and of 355 sq.mi. surface area, whose evaporation consumes the inflow. The Jordan extends southward from the slopes of the Lebanon and Hermon ranges at a distance of about 40 miles from the coast, dropping in elevation through Lake Merom, which is nearly at sea level, thence through Lake Tiberias, which lies 200 m. below sea level, to the Dead Sea.

Precipitation has been recorded by a number of scattered series of observations, at schools, monasteries and the like, in a few instances for as much as sixty years past. From the figures an average of 630 mm., or 25 in. annual, has been taken as the mean supply of Palestine. Evaporation from water surfaces is high, ranging in the southerly portion, for example, from about 40 in. at Jerusalem to about 150 in. at the Dead Sea. Rainfall contours are given in the left-hand drawing of Fig. 1, based on averages compiled from the various records. The other two diagrams of this figure show the monthly rainfall distribution and a long-time record of annual precipitation for Jerusalem.

Reference to the rainfall map will show that substantially the whole southern half of the country is somewhat deficient in rainfall, although a belt of rather high rainfall extends southward along the mountain and plateau region. The annual precipitation total is large enough to assure a sufficient stream flow, but the critical feature of the climate is the fact that practically all the rain falls in six months, from November to April inclusive, while May to October are dry months. Factors of run-off are the absence of forests, the steep slopes of the valley sides, and the intense rains during the winter months. The unfavorable distribution of rainfall creates the necessity for equalizing the supply of water by storage and irrigation.

Storage—In order to make the winter rainfall available for summer use, water must be stored. A large total of storage will be required, even without any carrying over of water from year to year. On the map Fig. 5 are indicated the locations of nine proposed storage reservoirs, with an aggregate utilizable capacity of about 600,000,000 cu.m., or 500,000 acre-ft., two-

fifths of which is in the upper Jordan valley, while the remainder is in the eastern tributary valleys.

While these quantities are large in themselves, they are hardly more than moderate in consideration of the large area of territory to be served. In this connection, however, the large storage or equalization effect of Lakes Merom and Tiberias must be taken account of. Controlling dams giving about 7-8 m. range of level in these lakes will develop utilizable storage of 100,000,000 and 1,000,000,000 cu.m., or 80,000 and 800,000 acre-ft. respectively, which exceeds the storage in the artificial reservoirs.

Relation to Dead Sea—All the drainage from the central part of Palestine is carried to the Dead Sea. When a large proportion of the river flow is distributed over the land for irrigation use and the evaporation from the land surface is thereby increased, the inflow to the Dead Sea will decrease correspondingly. Equalization of lake inflow and evaporation will therefore result in a smaller water area, that is, the lake level will be lowered. At present a large belt of the outer portion of the lake, possibly well over half its area, is shallow (2-3 m. depth) and this will be laid dry by the lowering of the lake resulting from irrigation use of the river water. As the lake water contains 33 per cent dissolved solids, the expectation is that the land exposed will be found to be rich in mineral deposits.

At present the Jordan flow at Lake Tiberias ranges from about 12 to 65 cu.m. per second. With complete storage and regulation, and some use of water above Lake Tiberias, the lower course of the Jordan will have a regulated flow of 33 cu.m. per second.

The Jarmuk River, flowing into the Jordan below Lake Tiberias, carries rather more than 20 cu.m. per second average flow. Its prime importance in the general scheme is due to the fact that its waters can be stored at a high elevation and therefore are best used for irrigation, since they can be brought to land lying at an elevation of as much as 250 to 300 m. above the level of Lake Tiberias, while even higher areas can be reached by pumping.

Accordingly, it has been deduced that the most favorable division of use of the waters in the lower Jordan valley will be realized if the Jordan outflow from Lake Tiberias is utilized for power—the larger part of the 186-m. drop between Lake Tiberias and the Dead Sea can be developed—while substantially the whole of the Jarmuk is taken for high-level irrigation supply for the Jordan valley, with siphons crossing the valley and conveying irrigation water from the east to the west slope of the valley.

Spring and Marsh Conditions in Upper Jordan—A fall of about 200 m. is available in the short stretch between Lake Merom and Tiberias, offering an inviting opportunity for power development. However, the present lack of means of communication and the more urgent necessity for reclamation and irrigation storage development above led to the conclusion that this intermediate stretch is not to be preferred as earliest power development site.

Some miles above the head of Lake Merom is a region of foot-hill springs, constituting the principal source of the Jordan. There are three main springs (the spring of Dan is illustrated in the view Fig. 6), and it is important that their outflow be conserved by developing a storage reservoir at each of them. The project provides for five such reservoirs accordingly, as indicated on the map Fig. 4. By their aid it will be possible to provide irrigation for the broad plains lying directly north of Lake Merom, after their reclamation. Lake Merom itself will also be used as an equalizing storage reservoir, and its outflow will be utilized for power development in the nearly 200-m. fall to Lake Tiberias.

Reclamation of the Hulle marshes, above Lake Merom, is the first necessity in connection with this

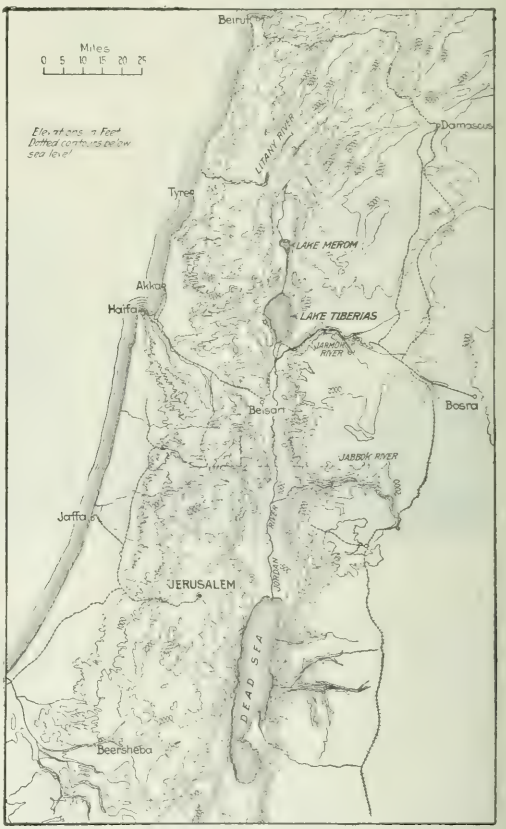


FIG. 3. MOUNTAINOUS TOPOGRAPHY CONTROLS PALESTINE WATER RESOURCES

headwater development. These marshes form a highly malarial region, and their drainage is important for headwater development. These marshes form a very fertile ground, which when drained and properly supplied with water by irrigation will increase the agricultural productivity of this part of the country very greatly. The governing condition in the maintenance of the marshes is a series of three rock dikes in the bed of the Jordan below Lake Merom, and the first step in drainage will be the enlargement of the river channel by cutting through these dikes.

Power Supply to Coast—Sufficient power-development capacity exists along Jordan and its tributaries to supply a large industrial population. The coast

cities will be the heaviest users, besides the railways. The cost of coal, now about $20 per ton, makes steam power of prohibitive cost; hence the great importance of hydro-electric supply to the coast.

A transmission network as outlined in the map Fig. 4 is to extend from Haifa in the north to Beersheba in the south. Hydraulic power stations would be located at the points indicated, providing an ultimate total of about half a million horsepower, which can be utilized advantageously in railway operation and industrial and agricultural use.

Canal System.—By the proposed storage of water of the upper Jordan, and its augmentation by a supply of 30 cu.m. per second from the Litany drainage area, three main utilization canals will be fed:

1. On the east side of the Jordan, the Trans-Jordan Canal, lying about 150 m. above the level of Lake Tiberias. This canal is wholly supplied from the Jarmuk in its upper section, but farther down receives additional flow from the Jabbok. The total amount of flow in the upper section will exceed 40 cu.m. per second maximum (20 cu.m. per second yearly average), while at the lower end this amount will be increased by 10 cu.m. per second yearly average from the Jabbok. A part of this water will be conducted by siphons to a parallel irrigation canal on the western slope of the valley, approximately on the same level as the main Trans-Jordan Canal.

2. West of the Jordan, the Cis-Jordan Canal (El.-208) supplied from Lake Tiberias. Its maximum flow will be something more than 70 cu.m. per second, i.e., twice its yearly average.

3. North and west of Lake Merom, the Western Hulle canal for the irrigation of the valleys of Esdrelon, Asoxi and Acre. Its flow, 30 cu.m. per second (60 in the irrigation season), will correspond to the Litany supply diverted to the upper Jordan. The Hulle marsh region will be irrigated directly by its own canal system from the Jordan water. There is also planned an irrigation supply to the valleys near Tyre and Sidon, from the lower reaches of the Litany.

As previously indicated, the relative elevations of the sources lead to devoting the Trans-Jordan Canal wholly to irrigation use in summer (power in winter), while the Cis-Jordan Canal is largely given to power development. It is calculated that the system as described will suffice for irrigating a total agricultural area of 282,000 hectares (650,000 acres), distributed as follows:

Hulle	22,000 hectares
Eastern slope of Jordan	82,000 "
Western slope of Jordan	48,000 "
Esdrelon, Asoxi, and Acre	90,000 "
Tyre and Sidon region	40,000 "

There is a possibility that the development of better reservoir sites in the Jarmuk valley, when more complete surveys can be made, will enable the level of the Trans-Jordan Canal to be raised by another 50 m. or more. This would permit direct irrigation of a larger area without pumping.

Jisr-el-Mujamieh Plant—The first unit of the enterprise to be built is the power plant on the Jordan just below Lake Tiberias. Detailed surveys have located it at Jisr-el-Mujamieh, about eight miles below the foot of the lake. At this point a flow of [illegible] of water is available, with 40-m. fall from the lake, giving a 24-hr. capacity of 20,000 hp., or 40,000 for 12-hr. use. It is planned to develop at the start 12,000 kw., with 8,000 working and 4,000 reserve capacity.

A low regulating dam in the Jordan directly at the lake will constitute the intake and river-control works. A canal leading thence along the hillsides to the power plant, an equalizing reservoir, supply penstocks and generating station will constitute the development. Transmission lines will carry the power to Haifa, Jaffa

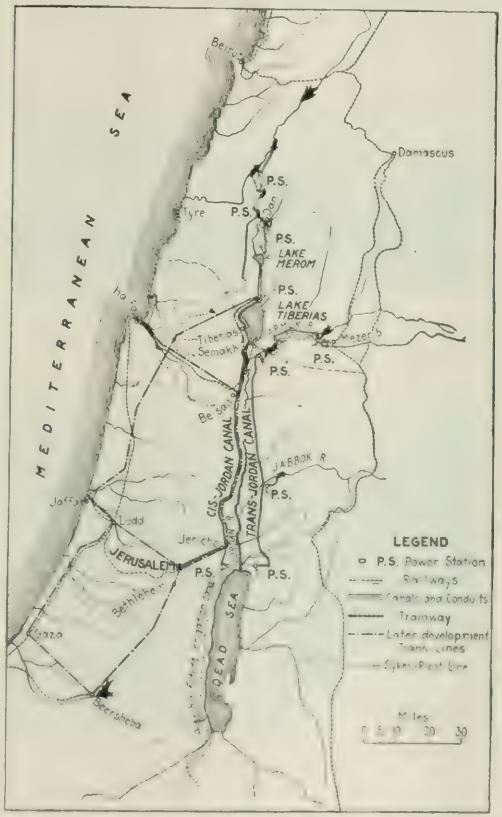


FIG. 1. COMPLETE IRRIGATION AND POWER PROJECT
[illegible] will ultimately be utilized for irrigation and power—the Litany, the Jordan, the Jarmuk and the Jabbok

and Jerusalem; they will form a 66,000-volt system with branch service at 15,000 volts, 6,000 volt supply networks in the towns, and 110-220 volt distribution to consumers.

On account of the availability of natural storage (Lake Tiberias), elimination of high dam construction and the like, the cost of the development will be low. The cost of the Jisr-el-Mujamieh development to 12,000 kw. capacity is estimated at £1,000,000, subdivided as follows:

Canals, headworks and penstocks, £250,000; power house and machinery, £180,000; 200 km. transmission line, £150,000; low-tension and distribution networks [illegible] half of ultimate cost), £100,000; steam reserve stations, £100,000; contingencies, £200,000; land £20,000.

An immediate market for an energy output of 15,000,000 kw.-hr. is available in domestic and industrial service. The low development cost will permit of selling at so low a rate, it is said, as to make electric power available for heating and cooking, and in the coast cities there is considerable need for domestic heating. Once the electric supply is available, it is believed, a very rapid growth of demand will take place.

Construction on this unit will begin next spring, the necessary initial capital having been largely secured in Europe and the United States. The main participants in the enterprise up to the present are the Jewish



FIG. 5. UPPER END OF LAKE MEROM
View looking northeast, Hermon Mountains in distance. Reclamation of marshes just north of the lake is to be one of the early parts of the enterprise.



FIG. 6. SPRING OF DAN, ONE OF THE MAIN SOURCES OF THE JORDAN
Impounding reservoirs will conserve the flow of the springs at the foot of the mountains and the flow of the upper tributaries.

Colonial Trust, of London; Baron Edmond de Rothschild, of Paris; the Palestine Development Council, of New York (Justice Louis Brandeis, honorary chairman). The company will be formally organized within the next few months, preparatory work will be carried on during the coming fall and winter, and construction will begin in March.

So far as can now be told, the second step in the execution of the enterprise will be drainage of the Hulle marshes and impounding of the Jordan springs. This will carry with it immediate irrigation following upon agricultural reclamation of the marsh land, and housing and transportation development.

It should be added, as a minor element of the scheme, that domestic water supply will be provided for throughout the region covered by the hydraulic works. Municipal operations in general will form a large part of the working out of the project.

Why One Standard for Portland Cement?

From a paper by P. H. Bates, of the U. S. Bureau of Standards, presented to the Franklin Institute, and entitled "The Application of the Fundamental Knowledge of Portland Cement to its Manufacture and Use."

AT THE present time there is but one standard for portland cement, no matter into what use it ultimately goes. Is this good practice? The answer must be in the affirmative if considered from the viewpoint of our present knowledge of cement testing. The practical cement user, however, has answered the question negatively in many cases, when he uses one or more brands in preference to others for certain classes of work or at certain periods of the year. In this connection may be cited the belief that certain brands always produce a non-dusting floor, while other brands produce a dusting floor. In all cases the various brands invariably meet the requirements of the standard. The requirements of the latter do not bring out the differences which usage has found to exist. Hence for certain uses special tests will have to be devised which will determine the desirability of any brand over another for any particular case.

The question arises as to what is a particular case. Should cements for massive construction be different from those for road construction, or for interior pavement, or for sea water or alkali work, or for reinforced concrete? The former does not of necessity demand high tensile or compressive strength like the latter, while for the pavement strength is of relatively minor importance when compared with non-dusting. For sea water or alkali resisting work the physical properties are relatively of minor importance when compared with the need of resistance to chemical action.

High compressive strength can be secured by a high tricalcium silicate content, a silica content of about 20 per cent, a usual alumina content and hard burning of such a raw mixture ground more finely than is usual. Such a cement, however, is brittle, and of low tensile strength after an early age, hence it is not desirable for road work. It commends itself for floors but requires special skill in handling or it will dust continuously. Material changes in our present tests would have to be made to show the value of any marked changes in methods or procedure of manufacture. Earlier strength tests than 7 days would be required; both a tensile and compressive test would have to be considered and a test to determine the coefficient of expansion with age. If by change in composition it can be shown that a cement more resistive to salt action can be secured it may be necessary to incorporate further chemical determination in our specifications. The possibility of determining the quality of the cement in a concrete at a late age by an accelerated test, in other words determining its cementing qualities when it has largely hydrated, is worthy of much research. Hence aging at higher temperatures in an atmosphere of water vapor should be a subject of much further and more logical work than heretofore.

Enforcing Vehicle Law in California

The California Highway Commission, co-operating with the supervisors and traffic officers of the state, is making a determined effort to stamp out overloading. The commission has organized an inspection department under direction of Major C. L. J. Frohwitter, a retired army officer, who has five assistants, mostly ex-service men deputized by the motor vehicle department. These inspectors equipped with automobiles and loadometers for weighing trucks on the highways where found are working through the state where overloading is most flagrant. To date Major Frohwitter reports that 50 per cent of the trucks apprehended violated either the gross weight or tire provisions of the Motor Vehicle Act. The allowable gross weight in California is 30,000 pounds.

To Avoid Variable Concrete Due to Variable Sand Wetness

New Method of Mixing Proposes Inundating Sand Before Dumping in Mixer Thus Keeping Moisture Content Constant

By R. L. Bertin

Chief Engineer, White Construction Co., Inc., New York City

VARIABLE moisture content of sand is responsible for a large part of the variation in the strength of field concrete. Not only does the changing amount of water, due generally to atmospheric conditions, affect the bulk of the sand and thereby the amount used in the mix but it makes it extremely difficult to gage the proper amount of water to add in order to get the optimum concrete.

In attacking this phase of the problem of proportioning concrete there has been evolved what is thought to be a practical method of measuring sand and water regardless of the moisture content. This method, which has been developed after a considerable amount of experimentation, should result in the elimination of such variables as are the direct cause for the lack of constancy in the absolute quantity of materials contained in successive batches of concrete. An extended series of tests is about to be made with the view of getting more definite information, but the present status of the development seems worth noting.

It is a well known fact that the volumetric measurement of sand with varying moisture content is no gage of the absolute amount of sand measured or the amount of water carried by this variable amount of measured sand. Measurements by weight while giving closer results lack constancy to the extent of the variation in moisture content. The problem which presented itself was to find some method of measuring sand containing any percentage of moisture in such a way as to insure a constant known amount of given sand and constant amount of water contained therein in successive measures, irrespective of the moisture content of the sand as measured.

Two methods of making the water content constant suggested themselves. One was to dry the sand, which is considered impracticable, and the second was to inundate it with water; in other words, fill the voids completely with water.

The next step, which was thought probable and later proved by a series of tests, was to determine whether a given sand in an inundated condition has a constant void factor. The basis of this belief was the fact that if surface tension were done away with in damp sand by inundation, the bulking effect would disappear and therefore a fairly uniform ratio be obtained between weight and volume. It was found experimentally that if sand be poured in a container partially filled with water, the amount of water therein contained being in excess of that required to fill the voids, until the sand and water level have reached the top of the container, a fairly constant weight of sand and water was contained therein, so long as the specific gravity and void factor of the sand remained constant or nearly so. The only two disturbing factors which it was thought might interfere with the accuracy of the measures, were first, the absorption of the sand and second, the air entrapped within the voids of the sand. However, since only the constancy of measurement was sought, it was thought and verified that these factors would not vary much, and would not effect the constancy of results.

The coarse aggregate carries a certain amount of water, but it was found that by keeping the stone pile wetted that this amount of water was small and fairly uniform and that no compensation was necessary since there was but a slight variation.

Sand and Water Container—A container was then designed based on the above principles, a description of which follows:

The container is cylindrical in shape and divided in two vertical sections, the upper intended to contain the right amount of inundated sand required for a batch, and the lower section the complement of water required beyond that contained in the inundated sand and the wetted stone to supply the total amount required for the batch. The two bottoms are made adjustable so as to permit of changes in capacity in the event of variations in grading or voids of the aggregate, or proportions of mix requiring changes in the sand and water quantities. The intermediate bottom is provided with fine screens to permit the water to enter therein and exit therefrom.

In operating the container, it is first partly filled with water, the lower container being completely filled and the upper container to a point so that enough water is provided to more than fill the sand voids. Sand is then dropped into the water contained in the upper section until it is filled to the top with inundated sand, the excess water spilling over the top sides. The container is then emptied into the mixer hopper, thereby delivering to the mixer known amounts of sand and water which are constant from batch to batch.

A number of preliminary tests were conducted with the view of ascertaining the practicability of the method described above and the accuracy of results obtained. In making these tests a certain proportion was adopted and the sand was used in different condition as to moisture content, from perfectly dry to saturated. The materials which were used were of one kind for all tests.

Conclusions—The observations and conclusions derived from these tests are as follows: (1) The amounts of water and sand in successive batches are practically constant; (2) the plasticity of the concrete produced as determined by the slump tests shows only slight variations; (3) the cement factor in successive batches is nearly constant; (4) the amount of concrete in each batch measured by volume or weight is nearly constant; and (5), the strength of the concrete tested at 28 days is fairly uniform.

If the conclusions noted above are proved to be facts by the tests, the method promises a solution of the problem of specifying of concrete by strength which has been recently proposed.

Iowa Spent $39,000,000 on Roads in 1921

Iowa, during 1921, spent for road and bridge building on her 104,082 miles of public highway, $38,741,627.53. Primary road expenditures on 6,616 miles for road work only totaled $16,996,807. County road system expenditures on 10,681 miles totaled $5,766,484. Township road expenditures based on 1,359 townships totaled $6,672,985. Bridge expenditures on the three systems, primary, county and township, totaled $9,305,352.

Large Steel Highway Bridge Destroyed by Abutment Washout

By G. G. Wickline
Bridge Engineer, State Highway Department, Austin, Tex.

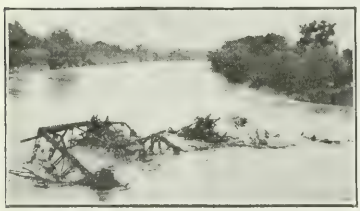
THE fall of a 300-ft. steel span, one of two forming the Marlin-Belton bridge across the Brazos River, five miles west of Marlin, Tex., on May 16, threw into the river about a score of people who were standing on the span, and eight of them were drowned. The river was at flood stage. A washout in the west approach was being repaired by constructing timber cribbing and filling it with stone and earth. This work was to have been done within a few hours, when the abutment slid into the river from undermining, dropping the span it supported.

A new oil field is being developed on one side of the river, and traffic is rather heavy and insistent upon using the structure. Due to the importance of the road and the development of the oil-field traffic, the chamber of commerce of Marlin and the commissioners court of Falls County have made arrangements with the War Department to maintain and operate a pontoon bridge at this location until a new structure can be provided, which will probably require several months.

The bridge was built a number of years ago, before the organization of the state highway department. It was erected by a bridge company, which furnished its own plans and acted as its own engineer in the matter of passing on the foundations for the piers and abutments. In those days a certain sum of money usually was available to build a bridge to cover a certain distance, and bridges were built to suit the available sum without very much regard to the strength and stability of the structures. However, it should be said that the Brazos River from Waco to its mouth is a very treacherous stream, in which shifting of the channel and sliding of banks are frequent occurrences.

As the bridge is not located upon a designated state highway, it will probably be rebuilt by some bridge company with a span that is as likely as not to be a duplicate of the span which remains.





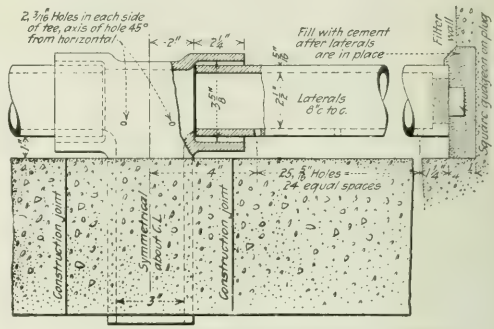


WRECKAGE OF THE BELTON BRIDGE OVER BRAZOS RIVER AND SITE OF WASHED-OUT WEST ABUTMENT

A score of people was on the span at the time it fell, and eight of these were drowned. The river was at a flood stage and a washed-out section of the west approach was being repaired with timber cribbing. The repairs were nearly completed when the abutment slid into the river as the result of undermining. The bridge was designed by the bridge company which built it, and this company acted as its own engineer in the matter of passing on the foundations for the piers and abutments.

Perforated Pipe Underdrains for Alpena Water Filters

UNDERDRAINS in the four filters of the new 3-m.g.d. municipal water purification plant for Alpena, Mich., are of the perforated-pipe type. There is no manifold but the 2½-in. cast-iron pipe laterals are leaded into tees, the long outlets of which extend through the floor to a rectangular concrete collecting conduit extending longitudinally under the center of the filter floor. The conduits are reinforced and form the tops of supporting columns. The accompanying drawing shows the detail of the setting, perforations and spacings.



PERFORATED FILTER LATERALS FOR ALPENA

In setting the tees, which are grouted in some time after the concrete in the floor has been deposited, a plank with holes drilled ⅜ in. deep at the 8-in. spacing is braced against the bottom of the floor to fix the lower ends of the tees while grouting. The extension of the tees below the bottom of the floor serves no other purpose.

The 17-in. gravel underdrain depth is designed for a 24-in. vertical rise in the wash water. The bottom layer of gravel is of 2-in. size and as the bottom of the laterals is 1 in. from the floor a channel is left under the laterals. The top of the 28-in. sand layer is 26 in. below the crests of the wash-water gutters to care for the maximum rise of sand expected with the minimum size of sand. At the maximum rate of washing the velocity through the openings in the lateral is 12.15 ft. per second. The opening is 0.27 per cent of the filter area.

The plans and specifications were drawn and the construction is being supervised by William G. Clark, consulting engineer, Toledo, Ohio.

Illinois Municipal Review

The Illinois Municipal League has begun the publication of a journal called the *Illinois Municipal Review*, which is to be issued six times a year.

Comparison of Mechanical Ashpits for Large Terminal

Various Types Studied as Economical Substitutes for Costly Hand Shoveling of Ashes from 150 Locomotives Daily

By W. H. Eiker
District Engineer, C., B. & Q. R.R., Lincoln, Neb.

THE desirability of introducing mechanical operation to improve the ash-handling facilities of the large engine terminal of the Chicago, Burlington & Quincy R.R., at Lincoln, Neb., led to a study of the situation in 1918 and 1919. In November, 1918, a daily average of 108 engines was handled over two parallel cinder pits 150 ft. long with pit tracks 28 ft. c. to c. Between the pits was a depressed track for cars into which the ashes were shoveled by hand, but this method had become expensive and inconvenient because of the labor shortage and the amount of ashes to be handled. The new plant was to be designed to handle the ashes from 150 locomotives daily.

Types of Ashpits—Six types of plants were examined: (1) Water pits; (2) pit cars on lateral incline tracks operated by cable hoists; (3) pit cars traveling on longitudinal track in box pit and delivering to a hoist or conveyor; (4) track hopper delivering to a conveyor or to a car in a tunnel; (5) steam conveyor in pit; (6) pit buckets handled by an electric gantry crane. Some features of these different types are noted below, together with certain objections which were made in most cases by foremen or operators. In general, ashpits of the different kinds are satisfactory to the local officials.

Water-Filled Ashpits—Two types of water pits were examined: (1) Large pits 12 to 15 ft. deep with an engine track over each side; (2) pits between the rails and 3 to 4 ft. deep. In both cases, the ashes are removed by clamshell buckets operated from a locomotive crane or electric gantry crane, the ashes being dumped into cars. These open pits are an element of danger to employees and others, and several fatalities have occurred from persons falling into the large pits. With the track at the side of the pit the fire must be cleaned from one side only, which is inconvenient. Stoppage of pit drainage may cause trouble. Water spilling from the bucket makes an untidy condition and may result in ice-covered tracks in winter, while the wet ashes may freeze in the car and thus add to the expense of unloading. Delays may occur at terminals cleaning over 100 engines daily, as the pits are about 300 ft. long and engines that are wanted in a hurry may be blocked at the pit.

Pit-Car Systems—Ashpits fitted with cars are of two types, with the cars operated either laterally or longitudinally. In the first case the pit car is handled by an electric or pneumatic cable hoist on a steeply inclined track at right angles to the pit, the incline being extended high enough to allow the ashes to be dumped into a railway car placed below the upper end of the incline track. With ashpits of this type, the car must be dumped after each fire is cleaned. Where two or more pits are required they must be spaced 80 to 100 ft. apart along the engine track so as to give ample room for the engines to stand on adjacent pits without fouling each other. This spacing may necessitate an undesirable length of track.

Engines must be moved along the track in cleaning both the smokebox and firebox. The ash car also must be pushed along its track under the incline in order to fill it from end to end. This intermittent movement or spotting of engine and ash car involves time and trouble. Pneumatic operation has proved objectionable in many cases owing to insufficient pressure, leaky piston packing and freezing of pipes. With electric operation this system of handling ashes is economical for terminals with not more than 25 engines daily.

In the second pit-car system the cars travel on a longitudinal track in the pit. They are either picked up by an air hoist which dumps the ashes into a car, or the pit cars dump directly through a hopper to a bucket conveyor which serves an overhead ash storage bin. The former arrangement is used mainly at small terminals, owing to the amount of labor required. In a case where a conveyor was used to handle coal and ashes, the machinery was frequently damaged by scrap metal, so that the conveyor was out of use until repairs could be made. Hot and wet cinders were also destructive to the metal parts of the conveyor, necessitating frequent renewal. In both systems, the pit car must be spotted by hand under the firebox and smokebox, and over-filled cars spill ashes into the pit.

Track Hopper Ashpit—In this system the engine is spotted over a hopper which delivers the ashes either to a bucket conveyor serving an overhead bin, or to a tunnel car serving a hoist for discharge into a bin or a railway car. It was found that with the conveyor there was frequent damage by scrap metal thrown into the hopper with the ashes, while rapid destruction of the machinery was caused by the hot or wet ashes. Tunnel work is undesirable and the work of cleaning fires may be delayed until the hopper can be emptied by dumping the ashes into the tunnel car.

Steam Conveyor—Only a short pit is required for this system, the ashes falling into a pipe across the bottom of the pit and being blown through this under the influence of a steam jet. The pipe may be extended upward for delivery to a storage bin or an ash car, or it may discharge directly onto an ash dump. Objections made may include the amount of steam used and the labor of conveying or shoveling ashes from the pit to the pipe intake. But in one case the pit is hopper shaped so as to feed directly to the pipe and the engines supply their own steam for the jet.

Pit Bucket System—Steel buckets placed in a pit of small cross-section receive the ashes and are handled by the hoist of an electric gantry crane, the ashes being dumped into cars on an adjacent track. This method appears to present no operating objections and when cast steel buckets are used the maintenance charge is almost negligible. It was recommended for the Lincoln terminal.

General Observations—The use of so many different types of ash-handling systems is accounted for by variations in organization of ashpit service, number of engines served, topography and track layout. It is usual to find several different types of ashpits on any one railway. For terminals where not more than 25 or 30 locomotives are cleaned daily the electrically operated lateral incline system has advantages, except that where a locomotive crane is available or is desirable for other work the shallow water-pit may be preferred,

being cleaned by a clamshell bucket handled by the crane.

Removal of ashes from dump pits by clamshell buckets appears to be general. At the larger terminals the buckets are handled usually by an electric traveling crane, but at the smaller terminals a locomotive crane is preferable, as the machine can be used also in coaling engines and for other work. At busy terminals and where track space is limited, the locomotive crane has the objection of blocking one track when cleaning the ashpit.

Organization for ashpit service varies on different roads and at different terminals. At Lincoln, a hostler and helper take over the engine from the road crew at the coaling station; they supply coal and water, knock the fire out at the ashpit and then run the engine to the roundhouse. A shovel gang of about 8 men in summer or 12 men in winter clean the pits. A more general arrangement is to have fire knockers at the pit, these men attending to mechanically-operated pits. In exceptional cases, at very small terminals the hostlers handle the engine, knock fires and clean the pit.

Ashpit for Lincoln Terminal—A plant consisting of a series of cast-steel pit buckets handled by an electric traveling crane having been recommended as the best type of mechanical operation for the Lincoln terminal, a general plan for size of pit and number of buckets was outlined. The plant of the Buffalo, Rochester & Pittsburgh R.R. at Rikers, Pa., was suggested as an economical form of construction, since it has a timber instead of a concrete structure to support the crane track. For the Lincoln terminal, the cast-steel buckets are to be 7 ft. long, with a capacity of 1.85 cu.yd.

It was thought that the new pits should provide for handling a daily average of 150 engines. Investigation showed that an average of 1.7 cu.yd. of ash is taken from each engine. This was based on car measurements from a one-day pit run of about 100 engines. The average weight of the ash was 1,500 lb. per cu.yd., this weight being taken on the day after wetting down and removal from pit. Illinois coal is the fuel used. It is desirable to clean the pits only during the day shift, making the pits large enough to accommodate the ashes from the night run. As the day and night run of engines is about the same, storage capacity for ashes from 75 engines was planned, requiring 69 buckets and 483 ft. of pit. A spacing of 18 ft. c. to c. of pit tracks is desirable to facilitate work on fires and for walking space.

There will be two pits 245 ft. long, with 35 buckets each, on the present pit tracks. The present depressed track will be raised to serve for the ash cars. These three tracks and an adjacent track for kindling-wood cars will be spanned with a 70-ft. electric crane. This plan fits the present track layout and allows for future expansion without track change by building a third pit on the ash car track and using the wood-car track for the ash cars.

Six ash cars are required to hold the ashes from 150 engines and the 245-ft. pits allow this number of cars to be set on the ash track under the crane. Shorter pits would increase the operating charges, as the pit has to be cleaned oftener and more switching of cinder cars is required. With two 245-ft. pits it was planned that a crane operator and one laborer working six hours per day could empty the pit, and only one switching of the ash cars per 24 hours would be required. The number of engines cleaned at this type of pit can be increased by added time for laborer and crane operator and additional switching of ash cars.

Comparison of Operating Cost—This comparison is based on conditions in November, 1918, as to wages and number of engines. The daily average of engines handled over the ashpits during that month was 108. A 48-bucket pit furnishes storage for 54 engines or a 12-hour run. The buckets would be emptied twice in 24 hours and the time required would be four hours for a crane runner. A laborer should be employed at the pit for the entire 24 hours (three 8-hour shifts) for cooling fires, cleaning up around pit and assisting the crane runner to empty buckets. The operating cost per day would be as follows, and on this basis the yearly cost for handling the ash from the mechanically operated pit is approximately $4,600:

Crane runner, 4 hours at 53c	$2.12
Labor, 24 hours at 35c	8.40
Electric current, 70 k.w.h. at 3c	2.10
	$12.62

Operation of the depressed-track pit with hand shoveling required an average daily gang of 10 shovelers working a 10-hour shift and one laborer working 10 hours at night. The daily operating cost was 110 hours at 35c., $38.50, or a yearly cost of approximately $14,000. This charge covered office overhead expense, car-body bunk houses for Mexican labor, and light, heat and water for living quarters. A foreman's time is not considered in this comparison as his time is distributed between ashpit, coaling station and other duties and he would be required at any pit. The mechanically operated pit will relieve him of one large gang.

Serious conditions have occurred because sufficient shovelers could not be had. The pits filled with ashes and it was necessary to take men from other work to clean the pits. The investigation noted above showed that there is no economic argument for hand shoveling of engine ashes at large terminals. After this investigation the Chicago, Burlington & Quincy R.R. constructed at Denver, Colo., a mechanically operated ashpit of the type recommended for Lincoln (see *Engineering News-Record*, Aug. 25, 1921, p. 310) and plans are now being made for a similar plant for the engine terminal at Lincoln, Neb.

Activities of British Guild of Builders

(London Correspondence)

According to its secretary the British National Guild of Builders commenced operations eighteen months ago without a penny of capital and without a cent's worth of plant. Since then they have spent £52,000 on plant, and have written off 33⅓ per cent of its value, though much of it is almost unused. The surplus actually earned is now £40,000, and £20,000 is held by city corporations pending the completion of contracts.

The original form of contract is still adhered to, by which the guild constructs houses at prime cost plus 6 per cent and £40 per house completed. At the time of the agreement with the Ministry of Health this showed a gross profit of around 10 per cent.

The guild has undertaken £1,500,000 worth of contracts, of which £900,000 represents work completed and paid for. During this year lump sum contracts awarded the guild amount to £700,000 of which £130,000 is for work which has been completed.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

From Another Engineer's Wife

Sir—Several weeks ago "Engineer's Wife" passed a just condemnation on the unwarranted use of the professional title by the layman engineer. Every engineer has met with such hypocrites of his profession, but the individual can do nothing to prevent this presumption upon one of the noblest professions on earth. Perhaps this laxness goes back to the fact that not so very many years ago America could use every man that knew ever so little about the profession. Europe has always produced more than enough to supply her demand for engineers. Consequently, a great many came to this country. There was nothing to prevent the would-be engineer from assuming the title of the graduate, for few employers looked up past records.

After all, he only fools himself who claims the engineer's title when he does not merit it. It is the results of your work that count, not the mere title after your name. It never takes very long for the boss to find out whether or not the man can do his work.

(Mrs.) SOPHIA GOOMS-BUCHER,
Chicago, Ill., June 3. (Another Engineer's Wife.)

Bureau of Standards on Radio Dangers

Sir—Our attention has been called to the editorial appearing on page 812 of *Engineering-News Record* for May 18, entitled "Shingles and Radio." We assume that your editorial makes reference to a press notice released under date of May 14, in which mention is made of the proposed revision of Rule 86 of the National Electrical Code, on radio equipment. Full discussion of the provisions of this proposed rule is very welcome, and it is believed that such discussion will result in calling attention to any features in the rule which are not practical or desirable. We are glad to note the statement in your editorial that the proposed rule is "moderate, sane and practical in the highest degree." The requirements of the proposed rule are less rigid, in a number of particulars, than are the corresponding requirements for other signaling systems.

Your attention is called to the fact that the press release pointed out that a failure to give cognizance to the proposed fire-insurance rules for radio equipment might result in the raising of insurance rates on property or the refusal of insurance entirely. It was not specifically a warning against lightning danger. There are other sources of danger in radio installations which may, in some cases, be more important than the lightning hazard.

The very existence of the need for a rule on radio equipment, such as that which has been drafted by the committee of the National Fire Protection Association, is in itself a suggestion that consideration must be given to such hazard as may exist.

In this connection your attention is drawn to the fact that within the last few weeks two deaths have resulted in the city of Cleveland, which, according to our understanding, could have been avoided if the proposed regulation had been followed. The cities of Cleveland, Detroit, Indianapolis and Chicago, among others, are enacting local ordinances on this subject, many of which are extremely drastic, and not nearly so lenient as the proposed revision of the Code rule. It is believed that some regulation for the safe installation of radio equipment should be as uniform as possible over the country, and it is therefore highly desirable that the proposed revision of the National Electrical Code in this respect receive careful consideration and discussion.

[illegible] BURGESS,
Acting Director, Bureau of Standards.
Washington, June 7.

Simple Formulas for Rivet-Hole Deductions

Sir—In your issue of June 1, p. 911, under the heading "Net Section of Riveted Tension Members," there appears a summary of a bulletin on the subject by Prof. C. R. Young. As a conclusion of his study of previously published discussions, Prof. Young recommends as a practical formula for rivet-hole deductions:

$$x = 1.50 - 1.25\ s/g$$

Where s is the stagger or longitudinal distance, and g is the gauge or transverse distance between rivets.

Two years ago, after a review of previously published studies, the writer submitted to the Bridge Engineers Committee of the New York Central Lines a similar but simpler formula: $x = 1.3 - s/g$. This formula yields values which agree closely with the results of published reports of rivet tests.

Both formulas (Prof. Young's and the writer's) are close practical approximations to the requirements of exact theoretical analysis. The adoption of either one would eliminate the inconsistent and anomalous results yielded by existing specifications for rivet-hole deductions.

The writer's formula, while yielding practically the same values as Prof. Young's, appears easier to apply. In his contribution to the discussions on the "Tentative Specifications for Steel Railway Bridges," published in the April *Proceedings* of the American Society of Civil Engineers, the writer recommended a specification for net-sections substantially as follows:

"In a zig-zag section across a member, deduct the full area of the first hole and a fractional part of each succeeding hole, the fractional part being determined by the formula $x = 1.3 - s/g$."

D. B. STEINMAN,
New York, June 6. Consulting Engineer.

[Attention is called to a typographical error in the note on Prof. Young's paper. The practical formula recommended by him should read $x = 1.50 - 1.25\ s/g$, as correctly quoted by Dr. Steinman in the preceding letter.—EDITOR.]

The Case of Shingle Roofs

Sir—This is to call your attention to the impression created by the editorial "Shingles and Radio" appearing on page 812 of *Engineering News-Record* of May 18. While doubtless there may be good reason for your "wolf" illustration, we submit that the matter of the danger of shingle roofs is not a well chosen illustration.

The conflagration hazard involved in a city of shingle roofs has long been recognized and all too often demonstrated. The shingle furnishes both the fire-brand to spread a conflagration and the tinder which is ignited by sparks. The Paris, Tex., and Nashville, Tenn., conflagrations are typical of many other shingle-roof fires which might be cited.

As recently as April 28 we had a striking example of the danger residing in shingle roofs. On this date there was a fire in Lynn, Massachusetts. The following day the Boston Post carried the headline "Change of Wind Keeps Lynn on the Map." This fire started in a wooden shingle-roof tenement district, and spread, because of shingle roofs, for half a mile along the waterfront, igniting some 38 dwellings and other structures. It is said that only the fact that the wind carried the shingle fire-brands over the water and away from the city "kept Lynn on the map."

In this connection the statements of Frank Jordan of the Indianapolis Water Co. before the recent convention of the American Waterworks Association are of interest:

> During the month of January and [illegible] of this year, our city had occasion to realize the absolute necessity of the elimination of the shingle roof, which according to our fire chief is our greatest fire hazard. We have approximately [illegible] buildings covered with wooden shingle roofs, and during the first two months of the year we had [illegible] fires, the maximum number for any one day being on March 10, when we had 26 fires, every one of which was the result of live coals or sparks on a shingle roof. We have at this time a city ordinance which prohibits the use of wooden shingles on new buildings and provides that [illegible] 50 per cent of a roof is damaged the entire roof must

be replaced with a fire-resistant roof. This ordinance, however, fails to specify a time when all shingle roofs must be replaced with fire-resistant roofs, and the change is therefore very slow. A great many of the cities over the country have rigid ordinances in reference to shingle roofs, and the value of these ordinances will be realized when we compare our record of more than 1,200 shingle-roof fires in 1920 with a record of New Orleans, where there were 24; Cincinnati, 56; Louisville, 110; St. Paul, 99, and Philadelphia, 110.

We know that you realize the importance of and take a decided interest in fire prevention and fire protection. We always follow with interest the excellent articles and editorials which you publish from time to time on these subjects. We hope that you may come to appreciate the importance of the use of non-flammable roof covering as a fire protection measure.

Boston, June 9. R. S. MOULTON,
Assistant Secretary, National Fire Protection Association.

Skew Arch Theory Imperfect

Sir—Referring to the letter of Daniel Royse in your issue of June 8, p. 968, concerning my article on skew arches, I will say that there are many points yet to be cleared up in skew arch theory. A small experimental arch which we tested proved conclusively the incorrectness of the usual method of calculation. In my article I also called attention to the fact that the results of this test could not be made to agree with Dr. Fischer's theory and made the statement that further tests are necessary to determine the amount of the component parallel to the abutment and the method of taking this into account in the calculation.

It is to be hoped that the experiments now under way will shed some light upon this point. CLYDE T. MORRIS,
Columbus, June 10. Engineer, Ohio Stadium Building Committee.

Observed and Computed Friction in Pier Test

Sir—In the article "Load Tests of Piers for Chicago New Union Station," Mar. 18, p. 822, I was surprised to find no attempt at a comparison between theory and experimental results. The experiments are valuable for the job at hand, but they can also be reduced to a form in which they may be of value to others.

The skin friction on a concrete cylinder of 4 ft. diameter, 70 ft. deep, was found to be equivalent to 315 tons, including the dead weight. The soil was saturated clay. This friction, corresponding to 25 tons or 50,000 lb. per foot width, is caused by the normal pressure of the soil and is in all probability the friction of clay on clay, and not clay on concrete. Since the coefficient of clay on clay is less than that of clay on concrete, the pores of the pier will soon be filled and its surface entirely coated with clay. The normal pressure on the pier is the passive resistance of the clay to pressure (often called the "passive pressure"), which by the Rankine formula is $P = \frac{1}{2}\, yh^2\left(\frac{1 + \sin\phi}{1 - \sin\phi}\right)$.

In the present case h in 70 ft., y is 80 lb. per cu.ft. (very approximately for wet clay), and the vertical friction, 50,000, is $P \tan\phi$, where ϕ is the angle of friction of clay on clay. This is in accordance with the principle of normal and frictional forces at the point of equilibrium. The formula then gives

$$50{,}000 = \tfrac{1}{2}\, yh^2\, \frac{1 + \sin\phi}{1 - \sin\phi}\, \tan\phi.$$

the solution of which is $\phi = 10° 10'$, corresponding to a coefficient of friction of about 0.18. It would be interesting to know whether the coefficient of friction of the material was obtained. The computed value is very close to the usual value of the coefficient of friction for wet clay, as given in the handbooks. JACOB FELD.
University of Cincinnati,
May 27.

A Challenge to Accepted Theories of Highway Finance

Sir—I have read with much interest and profit Dr. Haig's "A Challenge to Accepted Theories of Highway Finance," in *Engineering News-Record* of May 11, p. 790.

That the position which the State of Maryland has taken in connection with road maintenance is gradually coming to be adopted is, we believe, a tremendous step toward the solving of the highway transportation problem of today. When I presented a paper before the American Association of State Highway Officials at Washington in December, 1920, I advocated that all resurfacing of highways be charged to maintenance and that the word "reconstruction," as used previously, be eliminated from highway bookkeeping. It is interesting to note that not a single member of any state highway department agreed that this was proper.

That long-term bonds under this theory of financing are sound cannot be doubted, but the ability to pay for this resurfacing when such long-term bonds must be resorted to for construction is a question of very serious doubt in our minds. The greatest fallacy in the argument which I have heard put forth for long-term bonds is in the fact that it is all predicated upon a system of highways not in excess of 7 per cent of the total. We are convinced that no such figure as this begins to meet the demand. In Maryland today we have a system in excess of 15 per cent and we know that the roads which are essential to Maryland's development and progress have not yet been developed—I doubt if they have been half completed.

If it is true that it is necessary to borrow money on bonds for road construction not in excess of 7 per cent of the total, and if it is true that the next generation will require as many additional roads as does this generation, and unto the third and fourth generations, is it not necessary that each generation pay as it goes?

Maryland's system of financing both construction and maintenance is identical with the conclusions of Dr. Haig, except that we believe in 15-year bonds rather than 50-year bonds. The reason our conclusions differ on 50-year bonds is because we differ in the premises as to what constitutes an adequate highway system. J. N. MACKALL,
Baltimore, June 10, 1922. Chairman and Chief Engineer, State Roads Commission of Maryland.

Treatment of Strong Sewage in India

In "The London Surveyor" for May 12, 1922, F. C. Temple, chief town engineer to the Tata Iron & Steel Co., Ltd., Jamshedpur, has the following interesting comment on sewage practice in India:

The practice has been growing among sanitarians in India of calculating the size of sewage-works by the number of people that they are to serve. This would appear to be a logical process anywhere, for the purpose of any sewage-works is to oxidize a certain quantity of putrefactive organic matter to such a point that it will be non-putrefactive and harmless. The quality of putrefactive matter present will depend upon the number of users or persons served. Within certain limits of dilution, the size of the septic tanks and filters to oxidize the putrefactive matter will depend on the number of users. I have carried out a series of experiments extending over some six years, which indicate that, for the size of septic tank and filter found most useful in India, the maximum dilution is 40 gal. per head [Imperial gallons] and the minimum 5 gal. per head. With less dilution than 5 gal. per head the necessary changes do not take place; with more than 40 gal. the sewage passes through the tank as an emulsion—too rapidly for the changes to take place. Within these limits of dilution, sewage can be treated successfully in septic tanks with a capacity of 2 cu.ft. per user (including the grit tanks), the effluent from which is treated by filters having 3 cu.ft. of filtering material per user—provided that the final effluent can be discharged into a large river or somewhere on land.

NEWS OF THE WEEK

New York, June 22, 1922

Am. Soc. C. E. Directorate Elects Society Secretary

Also Authorizes Technical Division—Action on Joining Federation Deferred Until Fall

(Engineering News-Record Staff Report)

The most important action of the Board of Direction of the American Society of Civil Engineers in its two-day session prior to the annual convention of the society at Portsmouth, N. H., June 21-22, was the election of John H. Dunlap, of Iowa City, Ia., as secretary, establishment of technical divisions of the society, and a step toward the settlement of the question whether the society should join the Federated American Engineering Societies. Prof. Dunlap, of whom a biography appears elsewhere in this issue, accepted his appointment in the following telegram: "Your notification of my election as secretary just received. This high honor is valued beyond expression and I accept this great trust in sincerest humility of spirit and only in the hope that I may be able to serve our common cause worthily." Prof. Dunlap has had long experience in society conduct in his home state, having been secretary and later president of the Iowa Engineering Society and is now the president of the Iowa section of the American Society of Civil Engineers.

Technical Divisions Authorized

In authorizing technical divisions the Board of Direction adopted by-laws which permit the formation of such sections on the application of 20 members, the division then being authorized to include non-members in its activities. At the Portsmouth meeting four technical sections were authorized—in sanitary, irrigation, power and highway engineering. The manner of functioning of these divisions will have to be worked out later.

The question of joining the Federation was discussed informally by the board, which finally adopted a resolution that it be considered at the San Francisco meeting, and that the secretary and the president of the Federation be invited [illegible] the matter.

The question of advertising in the society's publications was postponed.

The following elections to honorary membership in the society were announced: Clemens Herschel, hydraulic engineer, New York; John F. Stevens, president, Inter-Allied Technical Board, Harbin, Manchuria; W. C. Unwin and Sir Maurice Fitzmaurice, distinguished British engineers; and M. Chagnaud, president, Société Française des Ingénieurs Civils.

The Board of Direction passed a resolution asking Engineering Societies to make a thorough study of existing society organizations and urging other societies to join in that [illegible].

The Committee on Membership presented a report at the next board meeting

American Construction Council Organizes

Fifty-four Associations Represented—Program Partly Outlined—Franklin D. Roosevelt Elected President

(Engineering News-Record Staff Report)

With an attendance of more than 200 men interested in the construction industry, representing 54 associations, the American Construction Council, under the initial chairmanship of Secretary of Commerce Herbert Hoover, was formally organized in Washington, D. C., June 19. The responses of the spokesmen of the various groups were without exception expressions of appreciation of the magnitude of the council's opportunity and of confidence in the ability of the interests represented to bring it to success. By-laws, tentatively drawn up at Cleveland two months ago, were amended and adopted, an executive board elected and a program endorsed and referred to the executive board for its consideration, modification and action.

Opening Session

The opening session was devoted to addresses outlining the purposes and opportunities of the council. Secretary Hoover, after enumerating the many things to be done placed great stress on the need for industry to govern itself. Otherwise, if there be abuses, there will be public control through government agencies. He believed that the council would help to stabilize the industry and to eliminate undue speculation. He characterized the movement as "one of the most important steps taken in the history of the industry."

The need for the industry to square its conduct with the interests of the public was the burden of the address by Willis H. Booth, vice-president of the Guaranty Trust Co., of New York. He protested against what he termed the "stratification" in American economic life—the setting off of interests into groups for the attainment of selfish objects. The council would make the industry articulate and enable it to interpret itself to the bankers, to the transportation interests, to the industries and to the public.

Mr. Booth's talk was followed by short addresses by the representatives of the various groups: Henry H. Kendall, of Boston, for the architects; Thomas H. MacDonald, of Washington, for the federal, state and city construc[illegible] departments; Calvert Townley, of New York, for engineers; Frederick L. Ca[illegible]rnell, of Brooklyn, for general contractors; John R. Alpine, of New York, for sub-contractors; John Donlin, of Washington, for labor; M. T. Bannigan, of Utica, N. Y., for dealers in materials [illegible]; William McClellan, of New York, for public-utility construc[illegible]; and Ralph E. Proctor, of Baltimore, for banking, insur[illegible] and real estate interests.

Mr. Kendall counseled that controversial questions be studiously avoided at the start. Mr. MacDonald believed that highway building was now so well organized that it could be used as a balance wheel to fill up in part the depressions in the business cycle. Mr. Donlin pointed out how the misconduct or disruption of one element of the industry affected every other element.

Work for the Council

Much of the second day of the meeting was taken in discussions of work that the council might do to further the aims of the several groups. Robert D. Kohn, architect, of New York, urged the need of establishing conferences to bring together locally all the interests that the council is endeavoring to bring together nationally. He cited the success of the local building congress at New York, Boston, Seattle and Portland, Ore. The New York congress has been instrumental in having the city educational authorities establish an apprenticeship system. It has also adopted a code of ethics for the industry. The Boston congress has done its best work on the mitigation of seasonal unemployment.

M. C. Rorty, vice president of the American Telephone and Telegraph Co., New York, believed that the council should gather statistics from which a reliable set of index figures of construction cost, of volume, and of future work could be prepared.

John M. Gries, chief of the Building and Housing Division of the Department of Commerce, speaking on the same topic as Mr. Rorty, condemned severely the inadequate collection of statistics, characterizing as "lies" those statistics in which estimates play a large part. He believed it necessary to develop statistical sources in each of the moderate and large-sized cities of the country, sources that were dependable, thorough, and that would have no reason for desiring to color the statistics by making choice of data.

John B. Larner, president of the Washington Loan and Trust Co., dealt with the need of establishing moral standard[illegible] a matter more fully developed later by F. M. Feiker, vice president of the McGraw-Hill Co., in an address on "The Need of a Natural Code of Ethics." Both speakers pointed out the benefit that would flow to the public from adherence to high standards, and Mr. Feiker emphasized the necessity for local machinery for enforcement if tangible results were to be attained.

Walter Gordon Merritt, attorney, of New York, spoke on "The Proper Relations Between the Several Elements of the Construction In-

dustry," made one of the hardest hitting speeches of the meeting. The council, in his judgment, must so function that constant co-operation between employer and employee must replace the "periodic armistices" which are now the history of their relations. He declared that the trouble with the industry now is due not to lack of organization, but to organization with selfish motives. The council must replace selfishness by a sense of responsibility to the public. Finally he declared that our acute building troubles in certain cities have been due to "bargaining with corruption" because such bargaining was the easiest way of carrying on business. The council, he contended, must meet this situation and remove and prevent corruption instead of permitting the industry to bargain with it.

By-Laws

On the first afternoon the groups met separately for the consideration of the proposed by-laws and for the selection of their representatives on the executive board. At the evening session several of the groups reported amendments, but the main framework proposed for the organization was left undisturbed. An additional group, No. 11, composed of the National Association of Builders' Exchanges, the Building Trade Employers Association, the Federation of American Plan Associations and similar bodies containing both general and subcontractors, was established. The executive board was given power to establish still other groups. The number of representatives of each group in the executive board was increased from two to four. After these and several other amendments of detail had been made, the by-laws were unanimously adopted, thus bringing the council into existence.

The cardinal feature of the council's organization is that it includes all the elements of the industry and that each has the same voting power. The groups, beside No. 11, referred to above, are: Architects, engineers, general contractors, sub-contractors, construction labor, manufacturers, dealers; financial, bond and insurance interests; public utility construction departments; construction departments of federal, state and municipal governments.

Executive Board Members

Elections to the executive board resulted in the following choice:

Architects: Abram Garfield, Cleveland; D. K. Boyd, Philadelphia; S. W. Parker, Boston; R. D. Kohn, New York City.

Engineers: C. T. Main, Boston; B. J. Arnold, Chicago; Peter Junkersfeld, New York; C. F. Loweth, Chicago.

General contractors: W. O. Winston, Minneapolis; F. L. Cranford, New York; N. F. Hoggson, New York; H. H. Wilson, Muncy, Pa.

Sub-Contractors: A. E. Coleman, Chicago; J. R. Alpine, New York; Benjamin Dickinson, Bedford, Ind.; Oscar A. Reum, Chicago.

Construction Labor: John Donlin, New York; John Coefield, Chicago; John J. Hynes, Chicago; J. C. McSorley, Cleveland.

Manufacturers: W. D. Goss, New York; W. M. Wood, Decatur; Wm. Ritter, Columbus; F. W. Walker, Beaver Falls, Pa.

Dealers: W. T. Rossiter, Cleveland; E. L. Jahncke, New Orleans; John E. Lloyd, Philadelphia; M. T. Bannigan, Utica.

Financial, bond and insurance interests: W. H. Booth, New York; Harry Wheeler, Chicago; I. B. Hiett, Toledo.

Public utility construction departments: Gano Dunn, New York; Francis Blossom, New York; Joseph Alexander, Cleveland; C. H. Markham, Chicago.

Federal, state and municipal construction departments: Paul D. Sargent, Augusta, Me.; John M. Gries, Washington; C. M. Upham, Raleigh, N. C.; R. P. Miller, New York.

Building exchanges: W. F. Chew, Baltimore; Walter Klie, Cleveland; D. T. Riffle, Pittsburgh; G. C. Mills, Webster City, Iowa.

The Committee on Program rendered a report at the closing session, merely listing the important subjects which the council might take up. These included: Formulation of a code of ethics for the industry, collection of statistics, en-

(Continued on p. 1057)

Dunlap Is New Secretary of Am. Soc. C. E.

John H. Dunlap, professor of hydraulics and sanitary engineering, State University of Iowa, Iowa City, president of the Iowa Engineering Society and of the Iowa Section, Am. Soc. C. E., was elected secretary of the American Society of Civil Engineers by the Board of Direction at its meeting during the annual convention at Portsmouth, N. H., this week. He became an associate member of the society April 17, 1917, and a member June 6, 1921. The new secretary succeeds to the office left vacant by the retirement of Dr. Charles Warren Hunt in 1920 and filled since that time in succession by Herbert S. Crocker and Elbert M. Chandler, with the title of acting secretary.

Prof. Dunlap, in addition to his university work, has devoted part of his time to private practice as a civil and sanitary engineer. He is 40 years old, having been born at Harrisville, N. H., Sept. 9, 1882. He was graduated from the Thayer School of Civil Engineering at Dartmouth College in 1908 after having received his A.B. degree at that institution in 1905. For a short period in 1905-6 he served as chairman and levelman in Nevada on the Truckee-Carson project of the U. S. Reclamation Service, returning to college to continue his engineering studies. During the summer of 1907 he joined the engineering corps of the Indianapolis Division of the Pennsylvania R.R., with headquarters at Columbus, Ohio, and the following year served as field instructor in surveying at the Thayer School.

After graduation he joined the faculty of the State University of Iowa as instructor in descriptive geometry and was promoted until he became professor of hydraulics and sanitary engineering in the College of Applied Science at that institution. He filled a summer engagement in 1914 with the Extension Division of the university and since 1915 has done consulting work in the civil and sanitary engineering fields.

Franklin D. Roosevelt Heads Construction Council

Franklin D. Roosevelt, former Assistant Secretary of the Navy, whose election to the presidency of the American Construction Council is announced in another column of this issue, is a lawyer by profession and has been active in a wide variety of public affairs. He was born in Hyde Park, Dutchess County, N. Y., Jan. 30, 1882, was graduated from Harvard in 1904, and from the Columbia University Law School in 1907. Admitted to the New York bar during the year of his graduation, he began practice with the firm of Carter, Ledyard & Milburn of New York, where he remained until he joined the firm of Ennet Marvin & Roosevelt, formed in 1910.



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FRANKLIN D. ROOSEVELT

As a political figure Mr. Roosevelt received recognition in 1910 when he was elected a member of the New York State Senate, resigning three years later to become assistant secretary of the navy. He was the candidate on the Democratic ticket in 1920 for the vice-presidency of the United States, he and Governor Cox, of Ohio, being defeated at the polls in November of that year by the Republican nominees, Harding and Coolidge.

His activities during and after the war included inspection of the U. S. naval forces in European waters from July to September, 1918, and of demobilization in Europe in January and February, 1919.

Mr. Roosevelt is at present vice-president in charge of the New York office of the Fidelity & Deposit Co. of Maryland.

Dissolves Injunction Against Narrows Tunnel

The temporary injunction obtained by the Citizens Union against the building of the Narrows freight and passenger tunnel by the City of New York has been dissolved. The Court takes the ground that the need for the tunnel was decided by the enabling legislation and that questions of construction are within the discretion of the city Board of Estimate and Apportionment.

John A. Bensel

Former State Engineer of New York and Past President, Am. Soc. C. E., Died June 19

John A. Bensel, formerly state engineer of New York and past-president of the American Society of Civil Engineers, died at his home in Bernardsville, N. J., June 19. For many years he had been a prominent figure in the public affairs of both the state and the city of New York and had been mentioned as a candidate for mayor and for governor. His professional experience dealt largely with the design and construction of water-front improvements and he served under Mayor McClellan as commissioner of the New



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JOHN A. BENSEL

York City Department of Docks and Ferries, and later as chairman of the Board of Water Supply of the City of New York.

Mr. Bensel was born in New York City, Aug. 16, 1863, was graduated from Stevens Institute of Technology in 1884, and began engineering work with the Croton Aqueduct Commission. A year later he went with the Pennsylvania R.R. as rodman and during four years with that organization was advanced to the rank of assistant supervisor of the New York Division, a position from which he resigned in 1889 to become assistant engineer in the New York Department of Docks. Here he remained six years and was promoted to assistant engineer in charge of construction. He resigned in 1895 to enter private practice, specializing in water-front improvements and valuation work connected therewith.

In 1898 Mr. Bensel became chief engineer of the New York Department of Docks and Ferries and under his direction the Chelsea dock, as well as extensive works on the water front of Brooklyn, were designed and constructed. After seven years' service as the head of the department's engineering forces he was appointed a dock commissioner, a position which he retained for two years.

In January, 1902, Mr. Bensel was appointed president of the New York Board of Water Supply, which was then beginning the construction of the 92-mile Catskill aqueduct to deliver to New York City a daily supply of 500,000,000 gal. of water, involving an initial expenditure of $160,000,000.

The Democratic State Convention, in 1910, nominated Mr. Bensel for the position of state engineer and surveyor, and he was elected in November of that year for a two-year term, and re-elected for a similar period in 1912. In this capacity he had charge of the New York State Barge Canal work.

Evidence of the high regard in which he was held by his professional associates was furnished in 1910 when the American Society of Civil Engineers chose him for its president.

Following the termination of his duties as state engineer in 1915, Mr. Bensel had been engaged in private practice in New York. He served as a member of the board of consulting engineers on the Hudson River vehicular tunnel until the board was abolished by the consolidation of the New York and New Jersey tunnel commissions this year. During the war he was commissioned a major, Engineers, and was assigned to duties involving cantonment construction in the United States.

Buffalo Invites Bids for Garbage-Disposal Land and Plant

Bids for land and for plant for the disposal of the garbage of Buffalo, N. Y., (1) by feeding to hogs with either an incinerator or a reduction plant of 50 tons daily capacity to dispose of the residue, or (2) by either incineration or reduction of all the garbage, the plant to have a daily capacity of 200 tons, are desired up to 11 a. m., July 25, by Arthur W. Kreinheder, Commissioner of Public Works.

Bidders for a disposal plant, by either method, must submit detailed plans showing the method proposed, cost per ton, commercial value of the residue, names of cities where similar plants are located, and a guarantee that no obnoxious gases or odors will be created through the operation of the plant.

Acknowledgment for a Photograph

The view of the Poydras crevasse published on page 868 of the issue of May 25 was furnished *Engineering News-Record* by courtesy of the New Orleans *Item*. Inadvertently this acknowledgment was left out of the original article.

Cement Trial Date Not Set

The report recently emanating from the Department of Justice, Washington, D. C., to the effect that the criminal trial against the Midwest cement manufacturers was to begin on June 15 as reported in *Engineering News-Record* June 8, p. 970 was in error. According to the best information available no date has been set either for the trial of Midwest cement manufacturers or for a re-trial of eastern manufacturers. However, in view of the fact that tedious criminal cases of that nature are usually not prosecuted during the summer months, it is quite possible that both cases will go over until fall.

Prof. Prescott Succeeds the Late W. T. Sedgwick at M. I. T.

Prof. Samuel C. Prescott, whose appointment as head of the Department of Biology and Public Health at the Massachusetts Institute of Technology to succeed the late Prof. W. T. Sedgwick was officially announced on June 8, graduated from the Department of Chemistry at M. I. T. in 1894 and then became assistant chemist and bacteriologist at the Worcester (Mass.) sewage purification works. The following year he was Prof. Sedgwick's private assistant and in 1896 he became instructor in biology at the institute, progressing to the grade of professor of industrial microbiology in 1914.



During this period he had charge of the instruction in bacteriology, especially as it applies to the examination of water, sewage, milk and foods, and developed a course in the industrial applications of bacteria and other micro-organisms which was the first of its kind given in the United States. In 1900 he spent several months studying and inspecting methods in laboratories in Germany, Denmark and Belgium.

In 1905 Prof. Prescott established the Boston Bio-Chemical Laboratory, devoted to the study of commercial problems relating to bacteriology, fermentation and food chemistry. He was director of this laboratory until 1921 when he gave up its active management on account of the increasing work at the institute. From 1914-17 he had charge of a research laboratory devoted to problems of agriculture and bacteriology and plant disease control for the United Fruit Co. in Central America.

Soon after the United States entered the war Prof. Prescott was commissioned a major in the Sanitary Corps. One of his most important duties was the inspection of food storage in the large quartermaster supply warehouses in the training camps. In this duty he visited nearly all the large camps east of the Mississippi.

Since the death of Prof. Sedgwick, in January, 1921, Prof. Prescott has served as acting head of the department of which he now becomes head.

May Not Move Denver Office of Reclamation Service

(Washington Correspondence)

While no [illegible] has been rendered by the Secretary of the Interior in connection with his proposed discontinuance of the Denver office of the U. S. Reclamation [illegible] in consolidation with the office of the service in Washington, the impression prevails that the proposal will not be put into effect. When the consolidation proposal became known, it encountered [illegible] widespread protest that Secretary Fall stated that he would hold the matter in abeyance for the time being. It is believed that he hardly will insist on the consolidation in view of the representative character of the opposition.

Wasser Named President of Road Builders

Adjourned Annual Meeting Declares This Year's Directors Illegally Elected

After several hours of heated discussion, punctuated by motions for adjournment and appeals from the decision of the chair, the annual meeting of the American Road Builders' Association held in New York City, June 15 (adjourned from May 15), received from its board of directors an announcement of the election to the presidency of Thomas J. Wasser, state highway engineer of New Jersey, as successor to Lt.-Col. H. L. Bowlby. The board's action broke the deadlock which ended the May 15 meeting with a tie vote between Mr. Wasser and Col. W. D. Uhler, state highway engineer of Pennsylvania.

The adjourned annual meeting, acting upon the unanimous recommendation of the directorate, declared illegal the election of directors announced a month ago, as reported in *Engineering News-Record* of May 18, page 843. This action was based on evidence produced showing that two violations of the constitution had occurred, the first in the failure of the Nominating Committee to send the results of its choice to the secretary sixty days before the annual meeting, and the second by the secretary in failing to send out letter ballots to the membership at least thirty days before the date of the annual election. During the current year, therefore, the board will continue with its old membership minus those directors whose terms of office expire this year.

Clash Over Balloting

The first clash at last week's meeting occurred when Major F. A. Reimer offered a resolution calling upon the secretary to announce the result of the total number of ballots cast by the directors up to June 15 for the office of president. This motion was seconded and in the discussion it was brought out that while a tie vote of 14 to 14 had occurred at the May 15 canvass of votes, two ballots had subsequently been received which, it was stated, would elect Mr. Wasser. Col. H. L. Bowlby, president of the association, ruled the motion out of order. Major Reimer disagreed on the ground that the June 15 meeting was an annual meeting adjourned from May 15 and was, therefore, not a new session but in reality a continuation of the former. Col. Bowlby, however, remained obdurate and on an appeal from the decision of the chair Major Reimer won his point, but the chairman still refused to call for a vote on the resolution on the ground that he considered it "frivolous." He maintained that the poles had closed on May 15 and that therefore no other votes could be received. A bitter exchange of opinion followed. When Secretary E. L. Powers was called upon to clarify the question of fact as to the receipt of additional ballots, he contributed only the information that he didn't remember about them.

Ten days prior to the adjourned meeting on June 15 new blank ballots for the vote on president had been sent out by the secretary. The chairman called upon the meeting to recess, in order to give the board of directors an opportunity to meet and canvass the ballots for president. Col. Bowlby here injected a new phase into the situation by presenting a written statement announcing that in spite of the wishes of some of his friends he had not been and was not now a candidate for re-election to the presidency. Following this statement, S. T. Henry, of the Allied Machinery Co., asked Col. Bowlby the pointed question whether or not he would actually accept the presidency if a canvass of the votes by the board indicated his election.

"That is a personal question," replied Col. Bowlby, "I do not care to answer."

Again the discussion turned to the Reimer resolution and the two uncounted ballots and after pleas for harmony had been made by James H. MacDonald and Irving Patterson, the meeting recessed to enable the directors to meet and vote. After half an hour's deliberation it was announced that of 27 votes cast, Mr. Wasser had received 15, while 12 had gone to other candidates.

In accepting the presidency Mr. Wasser urged that old differences be buried and that co-operation be the slogan in the future.

Thomas J. Wasser



Thomas J. Wasser, whose election to the presidency of the American Road Builders Association is noted elsewhere in these pages, has had an experience of thirty-two years in general construction, railroad and highway work. He was born in Philadelphia in 1871 and at the age of 21 began work on macadam highway construction with B. M. and J. F. Shanley, general contractors of Newark, N. J. During the next few years he served with the Long Island Railroad, with the Consolidated Traction Co. of Jersey City, and with the Sanford & Stillman Co., general contractors and bridge builders of Jersey City, acting with the latter organization as foreman in charge of building the Harlem transport freight yards at 135th Street, New York City, piers for the Lehigh Valley R.R. at Jersey City, and buildings for the United Gas Improvement Co.'s plant at East Chester, N. Y.

Beginning in 1899 he spent four years with Robert W. Hunt & Co., engineers, New York, on mill, shop, and erection inspection, and in 1903 was appointed by James Owen, Essex County engineer, and J. W. Leahy, Hudson County engineer, to assume charge of preliminary work for the Hackensack bridge and Newark plank road, and later was placed in charge of this construction. Mr. Wasser also directed the construction of the 14th St. viaduct in Hoboken.

Mr. Wasser became engineer of Hudson County in 1913 and designed and constructed most of the Newark turnpike. Resigning that position in 1920 he was selected by the reorganized State Highway Commission to be state highway engineer of New Jersey. In addition to membership in a number of the national engineering societies, he is president of the New Jersey Board of Professional Engineers and Surveyors.

The Engineer in Public Life

HARRISON W. FITZGERALD

Citizens of Hamburgh, N. Y., a suburban town outside of Buffalo, recently elected Harrison W. Fitzgerald, chief engineer of the Donner Steel Co. of Buffalo, N. Y., as mayor for the coming year. Hamburgh is confronted with two municipal problems: one, the construction of a sewer system and a sewerage disposal works and the other either the building of a new and adequate water supply system which now chase and rehabilitation of the system which now supplies the town. With these questions before them the citizens thought that a professional engineer would be their best choice as head of the incoming board of trustees. That this sentiment was held generally was evidenced by the fact that no other candidate contested either the nomination or election of Mr. Fitzgerald.



Mr. Fitzgerald has had an extensive experience in the engineering of the steel industry. Before assuming his present duties with the Donner company, he was associated respectively with Garrett-Cromwell Co. of Cleveland, the Illinois Steel Co. at South Chicago and the Lackawanna Steel Co. at Lackawanna, N. Y.

He is a charter member of the Buffalo Chapter, American Association of Engineers, and is one of the pioneers who organized the original American Association of Engineers Club to which he contributed his services as secretary.

House Minority Report Scores Ford Muscle Shoals Offer

A new minority report, submitted to the House by the House Committee on Military Affairs, entirely repudiates Ford's offer in regard to the purchase and operation of the Muscle Shoals property and recommends that the federal government continue the work on Dam 2 and lease, not sell, Nitrate Plants 1 and 2. The report also recommends that any lease for use of power be executed in accordance with the provisions of the Federal Water-Power Act, and that as there is no apparent reason for the present construction of Dam 3, it be not built.

The report points to the large money loss to the federal government in accepting the Ford offer, and to the total lack of any provision in the Ford offer that he will continue to manufacture fertilizers at Muscle Shoals during even a small part of the 100-year life of his proposed contract. "Our position," says the report, "is that this (the manufacture of fertilizers) is a hollow promise made to enlist the support of the farmer and not founded on any fact either contained in the contract or existing under the contract."

American Construction Council

(*Concluded from p. 1054*)

couragement and aid in the establishment of apprenticeship systems for training building trades mechanics, mitigation of seasonal unemployment, development of means for lengthening the construction season, encouragement of local building shows, study of and support for a uniform building code, assistance in the work of simplification of variety, standardization and elimination of waste in construction.

Executive Board Action

Upon the adjournment of the meeting the executive board went into session and elected as president Franklin D. Roosevelt, of New York, formerly Assistant Secretary of the Navy, and as treasurer, John B. Larner, of Washington, president of the Washington Loan & Trust Co., and vice-president of the American Bankers Association. The remaining officers (three vice-presidents and a secretary) are to be elected at an adjourned meeting of the board to be held in New York at the end of this week.

Following its organization the board authorized the appointment of the following committees: On code of ethics, on seasonal unemployment, on apprenticeship, on building codes, on transportation rates, on publicity, on simplification, standardization and waste elimination and on methods to be pursued in gathering statistics. The personnel of these committees is to be determined later, but a general resolution declared that there should be on each committee at least one representative of each of the groups in the council.

The financing of the organization was quite fully discussed and while it was agreed to drive hard for association and sustaining members, it was felt that the magnitude of the opportunity demanded the raising of funds in excess of what can be expected from dues. It was freely expressed that the council would not be living up to its opportunities if in three years its annual budget was less than $250,000. No conclusion on the method of financing, other than by dues, was reached, but the subject was set as one of the chief items of business at the later session of the board this week.

Supreme Court Decision on Interstate Waters

Wyoming-Colorado Case Sets Up Paramount Interest of Prior Use Despite State Lines

(*Washington Correspondence*)

A decision of great importance to irrigation and power development has been rendered by the U. S. Supreme Court in the case of the State of Wyoming vs. the State of Colorado, the Greeley-Poudre Irrigation District, and the Laramie-Poudre Reservoir and Irrigation Co. The opinion has the effect of obliterating state boundaries in the matter of the use of water. States as such have no ground on which to base an appearance in court. This privilege is enjoyed, however, by any citizen of any state who considers himself aggrieved.

Under the Supreme Court's decision, it is a matter of first come first served. Any citizen regardless of the state in which he resides may put the water to use. Those putting the water to use first have a prior claim against any subsequent appropriator.

Justice Van Devanter's Opinion

Justice Van Devanter's opinion, delivered from the bench several days prior to the completion of its text, consists of 34 printed pages—an unusual length for a Supreme Court opinion. The more important pronouncements are contained in the following extracts from the decision.

"We conclude that Colorado's objections to the doctrine of appropriation as a basis of decision are not well taken, and that it furnishes the only basis which is consonant with the principles of right and equity applicable to such a controversy as this is. The cardinal rule of the doctrine is that priority of appropriation gives superiority of right. Each of these states applies and enforces this rule in her own territory, and it is the one to which intending appropriators naturally would turn for guidance. The principle on which it proceeds is not less applicable to interstate streams and controversies than to others. Both states pronounce the rule just and reasonable as applied to the natural conditions in that region; and to prevent any departure from it the people of both incorporated it into their constitutions. It originated in the customs and usages of the people before either state came into existence, and the courts of both hold that their constitutional provisions are to be taken as recognizing the prior usage rather than as creating a new rule. These considerations persuade us that its application to such a controversy as is here presented cannot be other than eminently just and equitable to all concerned.

"In suits between appropriators from the same stream, but in different states recognizing the doctrine of appropriation, the question whether rights under such appropriations should be judged by the rule of priority has been considered by several courts, state and federal, and has been uniformly answered in the affirmative. . . . These decisions, although given in suits between individuals, tend strongly to support our conclusion, for they show that by common usage, as also by judicial pronouncement, the rule of priority is regarded in such states as having the same application to a stream flowing from one of them to another that it has to streams wholly within one of them.

"The contention of Colorado that she as a state rightfully may divert and use, as she may chose, the waters flowing within her boundaries in this interstate stream, regardless of any prejudice that this may work to others having rights in the stream below her boundary, cannot be maintained. The river throughout its course in both states is but a single stream wherein each state has an interest which should be respected by the other."

Decision Reverses Colorado Theory

The decision is a complete reversal of the Colorado theory. The position of Colorado, deduced from the decision in the case of Kansas vs. Colorado, is that it is the keystone of the arch. Since most of the water in the Colorado River falls on watersheds within the State of Colorado, it has attempted to establish a prior claim on any water originating in Colorado whether or not it was put to use in that state. Since the waters of the Colorado will be appropriated and put to use faster in the lower basin of the river than in the upper basin, it will mean that Colorado must do nothing which interferes with those entitled to priority in the use of the river's water.

In view of the Supreme Court decision, it is believed that greatest activity will be brought about along the entire Colorado in the effort to establish prior use. One of the fortunate features of the situation is that there is a great abundance of water. While it is assumed that the state laws will govern in giving irrigation the right to use the water before it is used for power purposes, the prior rights already established in the Imperial Valley and in other sections on the lower Colorado will require such a volume of water as to insure the development of large amounts of power in the Canyon sections of the river.

Secretary Hoover stated on June 13 that the decision has simplified greatly the task before the Colorado River Commission. The decision will add greatly to interest in the meeting to be convened at Santa Fe on June 14. At that meeting recommendations probably will be made for procedure in establishing prior rights.

Large Area of Wooden Dwellings Destroyed by Fire

Part of Arverne, a residential district on Rockaway Beach, New York City, was swept by fire on the evening of June 15. About 150 buildings, chiefly dwellings but including also half a dozen large hotels, were destroyed. All were of wooden construction. W. E. Mallalieu, president of the National Board of Fire Underwriters, said after the fire, "The Arverne fire was what is known as a wooden shingle roof conflagration. It is probable that if there had been no wooden shingle roofs in Arverne in the immediate neighborhood of the Hotel Nautilus [where the fire started] the original fire would never have spread as it did." The total loss is estimated at more than $2,000,000.



Attack Federal Water Power Act in Supreme Court

Permission to file an original bill against the Federal Power Commission has been granted by the U. S. Supreme Court to Attorney General Newton on behalf of the State of New York, who contends that the federal water power law is inapplicable to waters in that state on the ground that the government's jurisdiction extends to such waters in so far only as navigation is concerned. The argument and decision will not be had until after the next term begins in October.

The New York authorities seek to prevent the Federal Power Commission from enforcing the law in New York, on the ground that New York is entitled to control water powers within the state. It is contended in the brief of the Attorney General accompanying the motion that the federal water power act is invalid, unconstitutional and void, and not enforceable in New York. It is argued that the federal act interferes with the rights, powers and duties of the state. For the state it is contended that it has all power over waters in the state, including the development and use of water powers, and that government jurisdiction extends only over navigation questions.

It is contended that the federal power commission should not have authority to regulate and control rates for the sale of electric power developed under water power projects when such sales are intra-state and not related to navigation. The state also seeks to prevent the federal power commission from designating what licenses shall be granted for water power development.

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual Meeting, Atlantic City, N. J., June 26-30.

NEW ENGLAND WATER WORKS ASSOCIATION, Boston: Annual Convention, New Bedford, Mass., Sept. 12-15.

The Cleveland Engineering Society, in connection with its annual meeting held last week, made an all-day inspection of the public works in the city. Among the places visited were the pumping station, filtration plant, sewage-treatment works, Fairmount and Baldwin reservoirs, the municipal bath house and the municipal light plant.

The Cincinnati Section of the American Society of Mechanical Engineers and the **Cincinnati Engineers' Club** held a joint meeting recently. Dean M. E. Cooley, president of the Federated American Engineering Societies, was the principal speaker.

The San Francisco Post of the Society of American Military Engineers had as its chief speaker recently Frank G. White, chief engineer, state harbor commission, who spoke upon "Harbors and Terminals: The Port Facilities of San Francisco Bay."

The West Australian Branch of the Australian Institution of Engineers has elected the following as officers for 1922-1923: Chairman, W. H. Shields; vice-chairman, T. M. Carey; secretary, Assistant Prof. Tomlinson, and treasurer, J. Andrews. On the committee are R. H. J. Clarke, A. W. Galbraith, H. T. Haynes, P. V. O'Brien, J. Parr, and W. K. Weller.

Personal Notes

A. C. GODWARD, engineer for the Minneapolis Board of Park Commissioners, has been appointed engineer for the recently created Minneapolis City Planning Commission. He will continue for several months with the Park Board with which he has been for 15 years, and will then give full time to the new work.

J. S. WILSON has opened a civil engineering office in Bailey, N. C., where he will specialize in municipal consulting work and in land surveying and subdivision work.

H. H. DOLBY has been appointed chief engineer of all the Vacarro Bros. railroads in Honduras. He succeeds H. J. Hill, who resigned because of ill health and who has returned to his home in Ohio. Mr. Dolby has been locating engineer in Honduras doing railroad work for the United Fruit Co. and other organizations.

H. I. BENJAMIN, formerly office engineer in the maintenance-of-way department in the San Francisco offices of the Southern Pacific Co., has been promoted to the position of assistant division engineer of the Portland division with headquarters at Portland, Ore. H. MARSHALL will succeed Mr. Benjamin. The appointments were effective June 1.

FREDERICK L. FORD, city engineer of New Haven, Conn., has been appointed by Governor Lake one of six members of a commission from that state which, with similar commissions from the other New England States, will work out a plan for consolidating New England's railroads into one compact system. Mr. Ford was for fifteen years in the city engineering department of Hartford, resigning his position as city engineer in 1911 to enter private practice. A year later he was made city engineer of New Haven.

GEORGE A. REED, of Montpelier, Vt., has been appointed by Governor Hartness state engineer to fill the vacancy caused by the resignation of DANIEL A. YOUNG. Mr. Reed is a graduate of Dartmouth College and Thayer School of Civil Enginering, and his professional experience has included the positions of city engineer of Barre and of Montpelier, Vt., and assistant state engineer of Vermont, and service with the United States Reclamation Service in irrigation work in Klamath Falls, Ore.

J. W. DEER, formerly an officer of the American Sewer & Drain Construction Co. is now associated as president with the American Engineering and Construction Co., Chicago. This firm specializes in the design and construction of sewers, sewage-disposal plants, water-works and tunnels.

J. L. PERRON has been appointed minister of roads for the Province of Quebec. Other changes include the appointment of JOSEPH BOULANGER as deputy minister to replace B. Michaud, and the appointment of G. HENRY, formerly chief engineer of the department, as consulting engineer.

L. S. TRAINOR has been appointed district engineer in charge of the Illinois district of the Portland Cement Association, to succeed C. M. POWELL, resigned. Mr. Trainor has been with the association for the past three years, located principally in southern Illinois. Prior to joining the association's staff he was superintendent of highways of Marion County and city engineer of Centralia, Ill.

CHARLES H. ENSIGN has resigned from the staff of the New York Central R.R. to accept the position of field engineer with the George S. Rider Co., consulting engineers, Cleveland. For the past five and a half years Mr. Ensign has been assistant engineer in the valuation department of the New York Central at Cleveland.

C. G. ADSIT, executive engineer, has been elected by the board of directors a vice-president of the Georgia Railway & Power Co. Mr. Adsit, who is also a director of the company, became connected with the company in 1911 as resident engineer on the Tallulah Falls hydro-electric development. Later he was made chief engineer, then consulting engineer.

JOSEPH B. GUNNISON, formerly of the White Construction Co., Inc., New York City, has gone into the general contracting business for himself under the firm name of the Gunnison Construction Co. His offices are in New York City.

Business Notes

C. J. BRENDER, for the past ten years mechanical inspector for the Jones & Lamson Machine Co., Springfield, Vt., has resigned.

THE PITTSBURGH TESTING LABORATORY has opened a sales office and an inspection bureau in the Railway Exchange Building, St. Louis, Mo. Col. N. C. Hoyles has been appointed district manager. Except for service overseas Col. Hoyles has been with the Pittsburgh Testing Laboratory since his graduation from the University of Toronto. Since the war he has been assistant sales manager at New York and manager of the Cincinnati branch.

THE WOODWARD-REPUBLIC CONSTRUCTION CO., Cleveland,

Ohio, has been organized to do general engineering and construction work.

ELLERY, FROST & PATTEN, San Francisco engineers, have opened a branch office in Fresno, Cal. The new office is in charge of BYRON T. PATTEN.

LANGTHORN & SMITH, Inc., New York City engineers and builders, announce their incorporation to carry on the building business formerly conducted by C. H. Smith.

THE TITAN IRON & STEEL CO., Inc., Newark, N. J., manufacturers of mechanically-puddled wrought iron, announce the appointment of W. Woodward Williams as vice-president. Since his graduation from Harvard in 1905 Mr. Williams has successively filled important executive positions with the Bourne-Fuller Co., Cleveland, the A. M. Byers Co., Pittsburgh, the Reading Iron Co., and the Pittsburgh Gage & Supply Co.

THE CLEVELAND TRACTOR CO., makers of Cletracs, will be reorganized as the ALLYNE-ZEDER MOTORS CO. to manufacture and market the new six cylinder car which is being designed by F. M. Zeder, formerly chief engineer of the Willys Corp. and the Studebaker Corp. The reorganization will be brought about by adding approximately $5,000,000 of new capital to the present assets of the Cleveland Tractor Co., resulting in a corporation with a capital of $10,000,000 of preferred stock and 200,000 shares of no par common stock. A new corporation subsidiary to the Allyne-Zeder Motors Co. will be organized under the name of the CLEVELAND TRACTOR CO. and will continue the marketing of Cletracs through its present distributors and dealers. A new 1-ton truck will be added to the Cletrac line. For the Allyne-Zeder Co. Clement Studebaker will be chairman of the board and Rollin H. White, president. R. T. Hodgkins, general sales manager of the Cleveland Tractor Co., is a vice-president of the new corporation.

OBITUARY

CAPT. A. L. RUSSELL, civil engineer and Dominion land surveyor, formerly of Port Arthur, Ont., Canada, died June 11 in Ottawa, aged 80 years.

JAMES E. MCNEIL, for 35 years a construction engineer for the Atchison, Topeka & Santa Fe R.R., died at his home in Los Angeles, Cal., May 28, aged 75 years.

MILO A. ADAMS, head of the firm of M. A. Adams & Co., Minneapolis, for many years engaged in bridge building in the Northwest, died June 11 aged 73 years. Mr. Adams was actively engaged in construction work up to the time of his death.

J. C. O'DONNELL, general superintendent of the Canadian National Lines, maritime district, died in Moncton June 55. Prior to going to Moncton, Mr. O'Donnell was located at Winnipeg, being superintendent of the Edmonton, Saskatoon and Western branch of the Canadian Northern

JOSEPH B. WAUD, for many years surveyor and engineer for Ventura County, Cal., died at his home there June 1.

CAPT. ALBERT DE RUIZ, who served for 12 years as city engineer of Long Beach, Cal., retiring a year ago, died at his home in that city on May 29, aged 69 years. He was born in Havana, Cuba, and was graduated at the United States Naval Academy in the class of 1875, serving for 10 years as a naval officer.

HENRY L. KREUSLER, building contractor and banker of Pittsburgh, died recently at Saranac Lake, N. Y., aged 61. Since 1886 he has been head of the Building Construction Co.

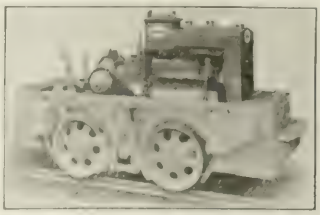
JAMES F. INGRAM, for more than half a century superintendent of bridges and buildings for the Louisville and Nashville R.R., died recently in Louisville, Ky., aged 87 years. He retired from active work about ten years ago.

CORNELIUS VAN VORST POWERS, chief of one of the bureaus of the New York Transit Commission and former division engineer of the commission, died in New York City June 18, aged 62 years. Mr. Powers was graduated from the School of Mines of Columbia College in 1882. From 1885 to 1900 he was employed by the New Croton Aqueduct Commission in various engineering capacities. He joined the engineering staff of the Rapid Transit Commission in 1900 and had much to do with the construction of the New York subway system.

EQUIPMENT AND MATERIALS

Combination Industrial Locomotive

A new use for a tractor power plant is illustrated in the accompanying picture of a new light industrial locomotive just announced by the Atlas Car & Manufacturing Co. of Cleveland. The Model F Cletrac made by the Cleveland



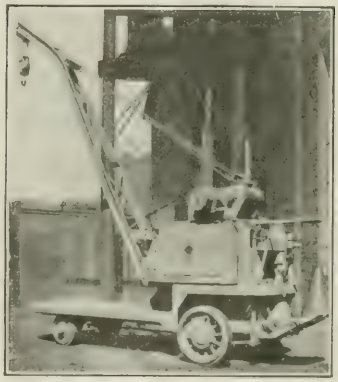
Tractor Co., mounts its side frames, trucks, seat and steering wheel is set bodily into the frame. The unit is designed particularly for road construction, industrial railways and general plant hauling.

Waterproof Cement Paint

The Sandusky Cement Co., Cleveland, Ohio, has recently placed upon the market a new product, Medusa waterproof cement paint which, it is claimed, is unaffected either by lime and alkalies present in portland cement or by moisture which causes deterioration of oil paints. The paint may be applied to any masonry surface, even when wet, and is designed to bond with such surfaces. The paint comes in the form of a dry powder to be mixed with water and the colors available at present are white, cream-buff, and stone gray, with others forthcoming. One pound of the dry paint, mixed according to specifications, will cover from 12 to 15 sq.ft. of surface, according to the manufacturers.

Electric Industrial Crane Truck

A low revolving and luffing electric crane, mounted on an electric industrial load-carrying truck, has been developed by the Elwell-Parker Electric Co., Cleveland. The unit is especially designed for inside work, although it may be used for outdoor service. Its lift capacity is 3,000 lb. at 6 ft. and 1,000 lb. at 12-ft. radius, without outriggers. A new design of single-motor, double-drum hoist unit handles a separate line to the boom and hook. The motor hoist unit, with battery, forms a counterbalance for the 12-ft. boom with load. A single battery furnishes propelling and hoisting power. The manufacturers claim that this is the largest capacity electric industrial crane truck built.



Out-of-the-Ordinary Trade Publications

THE SULLIVAN MACHINERY CO., Chicago, has issued two bulletins, the first No. 77-D, dealing with portable air compressors of three types, including gasoline-engine driven, belt driven from an electric motor, and belt driven from a tractor. These outfits are intended for rock removal in road-building or in city streets. The other bulletin, 70-X, describes a compressed-air spader or pneumatic clay-digging tool in the form of a light air hammer weighing 16 lb. designed to take the place of a hand pick and shovel.

In a 28 page illustrated booklet the PROTEXOL CORP., successor to the Carbolineum Wood Preserving Co., New York, publishes a list of authenticated specimens of wood preservation and a discussion of the general subject of timber treating by E. F. Paddock, chemical engineer. Charts and tables of cost data are included.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Debits to Individual Accounts Measure General Business Activity

Index Maintained by the Federal Reserve Banks Gives Good Indication of Industrial Trend

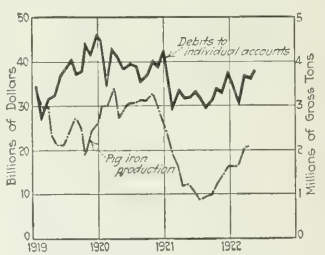
A corporation recently requested the Business Side of Construction to suggest a good curve showing general business activity, against which its own business might be plotted. Bank clearings were the first thought, but still better is the aggregate of checks drawn by individuals on their bank accounts. The following paragraphs explain this comparatively new barometer for the benefit of construction and manufacturing companies which might wish to check their individual activities against the swing of general business.

One of the major questions in the construction industry is whether the boom in building operations, which has raised the volume for contracts let for new construction to record figures in the early months of this year, is a temporary spurt, resulting from a great housing shortage, or whether it is destined to continue in heavy volume for some months to come. Some light on this question would be shed by any index which would show accurately changes in the volume of general business activity throughout the country. For in times past it has been rather clearly demonstrated that a genuine recovery in the construction industry usually accompanies a general recovery in business as a whole. For this reason, members of the construction industry should be interested in an index of business conditions which is being carried forward currently by the Federal Reserve banks and the Federal Reserve Board.

Debits Better Than Bank Clearances

This index of business conditions is not called by that name, but goes under the somewhat academic title, "Debits to Individual Accounts." To paraphrase this expression in more ordinary language, it means the checks drawn by individuals on their bank accounts. Somewhat similar figures have been available for a great many years in the form of bank clearings. For many years economists and business men have found the volume of business done by banks as represented by the checks passing through clearing houses an excellent indication of the degree of business activity in the country. These newer figures of debits to individual accounts are simply a refinement of the old clearing figures.

There were several difficulties with the clearing figures which made it desirable to find some more precise measure. The clearing figures, in the first place, represented simply the amount of checks which were sent through clearing houses in different centers, and they did not include checks presented for payment at the banks on which they were drawn. In the second place, there was found a considerable amount of duplication in the clearing figures, because very frequently a check would pass through two or more clearing houses and would be counted two or more times when the figures for several clearing houses were added together. While such difficulties as these did not prevent the clearing figures from being a good index of the general swing of business conditions, they made the figures frequently misleading as far as individual cities were concerned. For example, there has been in recent years a marked tendency toward the consolidation of big banks. Before a consolidation any checks passing between two banks go through the clearing houses; after the consolidation this clearing operation is eliminated, although the amount of business done through the two banks is exactly the same. It is clear that a consolidation of this sort would have an appreciable effect in decreasing the volume of clearings in any city. In St. Louis the reflection in clearing figures of just such a consolidation was reported as the underlying reason for the movement on the part of the Chamber of Commerce of that city looking to the suspension of the publication of clearing figures and the substitution of the debits to individual accounts. It was asserted that a false impression of the business of the city was given by the clearing figures. Changes such as this would have no effect on figures for debits to individual accounts.



The idea of substituting debits for clearings is not a new one. As far back as 1908 the clearing house section of the American Bankers' Association adopted a resolution recommending that the record of bank debits be kept instead of clearings, as a better means of determining the volume of business transacted. In 1913 some clearing houses began to report debits but it was not until 1916 that the figures of a sufficient number were available to warrant publication. In 1918 the Federal Reserve Board began to compile the debit figures. and since then these figures have been of increasing value until now they are regarded as an authoritative barometer of business conditions. Last year, at the American Bankers' Association convention in Los Angeles, the clearing house section adopted a resolution to the effect that the publication of clearing figures be abolished and those of the debits substituted.

There are now 243 clearing houses, situated in different parts of the country, which collect and forward the debit figures. The banks which are members of a clearing house total their six daily figures of each week and furnish them to the manager of their clearing house who in turn sends them at the expense of the Federal Reserve Board to the Reserve Bank of the district in which the clearing house is located. The Federal Reserve Bank, after tabulating the figures and checking up the number of reporting banks so as to insure comparability, forwards the totals for each clearing center to the Federal Reserve Board at Washington. There the figures are assembled for publication weekly in the consolidated press statement.

The reporting week covers the period from Thursday morning to the close of business on the following Wednesday, and the Board publishes monthly in the *Bulletin* the weekly totals for the month. The figures for the corresponding weeks of the preceding year are also shown. Although the Board, beginning Jan. 1, 1922, has been publishing figures from 243 clearing centers, the figures for only 166 of these centers are available for last year; and, therefore, in its summaries for last year and this year, the Board contrasts the figures of only the 166 centers, in order to maintain a strict comparison. The centers now reporting, it is estimated, handle between 75 and 85 per cent of the total clearings of the country.

What the Debit Figures Include

The debits reported are those to the accounts of individuals, firms, corporations, and the United States Government, including the debits to the war loan deposit account and against savings accounts, payments from trust accounts and of certificates of deposits, and cashier and treasurer checks issued by a firm or corporation. They exclude all debits to bank accounts, cashier and treasurer checks issued by a bank, debits in settlement of clearing house balances, charges to expense and miscellaneous accounts, and corrections and similar charges. Irrelevant material is eliminated and only actual business transactions are represented.

In the diagram on this page the solid line represents the debits to individual accounts from the beginning of 1919 to date, and there has been added a broken line showing pig iron production during the same period. This comparison is interesting because the production of pig iron, involving as it does such a multiplicity of products, follows closely the trend of general business activity.

The figures for debits represent a still wider range of activity as they reflect retail and wholesale transactions and wage and interest payments as well as transactions connected with production. They come nearer to measuring the entire business of the country and fluctuate less than pig iron production.

Their fluctuation would be still less than that shown in the diagram if allowance could be made for the changes in prices in the three years.

Both lines reflect in their movement seasonal influences which obscure somewhat the general trend. During the first months of each year, following the stimulus due to holiday buying, there is a distinct falling off in the volume of debits. About the third month there is an improvement, succeeded by another decline until the late summer. Then, coincident with the marketing of the crops, the debits increase until they reach their peak at the holiday season at the end of the year. The seasonal movement is somewhat less marked in the case of pig iron.

Although representing different phases of business activity, the two lines show a similar trend, excepting in 1919 when the curtailment of production in the pig iron industry, due to strikes, caused a downward movement in the line of pig iron. Debits at that time were increasing, reflecting trade expansion. Beginning with 1920 the two lines show a decline which followed the lessening demands of business, until in the late summer of 1921 they touched the lowest point. Since then, the rise in both lines indicates the substantial basis for the recent building activity.

Brick Prices at Yard and Delivered

Some idea of the relation between brick prices at the yard, f.o.b. city or delivered on the job may be had by comparing *Engineering News-Record's* quotations with those in the table compiled by the Common Brick Manufacturers' Association. The range at the various yards has widened a dollar or so in the last few months; that is, the minimum quotation is slightly lower, and the maximum a little higher.

Prices to consumers, however, have risen sharply in certain sections. New York, of course, is a glaring example; a jump of $3.10 in one month, current delivered price being $23.50, with $19 the price alongside dock. In May price advances were as follows: Memphis, $1 to $2; Atlanta, $1; Birmingham, $1; Philadelphia, $1.

The prices in the table are as of May 1. In the May 4 issue of the *Record*, delivered prices were quoted as follows: New York, $20.40; Boston, $16; Minneapolis, $15; Montreal, $16; Detroit, $16.50; Baltimore, $20; Pittsburgh, $17.50. Fob prices at other centers were: Chicago, $11; St. Louis, $14; Denver, salmon, $12; Dallas, $11.15; San Francisco, Los Angeles, Cincinnati, $15; Atlanta, $9; Birmingham, $9.50. The lowest quotations were in the South, both at the brickyards and to the contractor.

New York City still faces an acute brick situation. Building operations in this city take up all the common brick as fast as shipments can be made from four great centers of production, namely: Hudson River, Raritan, Hackensack and Connecticut. Brick men say that the shortage should not be attributed to slowing down of current production or shipments but to the fact that not enough unburned brick was reserved last Autumn to supply the demand until the new brick could be marketed.

To the price at Hudson River yards must be added the cost of towing, reaching as high as $3.43 per 1,000, resulting in a wholesale price of $20, alongside dock, New York. To the price alongside dock is added $1.50 for hauling, by a dealer's profit of 10 per cent, or $2, yielding a price of $23.50 per 1,000, delivered at job in New York City.

May Fabricated Steel Sales at 82 Per Cent of Capacity

Sales of fabricated structural steel during May amounted to 82 per cent of fabricating capacity, according to reports made to the Department of Commerce by firms comprising 70 per cent of the fabricating capacity of the United States. The May business reported by 82 firms, having a capacity of 130,600 tons, totaled 106,620 tons as against April sales of these same firms amounting to 121,211 tons, or at the rate of 93 per cent of capacity.

Total sales throughout the United States, based on the reported percentage and a total capacity of 180,000 tons, amounted to 146,900 tons in May, with 165,900 tons in April.

REPORT ON COMMON BRICK FROM 99 YARDS AS OF MAY 1, 1922

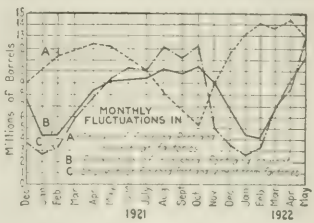
Dist. No.	Including States of	No. of firms report-ing	Plants Closed Down	Unburned Brick on Hand	Burned Brick on Hand	Orders on Books	Price Per Thousand At Brickyard
1	N. Y. New England	13	6	8,795,000	3,200,000	4,827,000	$12.00 to $20.00
2	Pa., N. J., Md., D. C. Del.	11	1	22,760,000	4,949,000	36,521,000	12.00 to 17.00
3	Va., N. C., S. C., Ga., Fla.	5	0	3,915,000	1,239,000	2,560,000	9.00 to 16.00
4	Mich., Ind., W. Va.	9	2	8,241,000	2,479,000	16,304,000	10.00 to 13.25
5	Ill., Ind., Wis.	24	1	91,000,000	1,799,000	163,865,000	10.50 to 14.50
6	Ky., Tenn., Miss., Ala., Ark., La.	13	3	6,136,000	5,221,000	4,329,000	8.00 to 15.00
7	N. and S. Dak., Minn., Neb., Ia., Kan., Mo.	9	1	7,015,000	850,000	1,338,000	10.50 to 16.00
8	Okla., Tex., N. M.	8	5	10,034,000	1,442,000	6,578,000	8.50 to 13.00
9	Wash., Ore., Mont., Wyo., Ida., Utah, Colo.	3	1	1,251,000	602,000	267,000	13.50 to 15.00
10.	Calif., Ariz., Nev.	4	0	1,775,000	5,918,000	14,045,000	14.00 to 15.50
	Total	99	20	160,000,000	27,717,000	250,645,000	

Chicago's Building Boom

During May the total value of buildings for which permits were taken out at Chicago was $7,029,650, which is said to be nearly $4,000,000 more than the previous high monthly record. These permits provide for 635 single residences and 371 apartment buildings, most of the latter being of large size. A statement issued by the City Committee for enforcing the Lathrop ordinance states that the May permits bring the grand total for 1922 to 11,000 new houses under construction or contemplated in the near future, while the city's original housing shortage was estimated at 4,000 homes.

Heavy Gain in Cement Production in May

May figures for cement production, recently released by the Geological Survey, show an increase of 1,895,000 bbl. over May, 1921, while shipments were 3,261,000 bbl. heavier. Stocks are 1,643,000 bbl. lower than at the end of April, but 447,000 bbl. larger than a year ago. May exports and imports



of hydraulic cement are not yet available. April imports were 10,855 bbl., against 1,597 in March; exports amounted to 75,412 bbl., against 103,556 in March.

Federal-Aid Road Bids Lower Throughout United States

A considerably lower level of prices for the various items entering into highway construction is reported by the Bureau of Public Roads of the United States Department of Agriculture. This conclusion is based on the following prices by successful bidders on Federal-aid roads during April and are averaged for the whole of the United States. Some of the figures cover a large volume of work well distributed over the country, while others are based either on small volumes or scattering reports.

The figures which cover the cost in place are as follows: Earth excavation, common, 33 cents a cubic yard; rock excavation, $1.26 a cubic yard; gravel, $1.44 a cubic yard; sand-clay, 45 cents a cubic yard; crushed stone, $3.42 a cubic yard; structural concrete of various classes ranges from $14 to $21.20 a cubic yard. For surfacing the following are the prices by the square yard: Gravel, 40 cents; surface-treated macadam, 50 cents; bituminous macadam, $1.06; bituminous concrete, $1.97; plain cement concrete, $2.17; reinforced cement concrete, $2.54; and brick, $3.70. Reinforcing steel has cost $0.053 a pound and structural steel $0.059 a pound. Cement has been furnished to contractors by the following States at the prices given by the barrel: New York, $1.73; Wisconsin, $1.94; and Arkansas, $2.70.

Freight Loadings Decrease 70,476 Cars in Week

Loadings of revenue freight during the week ending June 3 totaled 750,645 cars, compared with 821,121 cars during the previous week, a decrease of 70,476 cars, according to the Car Service Division of the American Railway Association. The reduction was due to the holiday, May 30. This was 50,142 cars more than in the corresponding week last year.

Coal loadings amounted to 86,636 cars, a decrease of 9,344 compared with the previous week. Coke, with a total of 5,207 cars, showed an increase of 76 cars over the week before. Ore load-

ings continue to increase, the total for the week being 31,552 cars, a gain of 7,681 over the preceding week. Forest products, with a total of 58,923 cars, showed a decrease of 5,097, under the week ending May 27.

Cars idle because of business conditions numbered 480,266 on May 31, compared with 504,702 on May 23, or a reduction of 24,436 cars. Of the total, 305,198 cars were surplus freight cars in good repair and in excess of current freight requirements, while the remaining 175,068 were disabled freight cars in excess of the normal number unfit for service.

Surplus coal cars in good condition numbered 195,439, a reduction of 13,252 since May 23, surplus box cars in good repair totaled 69,714, a reduction of 9,820 in the same period.

Commerce Dept. Shows Business Conditions by Ratio Charts

A series of charts plotted to logarithmic scale in order to permit direct comparison of percentage changes in index numbers has been incorporated in the Monthly Survey of Current Business, published by the United States Department of Commerce as a supplement to *Commerce Reports*. The diagrams in the May issue show for the years 1920, 1921, and for the first three months of 1922, the variation of the index numbers for pig iron production, bituminous coal production, cotton consumption, freight ton-miles, export values, bank clearings outside New York City, liabilities, wholesale prices, and industrial-stock prices.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted. Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section. The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of June 1; the next, on July 6.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$2.68	$3.50	$4.00	$2.48	$2.86	+$3.60	$3.10	$3.60	$3.75
Structural rivets, 100 lb	3.60	4.25	5.50	3.10	3.90	4.45	4.25	3.75	6.50
Reinforcing bars, ¼ in. up, 100 lb	2.58	3.50	3.50	2.38	2.76	+3.67½	2.55	3.60	+2.90
Steel pipe, black, 2½ to 6 in. lap, discount	61%	61.15%	.45%	59½%	61.9-5%	44%	49.1%	53%	30.00
Cast-iron pipe, 6 in. and over, ton	48.80@49.80	48.50	+51.50	44.10	50.50	57.00	51.00	+53.00	50.00
Concreting Material:									
Cement without bags, bbl	2.40@2.50	2.34	2.25	2.07	2.34	2.90	2.83	2.94	2.48
Gravel, ¾ in., cu.yd	1.75	1.85	2.25	1.80	1.50	1.75	2.25	1.25	1.50
Sand, cu.yd	1.00	1.15	2.25	1.80	1.00	0.75	1.50	1.25	1.25
Crushed stone, ¾ in., cu.yd	1.75	1.90	2.73	1.60	2.25	3.50	2.25	3.00	2.00
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	49.00	+39.00	+38.00	45.00	40.00	49.00	25.00	21.50	82.00
Lime, finishing, hydrated, ton	15.80@16.80	22.50	25.00	18.00	29.00	24.00	22.00	24.00	21.00
Lime common, lump, per bbl	2.75@3.18	1.75	2.50	1.40	1.40	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	23.50	10.00	11.15	11.00	16@17	12.00	15.00	14.00	16.00
Hollow building tile, 4x12x12, per block	Not used	.075	.115	.0707	.082	.08	....	.12	09
Hollow partition tile 4x12x12, per block	.1112	.0707	.115	.0657	....	.08	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal	.86	.92	—1.07	.96	.98	—1.08	1.04	.86	+1.09
Common Labor:									
Common labor, union, hour	.75	.35	.....	.80	.....	.50	.55	.50@.60	....
Common labor, non-union, hour	.44@.60	.20	.25	72½	.35@.50	.35@.50	.47½@.50	.....	.20@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed store quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks.

Montreal quotes on long-leaf yellow pine, short-leaf, $67.50. Sand, stone, gravel and lump lime per ton. Lime and tile are delivered; cement, sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.10 cents). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $30; 6-in., $110.

Changes Since Last Week

Advance in price of structural steel, effective last week in New York and Minneapolis warehouses, is followed by a similar advance this week, in Denver, where steel shapes are quoted at $3.60 as against $3.50 and reinforcing bars, $3.67½ as compared with $3.52½; mill shipments of structural shapes, $3 per 100 lb., f.o.b. Denver. Mill price of reinforcing bars, $1.70 Pittsburgh, with structural shapes nearing that figure. Quotations on shapes, plates and bars range between $1.60 and $1.75 per 100 lb.

Increased cast-iron pipe quotations are charged to higher fuel prices. Dallas quotes $51.50 as against $48.30, and Seattle $53 as compared with $52 per ton, last week.

Concreting materials remain firm throughout the country with no price changes. Long-leaf yellow pine continues to rise. Atlanta quotes $39, advanced from $38, and Dallas, $38, against $34.50 per M ft. b.m.

Raw linseed oil in Montreal quoted at $1.09 as against $1.07. Dallas reports $1.07, down from $1.09; Denver, $1.08, in wooden barrels, reduced from $1.10 and $1.06 in iron containers.

Reports from Seattle announce a general wage advance of 5c. per hr. in the Northwestern lumber mills. Wage increases bringing the common labor rate to 25c. per hr. have been effected in certain Southern steel mills.

Volume 88 New York, June 29, 1922 Number 26

Engineering News-Record

A CONSOLIDATION OF ENGINEERING NEWS AND ENGINEERING RECORD, WITH WHICH IS INCORPORATED THE CONTRACTOR

E. J. MEHREN, *Editor*

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Results of Heavy Traffic on Pittsburg Test Road 1066
TRUCKS TRAVEL 36,000 MILES. Wave motion in concrete slab plotted. Moisture percolates slowly in rolled adobe subgrade. Tests of wider scope to follow.
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EACH OPENING requires individual design. Formulas are makeshifts. Cloudburst data. Applying 1913 flood and Pueblo flood figures. Scour velocities. Other considerations.
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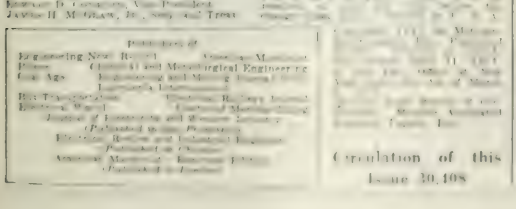
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Circulation of this Issue 30,108

Why a Big Staff?

TWELVE technically trained editors, supported by a staff correspondent in Washington, D. C., and the usual corps of stenographic and other assistants, compose the editorial staff of *Engineering News-Record*.

Why so large a staff?

Because specialization is needed and because in no other way can so broad a field be adequately served.

Here, for example, are the June convention assignments:

MR. DEBERARD—*Salt Lake City, American Association of Engineers.*

MR. BAKER — *Springfield, Mass., City Planning Conference.*

MR. MEHREN — *Washington, American Construction Council.*

MR. WIGHT — *Portsmouth, American Society of Civil Engineers.*

MR. SCHMITT—*Atlantic City, American Society for Testing Materials.*

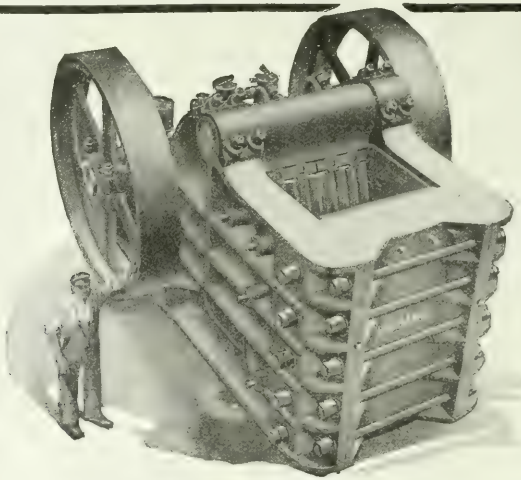
MR. WIGHT — *Atlantic City, American Society for Testing Materials.*

MR. BRAYMER *(editor of "Electrical World"), called in to help—Urbana, Ill., Society for Promotion of Engineering Education.*

Meanwhile other work must go on. MR. HILL, for example, starting the month in North Carolina, finishes it in the Middle West. And five issues of *Engineering News-Record* must come out in June no matter how many editors are away on trips.

THAT is the Why of the big staff—in order that you, the reader of the *News-Record*, may get promptly and from competent observers all the information about worth-while development in civil engineering and contracting.

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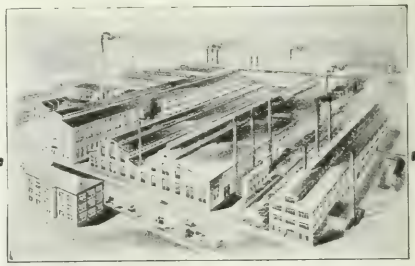
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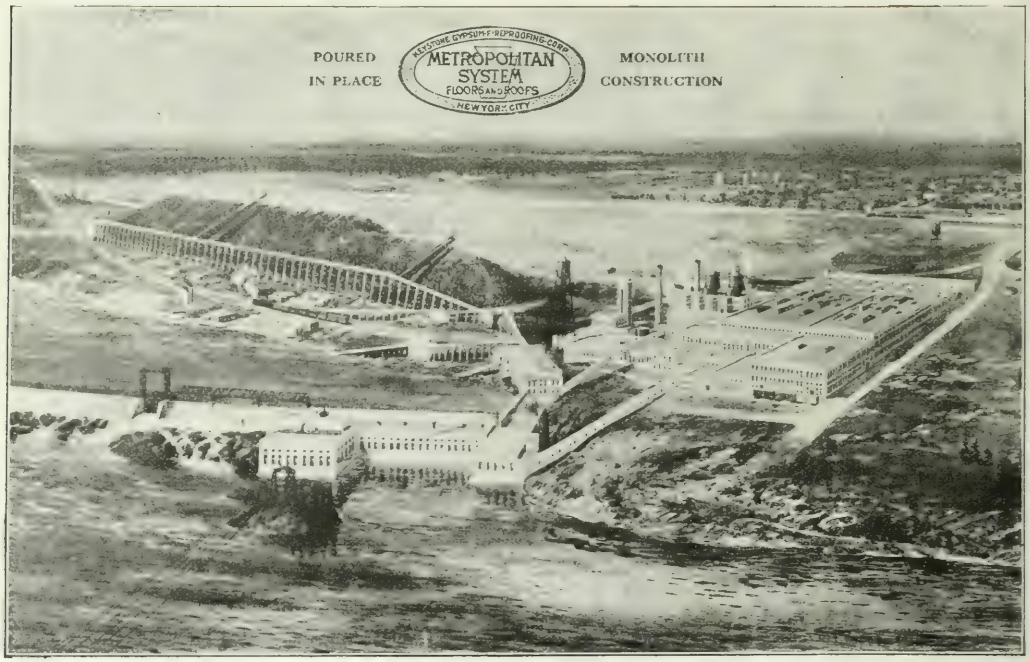
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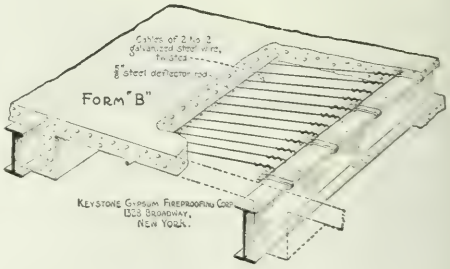
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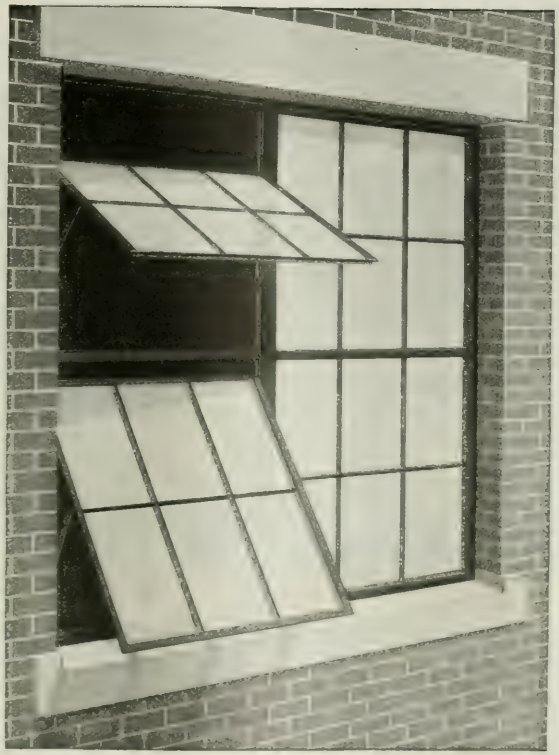
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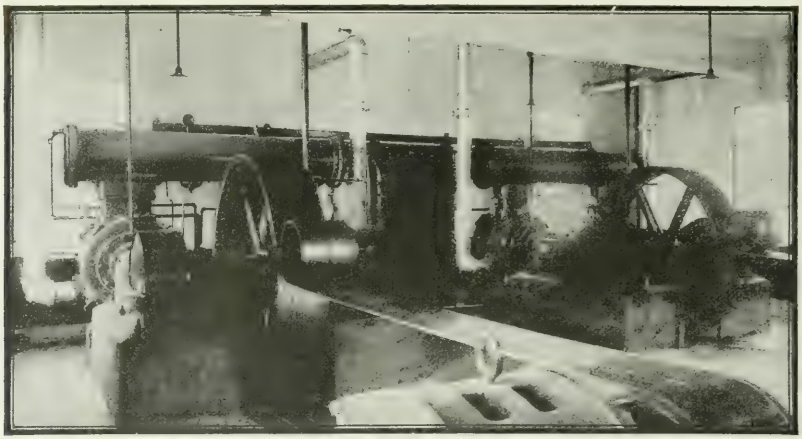
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C-106

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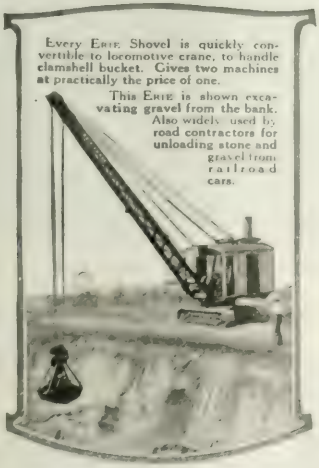
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Every ERIE Shovel is quickly convertible to locomotive crane, to handle clamshell bucket. Gives two machines at practically the price of one.

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"The ERIE has the best caterpillar type mounting I ever saw," *continues Mr. East.* "We have done some work on a 25% grade. (The ERIE will climb 30%.)

"This ERIE has made a mighty good record. We have moved more than 10,000 cu. yds. of rock and dirt in a month, loading to 1½ cu. yd. wagons. In our opinion the ERIE is the best shovel in its class."—*J. Hunter East, of Cooper, Piper & Co., Railroad & Highway Contractors, Field Office, Big Chimney, W. Va. Home Office, Charleston, W. Va.*

This concern has had plenty of previous experience with different makes of steam shovels. They have found that the caterpillar type ERIE has more speed, and greater climbing power, because it is the one continuous tread mounting that is *lubricated.* The power is *put to work,* to move the shovel—not wasted in overcoming internal friction.

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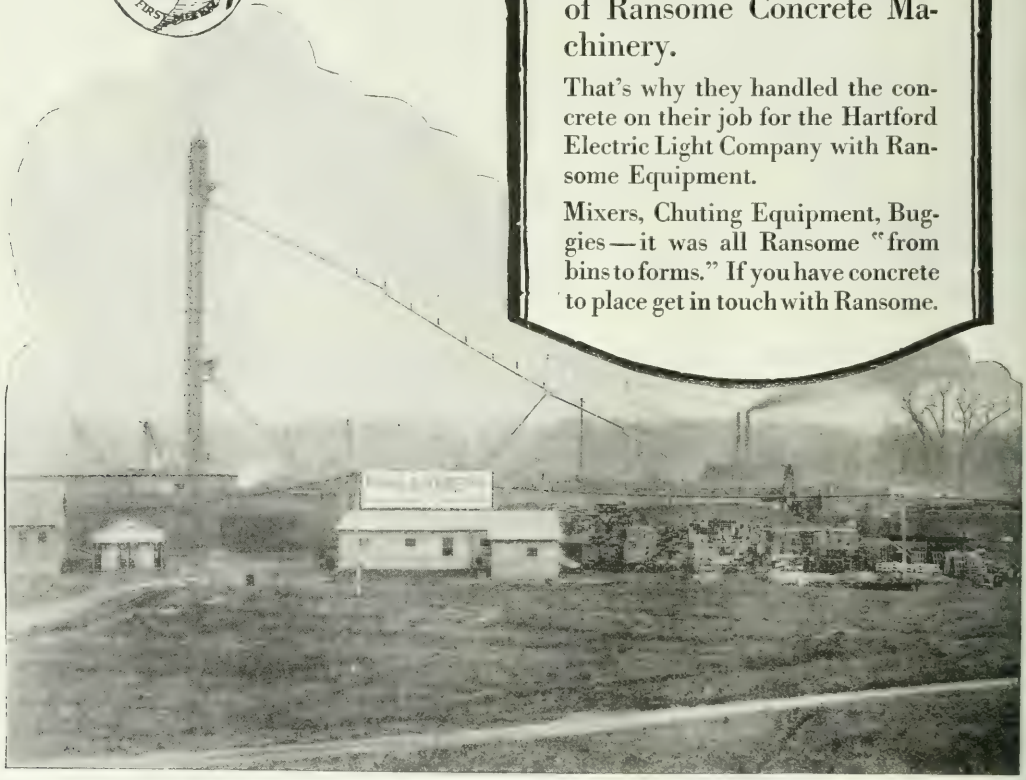
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Without obligation on my part, please send me information on:—
Building Mixers, sizes 4-S__; 7-S__; 10-S__; 14-S__; 21-S__; 28-S__; 56-S__. Driven by Belt__, Steam__, Gasoline__, Electric__.
Paving Mixers, sizes 7-E__; 10-E__; 14-E__; 21-E__. Concrete Chuting Plant for structure__ft. long by__ft. wide by__ft. high.

*NAME*_____ *ADDRESS* _____

Tel-U-Where will direct you to our nearest representative

31-286

Ransome Concrete Equipment

RANSOME CONCRETE MACHINERY CO.
1750 Second Street, Dunellen, N. J.



Unloading 10,000 Tons of Ore in Less than Three Hours

This is a typical example of Brownhoist engineering achievement. For more than forty years the Brownhoist organization has pioneered the development of material handling devices.

Beginning at the period when the movement of materials was a question of man-power, muscle and large sized wheelbarrows, this company has created and developed machinery for a multitude of handling needs.

Brownhoist Products

Locomotive Cranes
Concrete Bunkers
Overhead Cranes
Dock Machinery
Bridge Cranes
Buckets

With products ranging from the gigantic boat unloader, illustrated here, down to every size and type of locomotive crane, Brownhoist engineering skill is speeding up commerce and construction in all corners of the world.

Whether your handling problems be large or small, Brownhoist engineers will be glad to work with you toward lower handling costs.

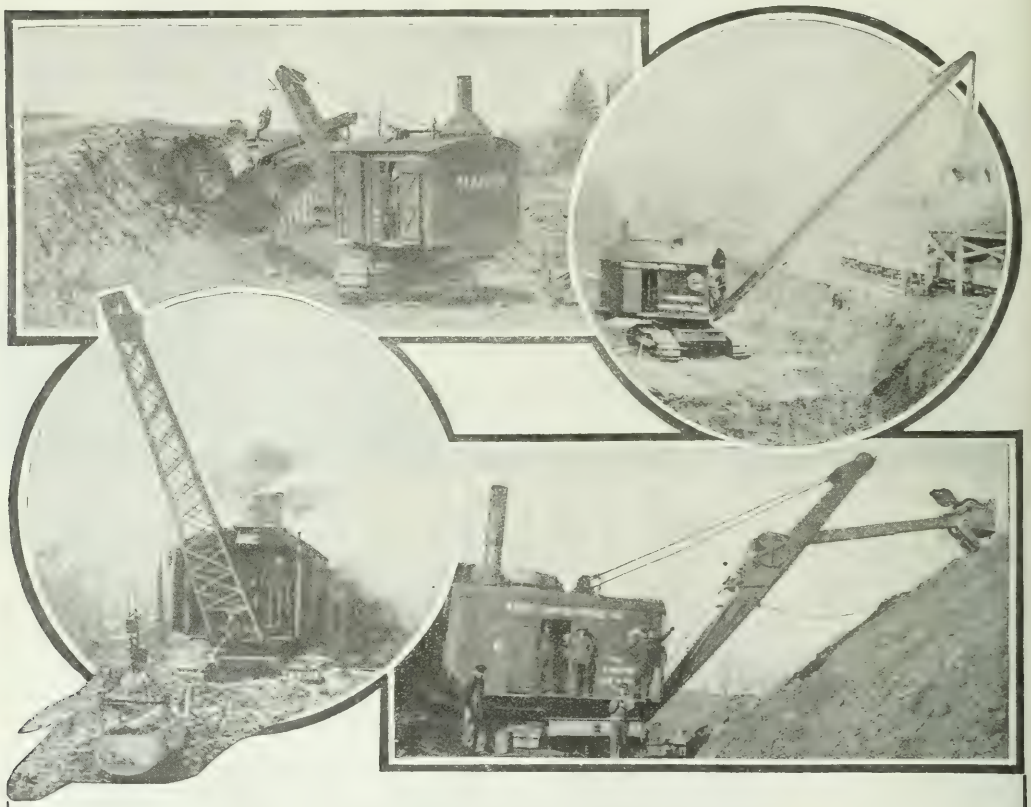
The Brown Hoisting Machinery Co., *Cleveland, Ohio*

Branches: New York, Chicago, Pittsburgh, San Francisco, New Orleans

BROWNHOIST

MATERIAL HANDLING MACHINERY

MARIONS for all Classes of Work



This Versatility of MARION Revolving Shovels
is of Inestimable Value to the general contractor.

Every revolving Marion Shovel can be converted, easily and quickly, into Dragline, Clamshell or Orangepeel Excavator or Crane. They are designed for this conversion because it enables the operator to handle a great range of work with one machine. And in each operation Marions have steam-shovel strength and efficiency.

For small drainage and irrigation ditches they give capacity and economy; also wider working range and ability to deposit material at a greater distance from the ditch. For building levees, handling sand and gravel from wet pit, making fills. High lift from basement and other wide-range work. Also as a pile driver.

Shovels
Steam Gasoline
Electric
Revolving and
Railroad Types
Dragline
Clamshell and
Orangepeel
Excavators
Dredges
R.R. Ditchers
Log Loaders
Ballast
Unloaders
Etc.

Consider these facts and what they can be made to mean to YOU in your work. In road building, railroading, excavating for buildings and pipe lines; in mining, quarrying, logging and contracting; in clay pits and brick plants. We have provided for an almost unlimited range of application.



The Marion Steam Shovel Co.

MARION, OHIO



RAILROADS, TOO, CHOOSE AUSTIN MIXERS

CUBE MIXERS
CUBE HEX PAVERS
CONCRETE TAMPERS
GASOLINE LOCOMOTIVES
INDUSTRIAL CARS
LATCH BOXES
WAGON LOADERS
SUBGRADERS
TRUCK TURNTABLES
TRENCH MACHINES
WHEEL EXCAVATORS
BACKFILLERS
DRAGLINES
CLAMSHELLS
CRANES
SHOVELS
SKIMMERS

Track elevation work, bridge construction, terminal improvements—railroad jobs, one and all, demand super-strength concrete.

Five Austin 28-S Cube Mixers were used on the Pennsylvania Railroad elevation near Rahway, N. J., here illustrated.

Cube-mixed concrete went into the Chicago track elevation work of both the Illinois Central and Northwestern Railways.

And a cube-equipped central mixing plant provided super-strength concrete for the Detroit River Tunnel of the Michigan Central Railroad.

Austin Cubes spell production, performance, quality and economy. Capacity and mounting are matters of choice, depending upon the particular work.

Our new Mixer Catalog gives complete specifications on the nine sizes of Austin Cubes. Ask for Catalog No. 3

An attractive novelty paper weight, showing the cube-mixing principle in miniature will also be sent if you specify GC 3

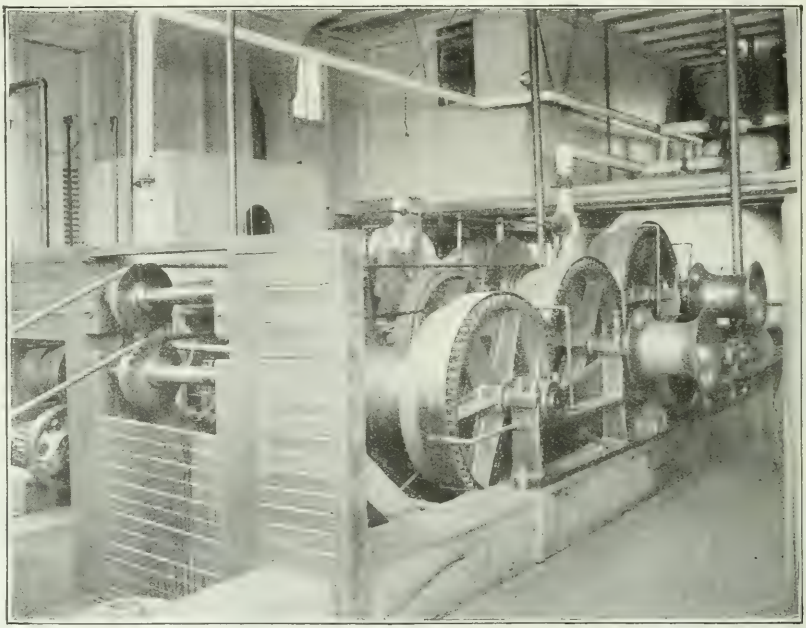
Austin Machinery Corporation

Railway Exchange Building
Chicago, U. S. A.

BIRMINGHAM
DAVENPORT
DETROIT
KANSAS CITY
MILWAUKEE
MINNEAPOLIS
NEW YORK
NEW ORLEANS
OMAHA
PORTLAND
SAN FRANCISCO
WOODSTOCK, ONT.

AUSTIN MACHINERY
"MOVES THE EARTH—MIXES THE CONCRETE"
TRADE MARK

ESTABLISHED 1869



In Service 10 Years—Still In A-1 Condition —Typical of MUNDY Equipment!

TRADE MARK ESTABLISHED 1869

This three-drum Mundy Hoisting Engine has been used for the past 10 years on one of three steam derrick barges operating clam shell buckets, removing gravel from the river bed.

This is so typical of Mundy durability that further comment is superfluous.

Write for Catalogs.



ATLANTA
BEAUMONT, TEXAS
BOSTON
BUFFALO
CHARLESTON, S. C.
CHICAGO
CINCINNATI
CLEVELAND
DALLAS, TEXAS
DES MOINES
GRAND RAPIDS
HOUSTON, TEXAS
HUNTINGTON
INDIANAPOLIS
JACKSONVILLE
KANSAS CITY
KNOXVILLE
LOS ANGELES
MILWAUKEE
MINNEAPOLIS
MOBILE, ALA.
MONTREAL
NEW ORLEANS
NORFOLK, VA.
OTTAWA, CANADA
PHILADELPHIA
PITTSBURGH
PORTLAND, ORE.
RICHMOND
ROANOKE, VA.
SAN FRANCISCO
SALT LAKE CITY
SEATTLE, WASH.
SHREVEPORT, LA.
ST. LOUIS

Use the HAISS Creeper Loader

to earn a wider margin of profit on a lower bid!

IT will save labor and cut handling costs—a direct saving. And it will speed the work, keep trucks moving and every man hustling to keep up with its pace—a saving just as important.

It is a heavy duty machine, mounted on creeper treads that take it anywhere—no going too soft or too rough. Powerful too—sufficient for any emergency.

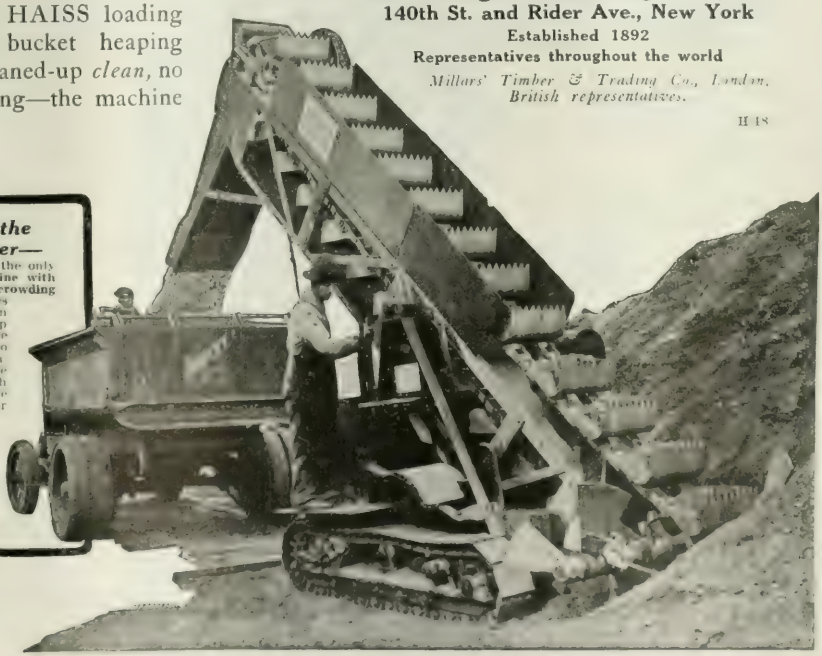
It lives up to the HAISS loading reputation—every bucket heaping *full*, the ground cleaned-up *clean*, no time loss for moving—the machine crowds in under power and digs a path right through the pile.

Only HAISS Loaders have the unique HAISS Self-Feeding Propellers—and there is no feeding device which compares with them in efficiency.

You want the best your money will buy—Ask about the HAISS Creeper Loader Bulletin No. 521.

The George Haiss Mfg. Co., Inc.
140th St. and Rider Ave., New York
Established 1892
Representatives throughout the world
Millars' Timber & Trading Co., London, British representatives.

H 18



A word with the HAISS Engineer—

The HAISS Machine is the only **automatic loading machine with patented slow speed crowding gear.** The machine does not have to be backed in and out in trying to keep crowded against the face of the pile. There is no violent or unwieldy manoeuvering necessary. The loader is crowded in with a **powerful, slow** drive precisely as the operator finds it necessary.

This is also an exclusive HAISS Feature. These are only two of the advantages of the HAISS Creeper. The HAISS Engineer will tell you of another next time. Watch this page.

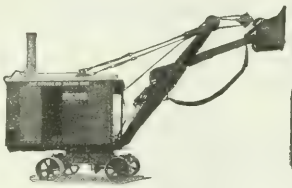


HAISS

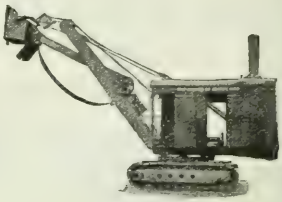
MATERIALS-HANDLING EQUIPMENT

CLAM SHELL BUCKETS



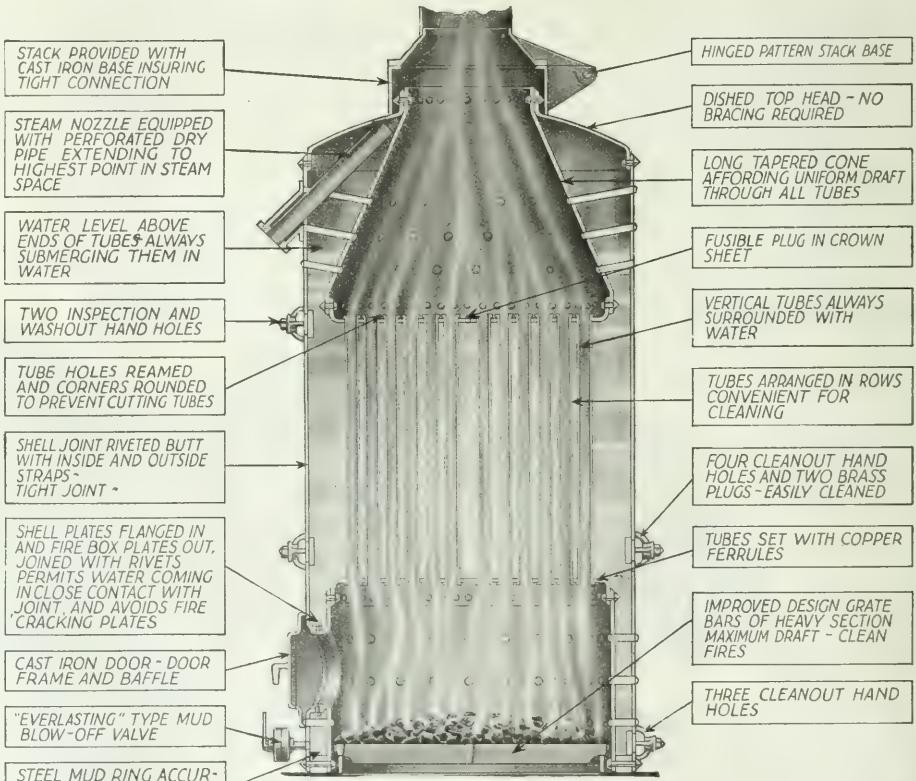


OSGOOD
STEAM SHOVELS



3-4 AND 1 CU. YD. STEAM SHOVELS

Vertical Submerged Tube Type Boiler



Built to A.S.M.E. Code

TUBES COMPLETELY SUBMERGED IN WATER TO PREVENT EXTREME EXPANSION, THUS REDUCING LEAKING AND OTHER BOILER TROUBLES.

The OSGOOD Company

Marion, Ohio, U. S. A.



Buda engines, due to their records for no-delay, low cost performance are standard on all Barber-Greene wagon loaders.

Buda Power Keeps the Job Moving

On wagon loaders, locomotives, ditchers, pumps, compressors and other construction machinery Buda engines are giving the same smooth, trouble-free power they furnish in heavy duty trucking. Buda engines are built rugged to stand the grind of hard, continuous working. They help finish the job on time. Their upkeep costs are low. They are backed by a nation-wide system of Buda parts distributing stations.

THE BUDA COMPANY, HARVEY CHICAGO SUBURB ILL.

Established 1881

BUDA *The* ENGINE

What Is Cement?

What is this finer-than-flour building material called cement, that you can mix with water, sand, and stone or pebbles, and cast into all sorts of shapes that become as hard and enduring as solid rock?

Portland cement consists principally of silica, lime, and alumina. In cement manufacture these are obtained from (1) Cement rock and limestone; (2) Limestone or marl and shale or clay; (3) Blast-furnace slag and limestone.

First the rock is quarried and transported to the mill. Then it is ground to a powder, analyzed, and the several ingredients mixed in accurate proportions.

Next it is subjected to long and gradually increasing heat until, at about 3000 degrees Fahrenheit, the mixed materials decompose and fuse into hard balls, known as clinker.

Then this hard clinker is cooled, mixed with a definite proportion of gypsum, and again ground to a powder so fine that at least 78 per cent of it will pass through a sieve having 40,000 holes to the square inch.

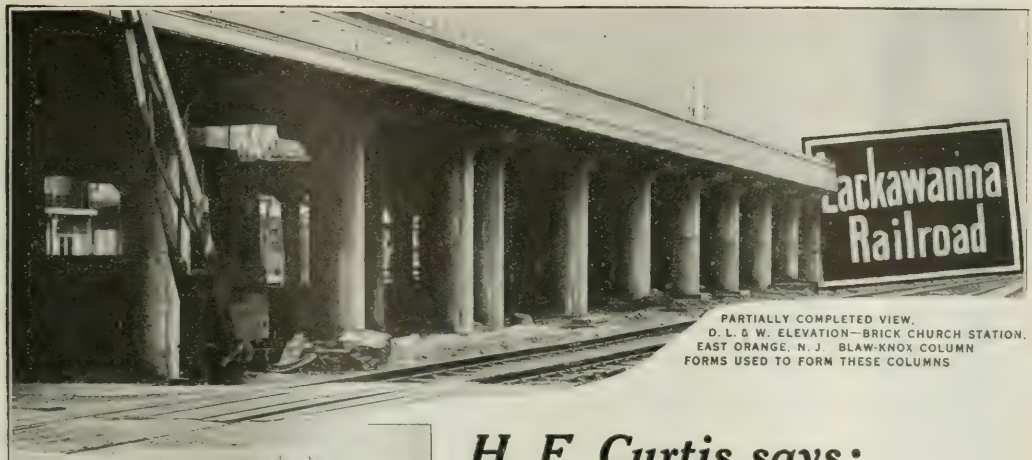
Finally this finished product must be analyzed to determine that it conforms to the exacting specification requirements of cement manufacture, packed in bags and placed in cars for shipment.

The manufacture of cement is a complex process involving great care, skill and expense, and requiring an enormous capital investment.

This Is the Age of Cement

PORTLAND CEMENT ASSOCIATION
111 West Washington Street
CHICAGO

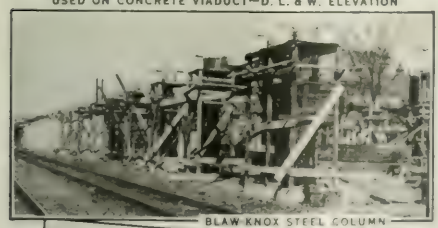
TO FURTHER THE BEST INTERESTS OF CEMENT USERS



PARTIALLY COMPLETED VIEW,
D. L. & W. ELEVATION—BRICK CHURCH STATION,
EAST ORANGE, N. J. BLAW-KNOX COLUMN
FORMS USED TO FORM THESE COLUMNS



BLAW-KNOX TRAVELING STEEL WALL FORM
USED ON CONCRETE VIADUCT—D. L. & W. ELEVATION



BLAW-KNOX STEEL COLUMN
MOLDS AT WORK



FINISHED COLUMNS
AND PANEL SHORING

H. F. Curtis says: Blaw-Knox Steel Forms Show a 50% Saving

H. F. Curtis is using Blaw-Knox Steel Forms on the D. L. & W. elevation work at East Orange, N. J. This includes the construction of retaining walls and a concrete viaduct 75 ft. wide, 1080 ft. long, supported by 230 round concrete columns. The long experience of Mr. Curtis in connection with engineering achievements of this character renders his opinion of special value. He says—

> *"On the above work I have and am still using the Blaw System of Steel Forms and by the use of these forms I have effected a saving over wood forms which I have used on previous work of this nature. I might add that the use of steel forms on my work has made a saving of 50% over wood forms."*

Mr. Curtis is enthusiastic about Blawforms because they prove their practical value and saving at every turn. Blaw-Knox Form Engineers will develop forms for you and prove their savings conclusively.

There is no job too big or too complicated for Blawforms to handle. Write for our catalog illustrating the work Blawforms have done.

Blaw-Knox Products

Sectional Steel Buildings—Clamshell Buckets—Fabricated Steel Specialties—Pressed, Riveted and Welded Plate Work—Steel Forms for Concrete Construction—Transmission Towers and Poles—Water Cooled quipment for High Temperature Furnaces—Sheldon anical Gas Producers—Mowry Dolomite Gun Road Builder's Equipment.

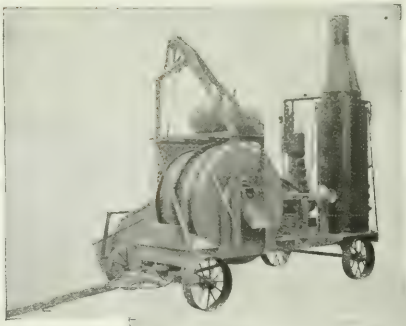
BLAW KNOX

BLAW-KNOX COMPANY

PITTSBURGH, PA.
601 Farmers Bank Bldg

New York · Chicago · Detroit · Baltimore
Birmingham · San Francisco · London, Eng.





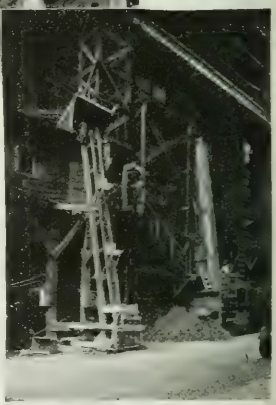
Concrete mixers equipped with Rex Chain can be depended upon for smooth operation and long life.



As a result of the better service it gave their customers the Pawling & Harnischfeger Company adopted Rex Chain as standard on all thirteen sizes of P. & H. ditchers.



The crushing plants built by the Smith Engineering Works are recognized for sturdiness. They are equipped with Rex Chain.



This cement bag elevator built with Rex Chain greatly reduces handling costs on this building project. There are many ways in which Rex Chain can save on building costs.



The well-known Russell graders are fitted with Rex Chain to assure utmost dependability.

REX

See That Your Machines Have REX CHAIN—

It Runs Smoother, Lasts Longer

One of the many savings effected for you by construction machinery builders equipping with Rex Chain is a maximum protection against breakdowns and delays.

Rex Chain is built to stand the wear and tear of continuous, heavy duty service. More than a dozen shop tests and inspections assure uniform strength in every link. It holds its pitch a long time.

Whether used on concrete mixers and pavers, road graders, ditchers, rock crushers, steam shovels, conveyors, cranes, wagon loaders or other construction machinery Rex Chain makes for steady, economical working.

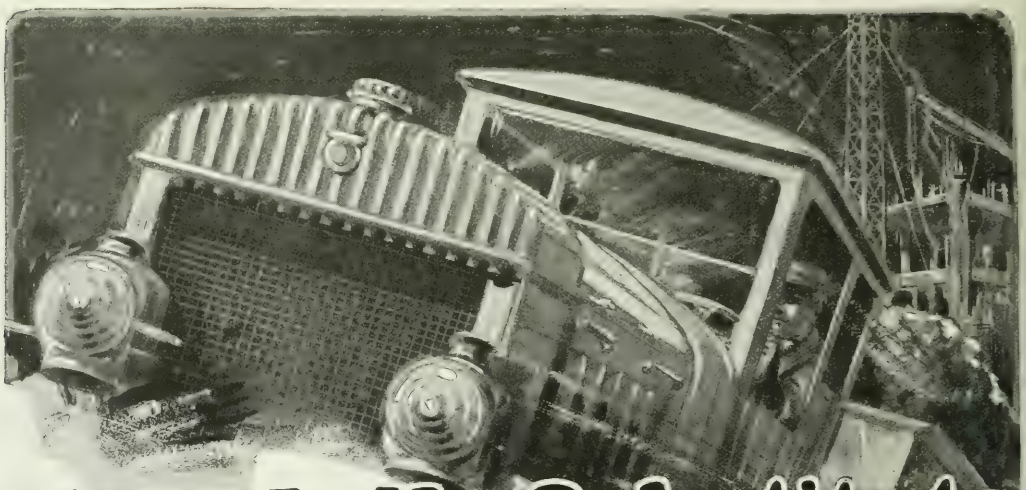
Rex Chain should be on the machines you buy. You can tell it by the word Rex or trade mark ———◇——— cast into each link. Make it a point, also, to use Rex Chain for all repairs and replacements. There is a size and type to fit every transmission and conveyor need.

CHAIN BELT COMPANY, MILWAUKEE
Branch Offices and Representatives in Principal Cities in the United States and Abroad



CHAIN

Rex Sprockets, Rex Conveyors, Rex Concrete Mixers and Pavers, Rex Traveling Water Screens



There Is No Substitute for Consistency



DAY-in-and-day-out dependability is a motor quality that can neither be counterfeited nor acceptably supplanted. There are no degrees—a motor either has it or has not.

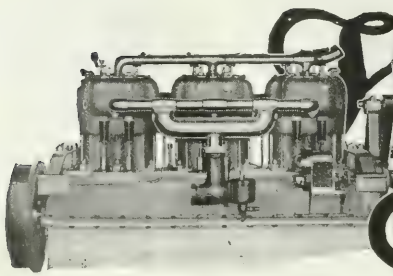
Motor achievement can go no higher than insuring its presence, and for its absence there can be no lasting compensation.

Neither cheapness of first cost, flash of appearance nor superficial sales arguments can be a reasonable temptation against the dominating dependability built into Wisconsin Motors.

Their consistency knows no substitute.

Offices in New York, Chicago, Cleveland, Los Angeles, Seattle.

WISCONSIN MOTOR MFG. CO.
MILWAUKEE WISCONSIN



Wisconsin
Consistent
Consistent

North Carolina Roads Are MULTIFOOTE Roads

North Carolina—that old North State of the South—is building hard roads. The sort of hard roads that typify the progressive spirit of the State.

Actual construction was started under a $50,000,000 bond issue in 1921; to this has been added federal aid money and local funds from cities and counties.

And North Carolina contractors know how to build good enduring roads—they know the value of up to date equipment in road construction and they know that only by good work and fast work can their business be built up and profits returned.

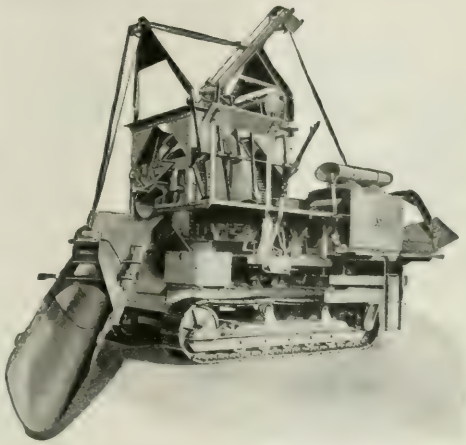
That's the reason why they are using MultiFoote pavers on nearly every job in the State this spring.

Get in touch with our nearest agent—let him show you why MultiFootes are so much in demand and why 65% of all our sales are repeat orders.

GENERAL AGENTS

Foote Concrete Machinery Co., 1241 Michigan Ave., Chicago, Ill.
Edward R. Bacon Co., 51 Minna St., San Francisco, Cal.
E. J. McHarg & Co., 3 Crandall St., Binghamton, N. Y.
Wilcox Bros., Inc., 152 West 42nd St., New York, N. Y.
Burton Franklin, Volunteer Bldg., Chattanooga, Tenn.
Made by Foote Co., Inc., Nunda, N. Y.

Thirty-five



Thirty-five of the forty-one modern full-length traction tread pavers that started off the paving season in North Carolina this spring are MULTIFOOTE Pavers. Their owners are:

	Number Owned	Size	Bought their first
Robert G. Lassiter & Co.	6	27E & 21E	1919
West Construction Co.	3	21E	1921
Elliott-Sholes Company	2	21E	1921
Murray Construction Co.	3	21E	1921
Willard-Wilcox Co.	1	21E	1921
Lampton & Burks	2	27E & 21E	1920
Atlantic Bitulithic Co.	1	14E	1921
F. J. McGuire & Co.	1	21E	1921
Fiske-Carter Construction Co.	1	21E	1921
Hedrick Construction Co.	1	21E	1921
Pitt County	1	21E	1921
Elliott & Sons & R. E. Boggs	1	21E	1921
Pittman Construction Co.	1	21E	1922
John N. Bohannon	1	21E	1922
Redman Construction Co.	1	21E	1922
Speed-Parker, Inc.	1	21E	1922
R. M. Hudson Co.	1	21E	1922
Hagedorn Construction Co.	1	21E	1922
George R. Martin	1	21E	1922
Asheville Paving Co.	1	21E	1922
Southern Dray Company	1	21E	1922
D. J. Brookshire & Co.	1	21E	1922
Wilson Construction Co.	1	21E	1922
Campbell Contracting Co.	1	21E	1922

ROAD MULTI FOOTE PAVER

TRADE MARK REGISTERED

Nemco EXPANDED METAL Products

For Every Building Requirement

KNO-BURN

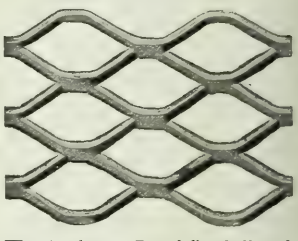


AN economical flat, small diamond meshed lath for interior plastering stucco, ratproofing and fire stopping. Requires a minimum amount of plaster, very rigid, yet easily cut, shaped and plastered. 24, 25, 26, 27 gauges—Sheets 24 x 96 in. Furnished painted, cut from Galv. Sheet, Pure Iron and Copper Bearing.

FREE SAMPLES
CATALOGS
SPECIFICATIONS

Dealers Everywhere
Prompt Deliveries

EUREKA



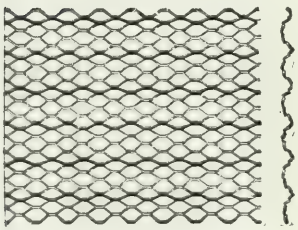
FLAT lath. Especially indicated for 2 in. Solid Partitions, Ornamental Plastering and wherever as small a meshed lath as KNO-BURN is not required. 24 and 26 ga. Sheets (respectively) 22 in. and 21 in. x 96 in. Painted, Cut from Galv. Sheet, Pure Iron and Copper Bearing.

ECONO Expanded Metal



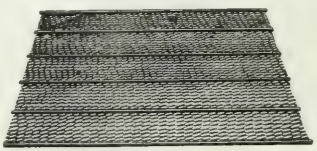
A MESHED reinforcing for all types of concrete work. Saves time and labor of tying and placing bars. Large flat sheets in various gauges and sizes of mesh, ranging from ½ in. x 1½ in. to 5¼ in. x 12 in. (small meshes mostly used for machine guards, open partitions, etc.)

CORRUGATED



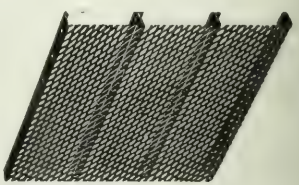
SELF-FURRING. Especially recommended for stucco. Furnished in either the KNO-BURN or EUREKA types of mesh and in the same weights gauges and finishes.

LONGSPAN



SELF-FURRING lath for partition work, ceilings, etc. U-ribs ⅜ in. high are easily spliced. Rigid, ships well. Sheets 2 ft. x 8 ft. 24, 26, 28 gauges.

T-RIB CHANELATH



USED with equal satisfaction either as a self-furring plastering lath or as a combined form and reinforcing for concrete. Especially indicated for roofs, partitions. T-ribs ⅞ in. high. 24, 26, 28 gauges. Sheets 4 in. to 48 in. wide. Lengths 3 to 12 ft.

NORTHWESTERN EXPANDED METAL CO.

1200 OLD COLONY BLDG., CHICAGO, ILLINOIS

Insley Equipment for
Concrete Distribution

THE Flexibility of Concrete Placing Equipment is an important factor in the efficient distribution of Concrete. By a glance at the illustration below the Flexibility of **The Insley Steel Tower, Quick Shift, Counterweight Chute Plant** is at once apparent.

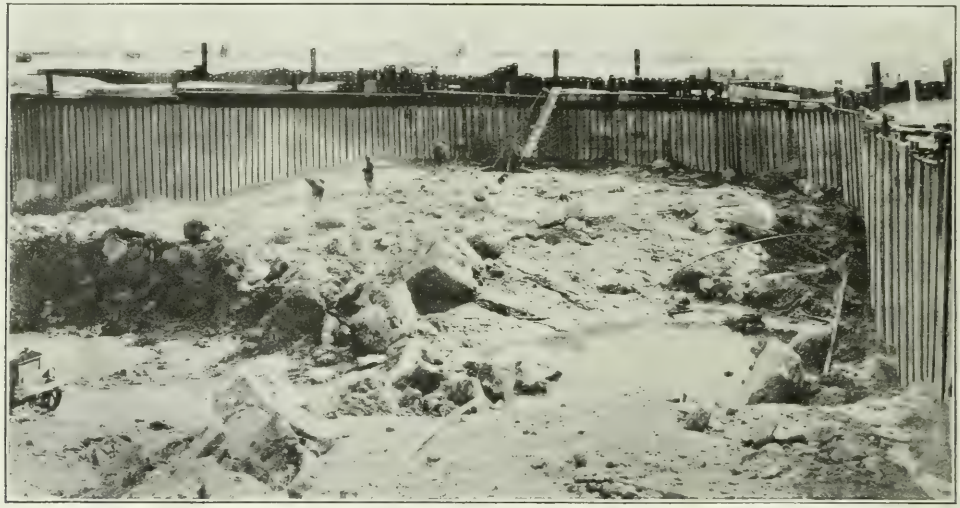
The Boom Supported Chute and Counterweight Chute make it possible to move from one pouring position to another with minimum effort, and the Quick Shift feature makes it possible to save much time when vertical shifts have to be made as the work progresses in height.

These Time and Labor Saving features make this the ideal Concrete Placing Equipment for the up-to-date Contractor. Our Engineers are at your service and will cheerfully help you work out your Equipment Problems.

INSLEY MANUFACTURING CO.
Engineers and Manufacturers
INDIANAPOLIS

INSLEY
CONCRETE PLACING EQUIPMENT
INDUSTRIAL CARS — DUMP BUCKETS
STEEL DERRICKS



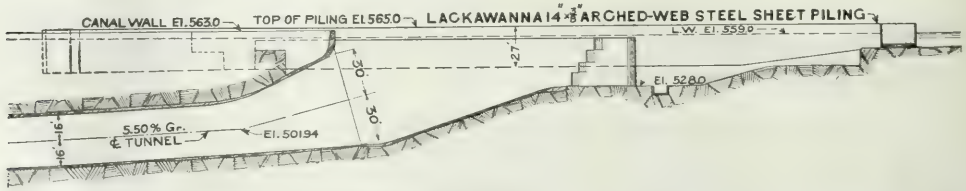


Lackawanna Steel Sheet Piling

A cellular or pocket type cofferdam used successfully in the Niagara River

The cells or pockets of this cofferdam vary in size, the smallest being 15 ft. in width and the largest 23 ft. depending upon the depth of the water.

The steel sheet piling was assembled around timber templates conforming with the inner dimensions of the pockets by means of a derrick mounted on a scow. After the closure was made, each pile was driven to refusal. Concrete was deposited under water in the cells to a depth of about 2 ft. after the rock was thoroughly cleaned. The pockets were then filled with river sand and gravel.



SECTION



DOUBLE-LOCK
LACKAWANNA
INTERLOCK

No trouble was experienced in unwatering this area and no movement of the pockets was discernible.

The rock excavation within the cofferdam was made to grade. The guide walls and gate piers were also built inside of this structure.

This design is especially desirable where, owing to the character of the underlying material, the gravity type of cofferdam is necessary. All interior bracing is also eliminated, which otherwise would impede the construction work.

For further reference to this development see article in the Engineering News-Record of April 27, 1922, by the engineers of the Power Company and our ad of June 22, 1922.

If you contemplate the use of steel sheet piling in your next job, let our Engineers help you analyze your work. Their advice is free.

NIAGARA FALLS POWER COMPANY

JOHN L. HARPER, *Chief Engineer*
O. D. DALES, *Construction Engineer*
J. A. SHEPARD, *Asst. Engineer*
N. A. GIBSON, *Hydraulic Engineer*

Lackawanna Steel Company

General Sales Offices and Works: Lackawanna, N. Y.

BUFFALO BOSTON CHICAGO CINCINNATI CLEVELAND DETROIT
NEW YORK PHILADELPHIA ST. LOUIS SAN FRANCISCO

Licensees for the manufacture of Lackawanna Steel Sheet Piling:

For Great Britain and British Colonies in the Eastern Hemisphere, Cargo Fleet Iron Co., Ltd., Middlesbrough, England. For France, Italy, Spain, French Colonies and Protectorates, Italian Colonies and Spanish Colonies in the Eastern Hemisphere, Cie des Forges & Aciéries de la Marine et d Homécourt, Paris, France.

Sole Exporter for Other Countries. CONSOLIDATED STEEL CORPORATION, 25 Broadway, New York



Greater Range

"HEY THERE! PULL THAT TRUCK AHEAD!" shouted the shovel runner.

"That fellow must think this is an ordinary shovel," said he to the fireman as the driver pulled up to safety. "He tried to get so close for a load that another foot and he'd be down in here with us. Well, he's all set. Let's go!"

And he did go. In double quick time the truck was loaded. Another took its place. Each truck stood well away and the Thew reached it with perfect ease, putting every dipperful up and out with no lost motion.

That's the advantage of the ¾ yard Thew. It is designed and built for the standard 19′ 6″ boom. This gives it the ability to load ahead for which it is famous.

Of course extraordinary range isn't always needed but it's never a disadvantage. With the shovel down in a hole and the trucks on the bank, a good long reach sure comes in handy.

Contractors who know that greater shovel range means increased shovel efficiency and larger actual profits have enjoyed reading Bulletin 111. Write for YOUR copy.

THE THEW SHOVEL COMPANY, LORAIN, O.

Thew
Power Shovels

BUCYRUS
20-B BULLSEYE



A NEW ¾-YARD SHOVEL

This is the machine you have been looking for. A Shovel built for the Shovelman. In designing this machine no detail has been too small to neglect which would make it easier to operate and more convenient for the operator.

Powerful, strong, fast, snappy, and yet light. Thoroughly tested by months of operation, under the severest of conditions, before being put on the market.

BUCYRUS

ESTABLISHED IN 1880

RAILROAD TYPE AND REVOLVING SHOVELS OF ALL SIZES · DRAGLINE EXCAVATORS · TRENCH EXCAVATORS · DIPPER, HYDRAULIC AND PLACER DREDGES, SPREADER PLOWS, WRECKING CRANES, ETC.

A SOLE AS PLANT DEVOTED EXCLUSIVELY TO SMALL REVOLVING SHOVELS

BUCYRUS COMPANY, SOUTH MILWAUKEE, WIS.

NEW YORK CHICAGO BIRMINGHAM SAN FRANCISCO PORTLAND DENVER

433

Clip this Coupon and Mail to Nearest Office

BUCYRUS COMPANY. Date

Please mail me your Bulletin C 401, describing your 20 B UNIVERSAL SHOVEL.

Name

Address

N



Model C-20, Chain-and-Bucket type, has cutting widths of 40 in., 44 in. and 52 in.—digs any depth to 20 ft.

Low Operating Cost Plus—

You can get the dirt back in a hurry with the Buckeye Back-Filler—at the rate of 100 to 125 cubic yards an hour.

Made small enough for working in streets and cramped places, this new Buckeye Back-Filler meets a long felt need. It is built with power-swinging boom like the larger Buckeye Back-Filler and possesses that same dependability characteristic of all Buckeye equipment. Ask for circular.

Aside from low operating cost, contractors often mention other reasons why they like their Buckeyes so well.

Take the East Side Realty Co. of Ashtabula, Ohio, for example. A feature of the Buckeye that particularly pleases them in their work is its convenience in moving from one location to another "and the setting in position more rapidly than we have observed in any other machine."

We shall be glad to send you proof of Buckeye advantages. Why not avail yourself of the profits possible with this low cost ditcher?

The Buckeye Traction Ditcher Co.

Manufacturers of Trench Excavators (both Wheel and Chain-and-Bucket Types), Concrete Breakers, Pipe-Line Trench Excavators, Tile and Open Ditchers, Back-Fillers, Pipe-Screwing Machines, Curb Diggers and Clay Diggers.

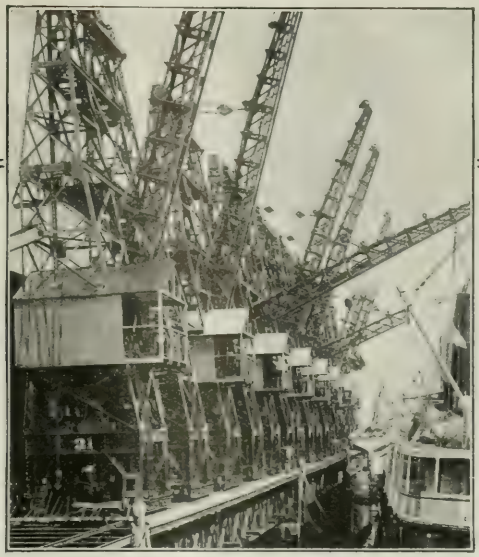
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BRANCH SALES OFFICES:

New York, Chicago, San Francisco, Los Angeles, Tulsa, Okla., Norfolk, Va., Miami, Fla., Mason City, Ia., Chatham, Ont., Salt Lake City

Immediate Shipment

Buckeye



What an opportunity for rust!

Steel—tons of it—air and moisture—here are all the necessary ingredients. It would not take long for corrosion to put one or all of these derricks out of service if they were not properly protected. But the rusting of steel can be prevented by careful painting with red-lead. It is the standard paint for protecting structural metal.

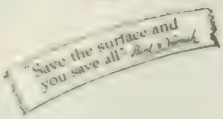
Dutch Boy Red-Lead is a pure red-lead that sticks tight to clean metal surfaces and keeps out moisture and harmful gases. It is particularly essential wherever there are framing connections, joined surfaces and rivet heads—spots that are concealed after erection.

Dutch Boy Red-Lead is an economical paint because of its great spreading power. It gives a uniform coating that is tough and elastic under all weather conditions.

As it is so fine and highly oxidized, we are able to supply Dutch Boy Red-Lead in both paste form and as a liquid. For application next to the surface the straight red-lead is used. In the liquid form it can be obtained tinted to light and dark brown, light and dark green and black.

Use Dutch Boy Red-Lead and don't give rust an opportunity to weaken your steel work.



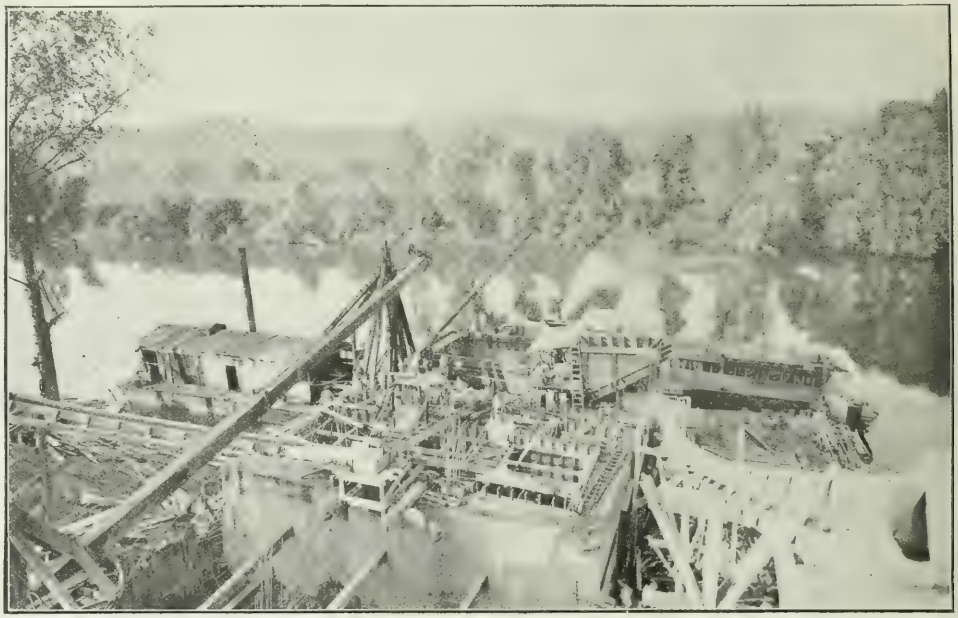


Ask for Painting Helps No. 5.

NATIONAL LEAD COMPANY

New York Boston Chicago San Francisco
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JOHN T. LEWIS & BROS. CO., Philadelphia NATIONAL LEAD & OIL CO., Pittsburgh

Dutch Boy Red-Lead



Intake for the Rollin Chemical Company, Charleston, West Virginia
The Foundation Company, General Contractors

THE Foundation Company has had extensive experience in building Water-works, Filtration Plants, Sewage Disposal Systems and Pipe Lines, and is especially qualified to undertake engineering construction demanding extraordinary skill, unusual plant or rigid economy. The nearest district office will gladly co-operate with you.

THE FOUNDATION COMPANY

CITY OF NEW YORK

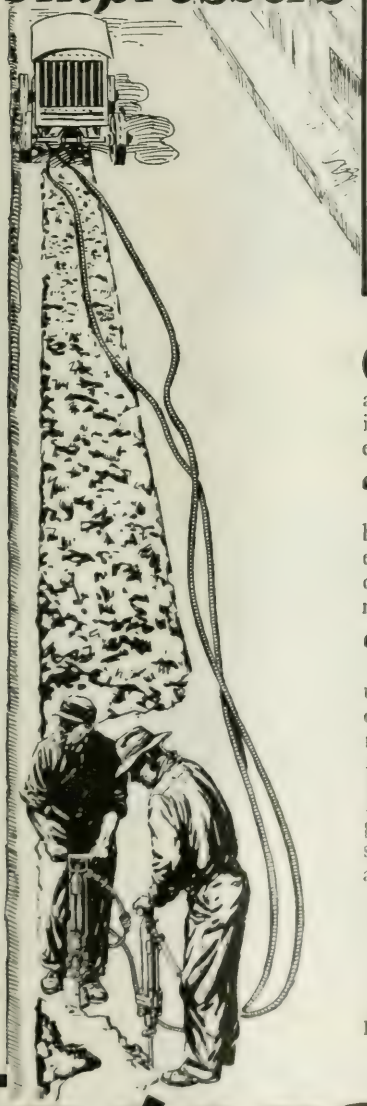
Industrial Plants
Office Buildings
Warehouses
Railroads and Terminals
Foundations and Underpinning
Flotation and Sewage Plants

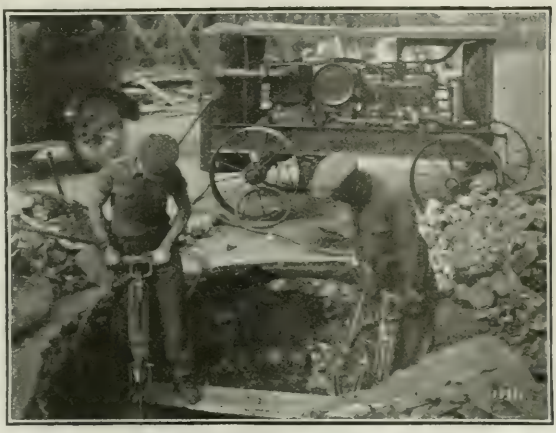
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BUILDERS OF SUPERSTRUCTURES AS WELL AS SUBSTRUCTURES

Use IR Portable Compressors





"PAVING BREAKERS" and I-R PORTABLE COMPRESSORS enlarging manhole.

COMPRESSED-AIR operating machinery is being used to a greater extent every day for cutting asphalt, breaking out concrete, drilling rock, sand-blasting, paint spraying, etc. It does the work rapidly and economically, is comfortable to operate and sturdy.

"PAVING BREAKER"—a light compressed-air operated one man machine for cutting asphalt, breaking up concrete roads and foundations and general demolition work. The compressed-air method does the work in 1/4 the time at 1/3 the cost of hand methods.

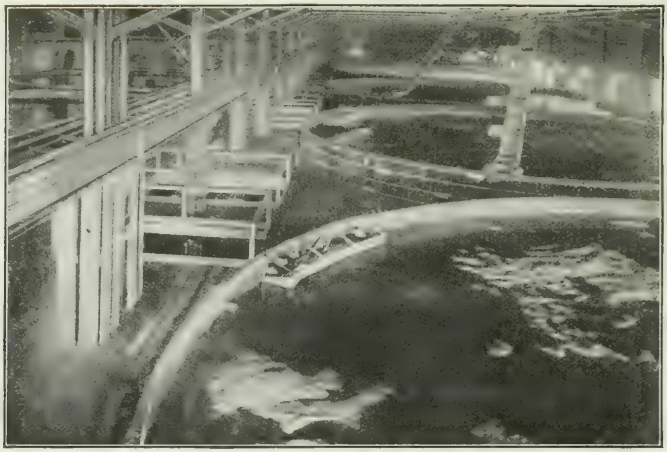
"JACKHAMER"—an automatically rotated hammer type rock drill, hand held or mounted and used in all kinds of general rock drilling work. It is operated by one man and is now the standard drill for road and contract work.

PORTABLE COMPRESSORS — complete air compressor plant consisting of: air compressor, gasoline engine or electric motor, radiator and cooling system, air receiver, etc., all mounted on a substantial all-steel truck with steel wheels and axles.

Bulletin No. 4051—Paving Breakers
Bulletin No. 4046—"Jackhamers"
Bulletin No. 3315—Portable Compressors

INGERSOLL-RAND COMPANY, 11 Broadway, New York

Ingersoll-Rand



Redwood tanks at the Anaconda Copper Mining Company plant used for leaching copper. Uninjured by constant contact with caustic solutions.

Uninjured by constant contact with caustic solutions

LEACHING copper ore is only one of the departments of engineering in which Redwood has proved its special fitness as material for tanks that must stand up under the most severe service conditions.

In tanning factories and textile mills, for the hot solutions of acids and alkalies used in soap making, in milk condensaries and cheese factories, for holding hot and cold water, or solutions for a wide range of uses in chemical engineering, Redwood has proved its endurance in hundreds of instances. East and West, North and South, Redwood has won preference.

A *natural,* odorless preservative permeates Redwood fibre during the growth of the tree and protects it against all forms of fungus growth, boring worms and insects, and against the destructive action of moisture, acids and alkalies.

Properly seasoned, Redwood will not warp, swell or shrink and can be supplied free from defects in any necessary dimensions. Redwood tanks stay tight and last for years.

For all purposes where exposure to moisture, weather, acids or alkalies is a continuing condition Redwood excels in endurance.

In every industrial center are established tank manufacturers prepared to give immediate prices and service in the erection of Redwood tanks.

The various engineering uses for Redwood are illustrated and fully described on our pages in the sixth annual edition of the Chemical Engineering Catalog and in the Eighth Annual Edition of Sweet's Engineering Catalog. Write our Chicago or New York office for copies of our "Construction Digest" and our "Engineering Digest."

The Pacific Lumber Co. of Illinois
Chicago — 2077 McCormick Bldg.
New York — 828 Rector St. Bldg.

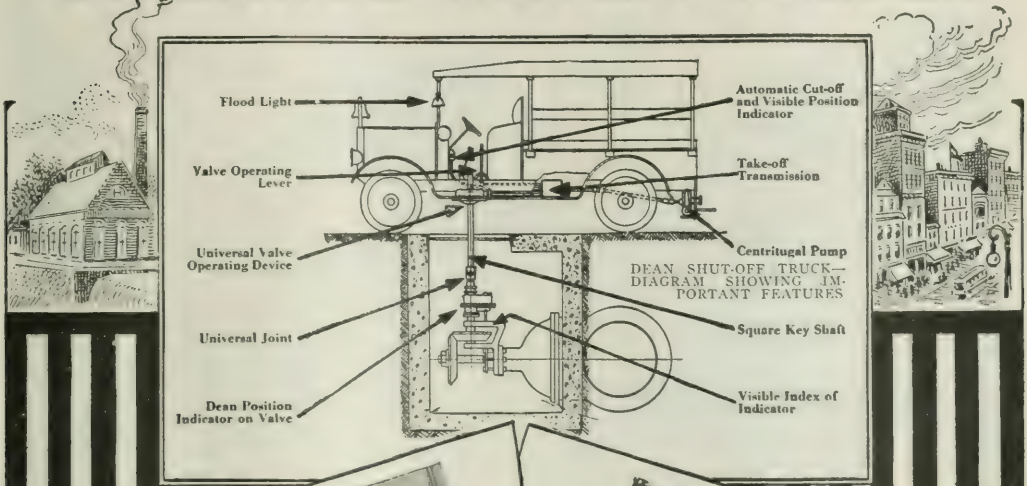
The Pacific Lumber Co.
San Francisco — 311 California St.
Los Angeles — Central Bldg., 6th and Main Sts.

Export Company: A. F. THANE & CO.
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Our extensive re-manufacturing operations provide a large supply of short, knot-free Redwood 1 in., 1¼ in., 1½ in. and 2 in. thick and 3 in. to 6 in. wide. For trays, stock boxes, tool boxes, small vats and wood specialties, this high-grade Redwood is ideal. Our prices are decidedly attractive. Full particulars furnished on request.

P L C The Pacific Lumber Co.
Redwood
The Largest Manufacturers and Distributors of California Redwood

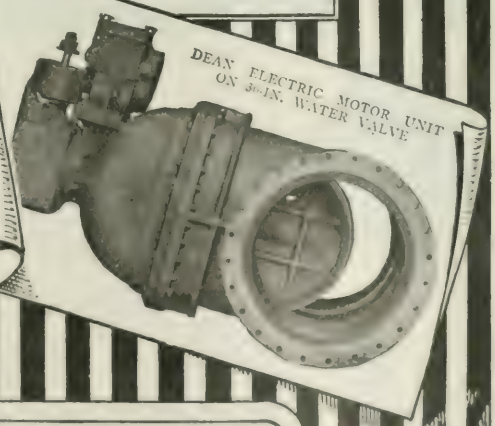
MOTOR OPERATION
OF LARGE WATER VALVES



DEAN SHUT-OFF TRUCK—DIAGRAM SHOWING IMPORTANT FEATURES



DEAN SHUT OFF TRUCK IN OPERATION



DEAN ELECTRIC MOTOR UNIT ON 36-IN. WATER VALVE

WRITE FOR BULLETINS 43-55-100

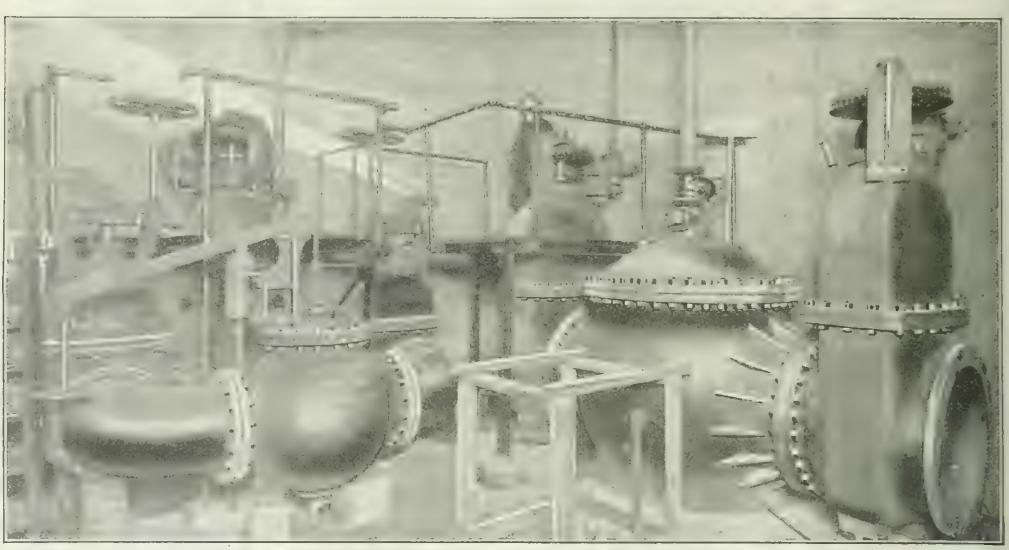
PAYNE DEAN LIMITED

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PITTSBURGH. NEW YORK. CHICAGO.

COFFIN VALVE COMPANY

Makers of the Largest Sluice and Gate Valves in America.



Coffin products predominate on big work — witness this Gate Chamber in one of the Catskill Aqueduct Shafts. We built four of the six big valves here shown for the N. Y. Board of Water Supply.

Check Valves
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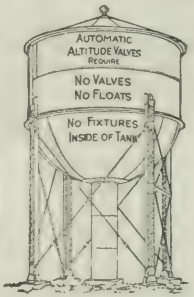


Look at it from a Revenue Viewpoint!

GOLDEN-ANDERSON

Automatic Cushioned Controlling Altitude Valves





Save the water that you spend good money to store and to pump, and that you depend upon to bring the revenue to your system. Meter your lines, by all means—but check the overflow that wastes water *before it turns the meter dials.*

GOLDEN-ANDERSON Automatic Cushioned Controlling Altitude Valves automatically maintain Uniform Stage of Water in Tank, Reservoir, or Standpipes. They do away with the annoyances of Freezing and Float Fixtures inside or outside of Tanks.

"Three Ways of Closing These Valves."

1st Automatically, by Water.
2nd By Electricity, if Desired.
3rd By Hand.

May also be arranged to automatically close when a break occurs in the mains. When necessary they may be so constructed as to "work both ways" on a single line of pipe.

No valves or fixtures inside or outside.
Sizes to 30 inches.

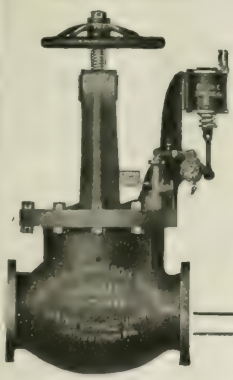
"Hosts of References"

Valves cushioned at all times by air and water

No water hammer or bursting mains

"Made with 'stop starter' attachment for Centrifugal pumps"

For Fire Service



Golden-Anderson Cushioned Electric Water Service Valves

No waste of current as it is only on solenoid a few seconds on either opening or closing of valve.

May be closed and opened from remote points electrically; also hand operated.

Air and water cushioned No metal - to - metal seats. Virtually indestructible.

Sizes to 30 in.

Golden-Anderson Automatic Cushioned Water Regulating Valves

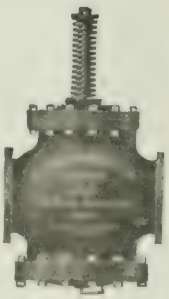
for high or low pressure service are a *necessity* for modern waterworks and railroads.

Positive in action and perfectly cushioned both in opening and closing.

Will maintain a constant pressure regardless of the volume of the initial flow.

When fitted with electrical attachment valve can be instantly opened to full area from any number of distant points insuring full pressure in case of fire etc.

Sizes to 30 in.





Golden-Anderson

Patent Automatic Double Cushioned Check Valve

Sizes to 30 in
Angle or Globe

Golden-Anderson Cushioned Water Relief Valves

Automatically Relieve Excess Pressure—
Prevent Stress, Strain and Bursting Mains

Essentials of a durable economic and reliable relief valve are first-class material and workmanship, correct mechanical construction and operation, with no metal-to-metal seats and perfect air and water cushioning to avoid shock or hammer on the various pressures all of which are contained in the Golden - Anderson Patent Automatic Cushioned Water Relief Valve.

Sizes to 30 in.

Angle and Globe Patterns



Golden-Anderson Valve Specialty Co., 1202 Fulton Bldg., Pittsburgh, Pa.



Coal and Ashes Handling Simplified

YOU can make the work of delivery of coal to your boilers and disposing of the ashes one of the easiest tasks in your power plant, and at the same time reduce the expense to a minimum.

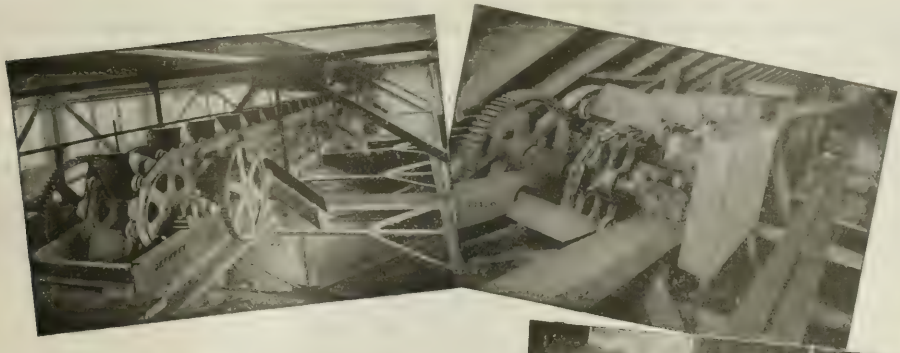
Handle them with Webster Conveyors, and combine the advantages which mechanical handling affords with the further advantages accruing through the general serviceability and low cost of operation and maintenance of Webster equipment.

We make all types of equipment for coal and ashes handling from the highly perfected Perkins Pivoted Bucket Carrier to the simplest flight or belt conveyor. Ask for one of our engineers to look over your present handling methods.

THE WEBSTER MFG. COMPANY

4500-4560 CORTLAND ST., CHICAGO

Factories-Tiffin, O. *and* Chicago – Sales Offices *in* Principal Cities



Some of the Advantages of the Jeffrey Standard Scraper Conveyer

Simplicity—It does not consist of much machinery and does not require much wood or steel for support.

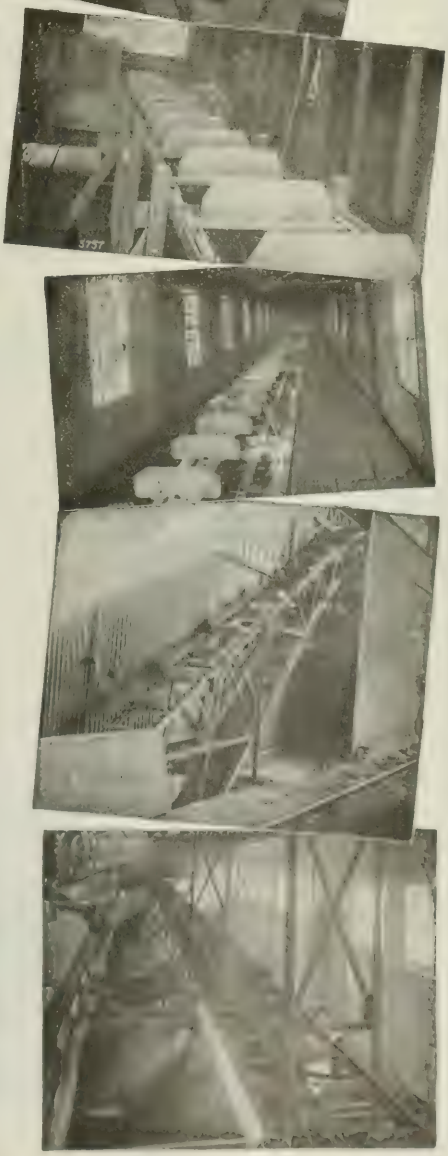
With timber supports it may be quickly installed as a temporary or permanent equipment in power house extensions.

Can be readily inspected. Consists of no complicated parts either in steel chains or its Scrapers.

Wide range of service from one conveyer. May be installed on the horizontal, on an incline, or as a combination in one conveyer of both horizontal and incline or of two inclines, with the joining connection between the horizontal and incline or the two inclines being made in a curve of large radius.

Low upkeep and ease of repair.

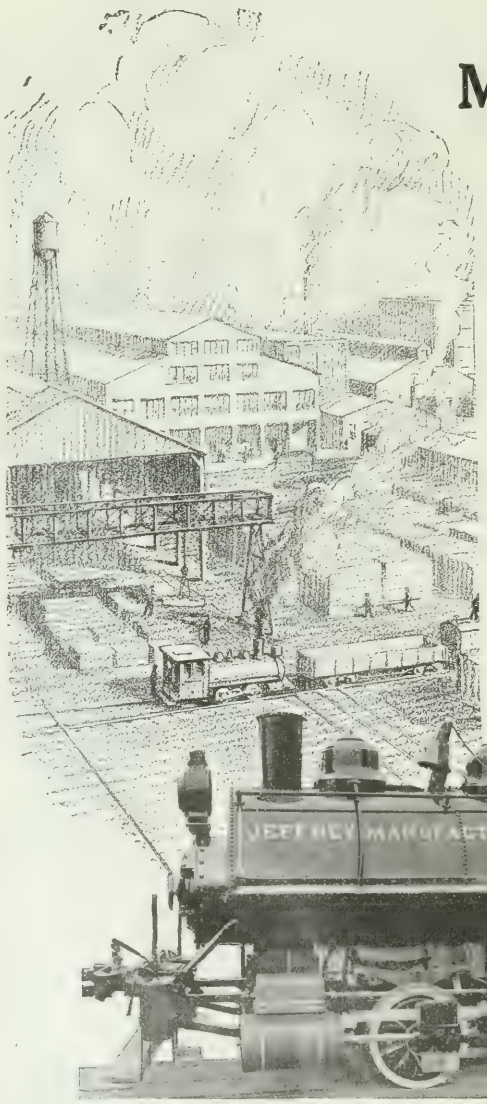
Write for Catalog No. 257-H on Jeffrey Standard Scraper Conveyers.



The Jeffrey Manufacturing Co.
923-99 North Fourth Street, Columbus, Ohio

JEFFREY
MATERIAL HANDLING MACHINERY

VULCAN INDUSTRIAL LOCOMOTIVES and leading Industrial Concerns



Jeffrey Manufacturing Co.

A CONCERN that builds heavy machinery such as the Jeffrey Manufacturing Company surely is fully informed on the essentials of an industrial locomotive. They know the kind of handling and the kind of work such an engine is up against. Naturally they turn to a builder who like themselves, have the experience and a reputation for building machinery that stands up under such conditions.

Men long on locomotive design are ready to serve you in determining your requirements.

VULCAN IRON WORKS

Established 1849

1737 Main Street Wilkes-Barre, Pa.



The Volume Factor

The LINDE business, which is the largest of its kind in the world, has been built upon the policy of sharing with its patrons the fruits of their patronage.

Every contract placed with LINDE helps to secure to oxygen users the country over the benefits in price and service accruing from greater volume.

The eighty LINDE Plants and Warehouses now in operation are convincing proof of the soundness of this principle.

A LINDE contract is an insurance policy—it insures a perfect product and a perfect service at an exceptionally favorable price.

No oxygen user, large or small, should close an arrangement for oxygen supply without first securing 1922 prices from the nearest LINDE District Sales Office.

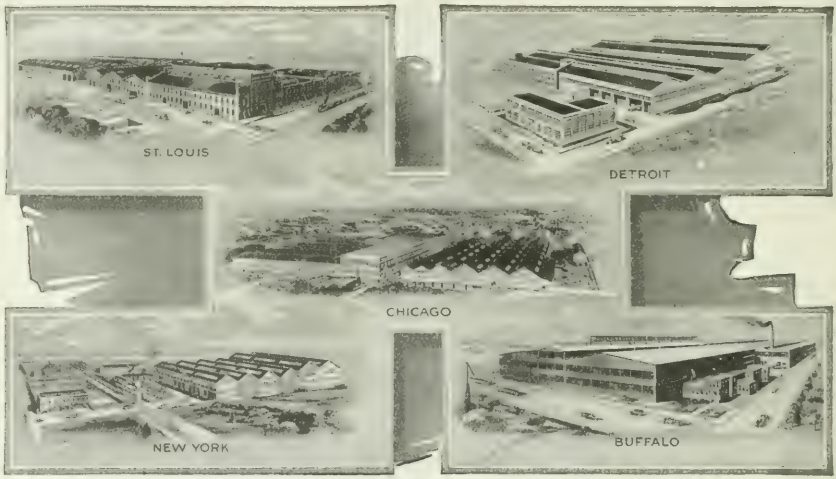
[Nation-wide chain of 30 plants and 50 warehouses]

THE LINDE AIR PRODUCTS COMPANY

Carbide and Carbon Building, 30 East 42nd Street, New York

District Sales Offices

THE LARGEST PRODUCER OF OXYGEN IN THE WORLD



Your Source for Steel

FIVE great plants are shipping steel every day throughout the United States and Canada. In most cases the steel is loaded and on its way within a few hours after instructions are received.

On direct wires comes an order from Nogales, Arizona, for tank plates to go to a mining camp in Mexico. A manufacturer in San Diego needs some cold rolled bars of a certain size. A contractor in Kokomo wires for some reinforcing bars needed to complete a penalty contract. From Toronto comes a call for a carload of flats. These from the countless orders of a single day.

No matter where you are located, Ryerson Steel-Service can furnish the steel you need at once. Call on the plant nearest you.

Write for Ryerson Journal and Stock List—the key to Immediate Steel.

ESTABLISHED 1842 INCORPORATED 1888

JOSEPH T. RYERSON & SON

CHICAGO ST. LOUIS DETROIT BUFFALO NEW YORK

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A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, President

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren, Editor

Volume 88 — NEW YORK, JUNE 29, 1922 — Number 26

Mixing Pleasure and Business

QUARTERLY meetings of the American Society of Civil Engineers, in different sections of the country, were prescribed by the new constitution both to distribute geographically the public activities of the society and to provide opportunity for more general technical discussion than the old monthly meetings at New York permitted. The first quarterly meeting at Dayton last April was an unquestioned success. Attendance was high and interest intense. The meeting last week at Portsmouth while planned in part to resemble the Dayton meeting turned out to be little more than the usual summer convention, that is a pleasant rendezvous for a comparatively small number of members sufficiently provided with leisure and funds to take a few days vacation in June. That an effort was made to furnish forth a technical menu is indicated by the number and variety of the technical papers on the program. But unfortunately the program suffered from these two virtues. Conditions of weather and architecture made the meeting hall a most unpleasant place and the papers themselves, all excellent presentations, were so many and of so great a variety as to weary the hearer. The Dayton meeting was of professional interest alone; the summer convention seeks to combine pleasure and technical discussion. It may be that it can be done, but those trying it in the future should consider the great advantage of concentrating the technical program on a single and live subject.

To the New Secretary

IF THE new secretary of the American Society of Civil Engineers has at his command a fairy godmother ready to bestow the traditional gift he will do well to ask for temporary deafness. The amenities of his new position require that he listen courteously and attentively to the hundreds of his employers who will claim his private ear. From Bingville and from New York, out of the East and out of the West, progressive and conservative, reactionary and anarchist will they come to him, to tell him just what is the matter with the society and more particularly what is the matter with those who differ from them on society practices and policies. For a few months Professor Dunlap will be the most talked-to man in the profession. Judicious deafness will be his only relief. Thus protected he may proceed to study the complications of his new office and to learn his new job unhampered by the few who have come to believe that their own ideas and private controversies are of more importance than, or at least are necessary to, the good of the society.

Cast-Iron Water Pipe Problems

THE outlook for a joint revised standard specification for cast-iron pipe, to be substituted by both the American and the New England Water Works Association for their respective specifications, is encouraging. The great need seems to be research work on a chemical specification for the metal, on the proper relation between bending moment and flexure in test bars, and on ensuring a better pipe coating than is now generally provided. This is attested by the paper on "Tars for Pipe Coating," abstracted in our issue of June 1, p. 913, and by the paper and committee report on cast-iron pipe abstracted elsewhere in this issue. Of great interest and importance to the water-works engineer and superintendent is the paper, also abstracted in this issue, by Prof. Gillespie, on centrifugally cast-iron pipe. The evident feeling of members of the pipe specification committees of both the American and New England Associations, and of other engineers and water-works men as well, is that the centrifugal process may go far towards solving the cast-iron pipe problem. The question of a better or more uniformly reliable coating will remain, whether sand- or centrifugally-cast pipe be the leading material ten or twenty years hence. The foundry men are making a further contribution of funds for research on the chemical and physical sides of cast-iron pipe and are working out the possibilities of the promising centrifugal process. Who will provide funds for the much needed investigation of pipe coating?

Rainfall vs. Judgment

OBSERVED fact, scientific deduction, and practical judgment come together in quite remarkable manner in the problem of bridges and floods that is discussed by Ivan E. Houk in this issue. Many years of observation since the deluge against which Noah provided have not removed the subject of heavy rainfalls from the realm of the unknown and unexplored, and the engineer will probably always be in the position of taking chances when he undertakes to proportion a bridge waterway. Mr. Houk expresses this clearly, by indicating that it is hardly possible to make every bridge opening large enough to carry the most intense flood flows that have occurred anywhere. Scientific deduction warrants the transfer of experience, in a degree, but practical judgment usually says that it does not pay to go to an extreme in safety provisions. The record of every spring, particularly of a wet spring such as this year's, brings an unpleasant surprise in the number of bridges washed out. Nevertheless the value of these structures is so minute a part of our total bridge investment that it is a question of engineering calculation, or rather trained judgment, whether the loss is large enough to warrant the great extra expenditure that would be needed if all bridges were built to survive the maximum possible flood. However, as has been urged more than once in these columns, there is a value to bridge permanence that is not measured in terms of direct physical losses. In other words, it pays to build bridges much more resistant than a mere estimate of the chances of washout would

indicate. If we must take chances in pitting economy against rainfall possibilities, it is better to favor the side of safety, which is somewhat different from the general trend of past practice.

Secure Foundations

TWO kinds of bridge failures by washout come to notice in the continuous record of such failures: those caused by exceptional floods, and those which occur during ordinary high water. The latter are considered by the public to be due to engineering error, and justly so, since an adequate foundation would have prevented them; and, in fact, one or two recent failures of this type reflect quite obviously on the caliber of the engineering applied to the structures in question. Washouts which are caused by exceptional floods, on the other hand, are usually looked upon as unpreventable, as cases in which man has lost in playing against nature's hidden game. But from a broader viewpoint even these washouts must be charged against foundations rather than against floods: they would not have occurred if thoroughly resistant foundations had been provided. If, then, the bridge engineer will fix his aim on making his foundations secure against scour, the matter of calculating flood volume and waterway area reduces to secondary importance, and the hydraulic phenomena merely determine the backwater but do not greatly affect the bridge. We believe that all bridge planning should be carried out on this basis. Waterway areas would still be calculated, but not primarily for the purpose of reducing the flow velocity below the scour limit. The flood problem in bridge design would be virtually limited to that kind of flood failure—a kind unfortunately too common—in which the partly submerged superstructure is torn away from its support by reason of deficient anchorage. Model bridge specifications still ignore the necessity of providing strong anchorage of bridge superstructures to piers, but the importance of such anchorage is a timely matter for consideration.

Borings as an Insurance Measure

AS A MEASURE of insurance against construction delays, improper design, and, in extreme cases, failure of the finished structure, sub-surface exploration by drilling has not received the wide acceptance by engineers which it deserves. This applies particularly to large-scale operations where millions are at stake. In planning the big dams and the deep rock tunnels of New York's Catskill aqueduct, the necessity for extensive preliminary borings became established as a recognized policy of the engineering department and the success of the finished project attests to the wisdom of the course followed. It is not enough, however, merely to make borings. There must be an intelligent interpretation of their results so that the information gained may be put to practical use. James F. Sanborn, in his article on p. 1024 of the last issue, draws upon a wide experience on the Catskill work and elsewhere in presenting data on boring methods and machines and an analysis of the information they disclose. There are many engineers who fail to realize that earth and rock samples are not the only indications of sub-surface conditions which borings yield. An important and oft-neglected factor is the matter of water and its relation to the porosity of the material penetrated by the drill. There is a growing tendency to attach far more importance than formerly to the proper collection and permanent storage of boring records. Boring records should be permanently preserved and made available to others in the same way that rainfall and run-off data are now collected and recorded.

Drawbridge Wrecks and Steamers

UNDER modern transportation conditions the blocking of a main freight highway, as occurred last week at the eastern end of the Lincoln Highway through the destruction of a drawbridge by a steamer, is probably as far-reaching in its effects as the interruption of a main railway line. We say probably, because study of road traffic has not yet gone far enough to warrant a more positive statement; better information as to this phase of the Hackensack River bridge wreck ought to develop in the course of the next few weeks. Even now, however, the gravity of the accident is sufficiently apparent that the question will be asked whether bridge engineers have done all they can toward protecting drawbridges from ships. Fortunately the facts of the case furnish a satisfactory answer to two parts of this question: first, whether engineers build their bridges sufficiently robust, and second, whether the swingbridge is inherently vulnerable and ought to be replaced by another type.

On the first point, the Hackensack River bridge was in general as robust in its detail construction as a bridge can reasonably be made; it lacked the thin, relatively fragile bar or latticed members that were responsible for the extent of the damage in some prior wrecks of the same kind. Even a much heavier and stockier bridge would hardly have fared much better. There is nothing in the present accident, therefore, to indict modern swingbridge practice.

On the other point the answer is supplied by comparison with another drawbridge collision that occurred quite recently within half a dozen miles of the Hackensack crossing. The Newark Bay bascule draw of the Central R.R. of New Jersey was struck by a ship, which rammed the side of the track span or supporting girder on which the bascule rested, bending it so badly as to necessitate replacement. Less damage was done than in last week's collision, but this is primarily a matter of the force of the blow struck by the vessel. The inherent liability to injury by collision seems to be about the same for either type.

Bridge engineering practice, then, is in no way shown at fault by the Hackensack River wreck. It is hardly conceivable that every bridge can be built so as to resist the impact from a moving mass of several thousand tons weight, and there are sure to be other drawbridge wrecks so long as ships run into bridges. For this reason thought should be given to protecting drawbridges more effectively than is now done, by placing adequate clusters of guard piling at the ends of the pier fenders, which ordinarily are quite flimsy. Dock and ferry practice has developed methods which prove their efficiency daily, and which could be applied at moderate cost to protecting a drawbridge. This, however, is as far as the constructing engineer can go toward eliminating these unnecessary bridge accidents. The safety of drawbridges will always in large measure rest on the care of shipmasters, and justice requires that they should be held to a strict accounting for their responsibility.

The Pittsburg Road Tests

THE official report on the Pittsburg (Cal.) road tests cannot be expected until after the field work has been completed, which means several months at least. Meantime highway engineers want to know something of the progress and trend of observations there. With the co-operation of engineers in charge and after a study of the work at Pittsburg, a member of *Engineering News-Record's* staff prepared the article appearing elsewhere in this issue. For the most part it is a bare statement of facts and preliminary findings which do not warrant definite conclusions. There are, however, certain indications from the test which should be worth while to record, as follows:

By thoroughly pulverizing and compacting the subgrade, in layers, adobe soil can be made practically impervious to moisture, and thus treated it is a fairly good material on which to lay pavement. If swelling in adobe soil can thus be reduced it will be good practice in constructing highways through adobe cuts to carry the excavation to an extra depth of 18 in. or 2 ft. and then to treat the material the same as in fills. This process is suggested because damage to pavement results from the action of adobe in both cuts and fills.

The continuous traffic tests have given another opportunity to observe the durability of concrete. Even after carrying more than 3,000,000 tons in heavy trucks there was practically no *wear* of the pavement surface; paint marks before traffic began were plainly visible.

Where there was anything in the path of continuous traffic to cause repeated impact, such as uneven joints, serious and extensive damage resulted. The fact that nearly all the disintegration on the test road began at construction joints or at transverse cracks emphasizes the need of designs that will strengthen these most vulnerable points, reduce impact to a minimum. In the repair of the test road various types of special joints were put in where new concrete was poured and comparative results on these joints will be interesting, but it should be remembered that at best these repairs are patches and that an absolute test can be made only where such joints are put in at the same time and under the same conditions as the pavement itself.

Not only the construction joints, but also the edges of the pavement, appear to be vulnerable and the frequency with which cracks and breaks start at the edges warrants special attention. Sections with thickened edges which would have inherently the best protection against failure of this sort have made a very favorable showing as to relative strength and durability for a given thickness of slab.

Motor-truck traffic was applied to the Pittsburg test road with such intensity that in the 51-day operating interval between Nov. 9, 1921, and Jan. 28, 1922, the total duty imposed on the pavement was equivalent to the truck duty of an average California road for a period of 25 to 40 years. That disintegration of failed sections was correspondingly accelerated is not surprising, particularly since proper repairs were almost impossible under the conditions of the test.

On the whole the Pittsburg tests are providing data of many kinds that will have an important bearing on the design of concrete roads. While too much credit cannot be given the Columbia Steel Co. for its initiative in undertaking the test, the scope and importance of the research have passed beyond that which any company alone could handle successfully. It is fitting that the U. S. Bureau of Public Roads and the California Highway Commission should share the direction and financing of further work and it is good news that they will continue with another series of experiments at the same site when the present tests are finished.

Construction's Step Forward

IF THE promise of the organizing meeting be fulfilled the construction industry took a great step forward last week when the American Construction Council was organized in Washington. There have been attempts before to bring a number of branches of the construction industry together, but never to co-ordinate the efforts of all of the elements. The response was remarkable. All elements were represented at Washington and all voiced appreciation of the magnitude of the opportunity and faith in the ability of the leaders to accomplish the desired results.

Regarding the prime object of the council little needs be said. It is so important that its necessity is granted by all. The industry must establish itself in the confidence of the public. It may work for its own ends but those ends must never run counter to the public's interest. In other words, it must serve itself by constantly rendering better service to the people at large.

There are other ends in view that are not so apparent. The new council should make the industry articulate. No one knows today what the construction industry really is. The statistics have never been gathered. All elements have not been sought out. These things the new council will do. Before the industry can properly interpret itself to the bankers, to the transportation interests, to other industries, to the public, it must interpret itself to itself. It must know its own magnitude and its own importance before it can have an adequate conception of its power, of its influence on the community, and of its responsibilities.

One of the difficulties which will be met is that the council is confronted with a well matured industry. It must therefore combat self-satisfaction and conservatism. The electrical industry, the automobile industry, and the motion picture industry are examples of what can be accomplished with industrial youth. Youth always means enthusiasm. In construction we have age—almost old age. It will be much harder to generate enthusiasm, to secure the virility and freshness of viewpoint which an industry awakening to new consciousness of responsibility should have.

But though it needs enthusiasm and a new viewpoint, it must, because it is dealing with long entrenched practices, with conservative policies and conservative men, carefully avoid, in its early days, controversial subjects. There are many rocks on which it could instantly go to pieces. If it will choose only those subjects on which it is apparent that agreement can be reached, then, when all of the elements have learned to work together and to have confidence in each other, it will be soon enough to take up those difficult problems that right now would raise destructive controversy.

Judging by the men who have participated in the organizing work and who were at Washington, high purpose will be combined with virility and with a studious avoidance of needless and harmful controversy. The council is well launched. There is a big goal ahead. There is promise of success.

Results of Heavy Traffic on Pittsburg Test Road

Trucks Travel 96,000 Miles—Wave Motion in Concrete Slab Plotted—Moisture Percolates Slowly in Rolled Adobe Subgrade—Tests of Wider Scope to Follow

THE operation of an average of 30 fully loaded 3½- and 5-ton trucks over the concrete test road at Pittsburg, Cal., described in *Engineering News-Record*, Dec. 29, 1921, p. 1049, was continued until Jan. 28, 1922, at which time 4 of the 13 sections were rated as failures. At that time the subgrade had not yet become saturated and because it was apparent that an excessive amount of traffic would be required to break down the concrete on dry adobe traffic was temporarily suspended at the suggestion of the regional director of the U. S. Bureau of Public Roads.

In the interim those portions of the road on which the paving was no longer serviceable were replaced with new concrete. The results of the test so far have proved to be of such value that the test will be continued under the joint supervision of the U. S. Bureau of Public Roads, the California State Highway Commission and the Columbia Steel Co. When the tests are completed or when the destruction of the pavement is carried as far as may be considered worth while, it is probable that an entirely new and more comprehensive series of experiments will be undertaken at the same site and under the same joint supervision.

Results.—While the replacement of destroyed portions of the pavement was under way measurements taken during traffic were plotted and studied. Some of the results noted by those in charge of the tests are as follows:

(1) Thorough rolling of the sprinkled adobe subgrade, layer by layer, compacted it to such an extent that, after being flooded for three months, horizontal percolation was less than 1 ft. and vertical percolation less than 2 ft. (2) Edges and corners of the slab, particularly at construction joints and transverse cracks where there may be some deflection under load, are the weakest portions and ordinarily will be the first to fail under heavy loads or adverse subgrade conditions. (3) Because of the excessive deflection and corresponding destruction effect caused by impact a greater percentage of the time and money spent on pavements might well be devoted to getting a perfectly smooth surface, particularly at construction joints. (4) A truck moving over a pavement produces wave motion tending to lift the slab just in front of the deflection caused by the front wheels. (5) A 6-in. slab, after deflecting under a loaded 5-ton truck, does not recover its former position for more than 2 hr.; after long-continued traffic this rate of return is somewhat slower, due, perhaps, to fatigue of materials. (6) Concrete surfaces will carry about 3,500,000 tons of traffic on solid-rubber tires without abrasion; the marks of the finishing tool on the concrete surface still are apparent and even the paint marks with which the pavement was laid off in squares are plainly visible.

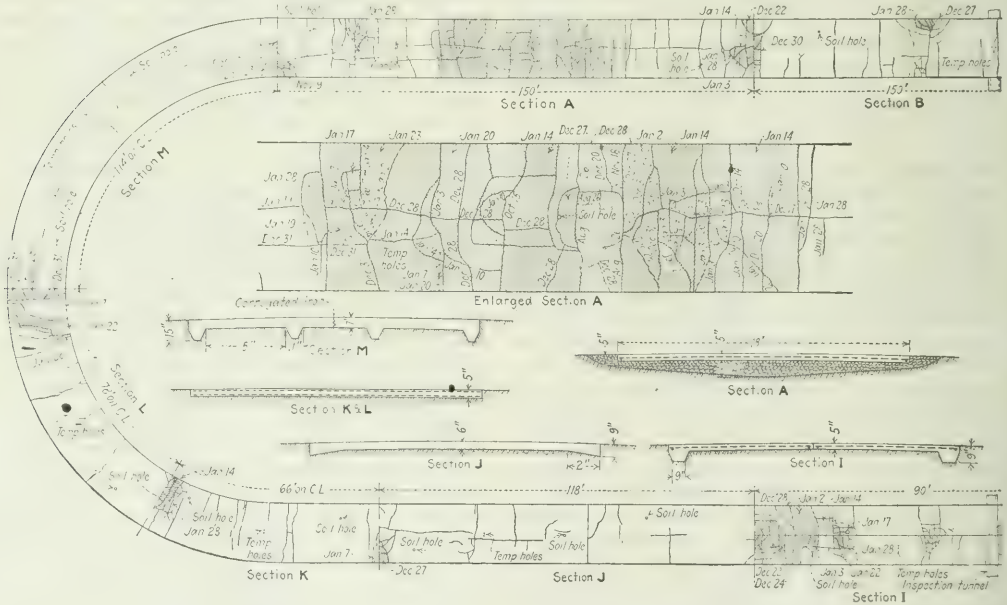


FIG. 1. LOCATION AND EXTENT OF CRACKS IN EACH
Shaded areas show concrete that was actually broken out by traffic. There is no difference between the cross-

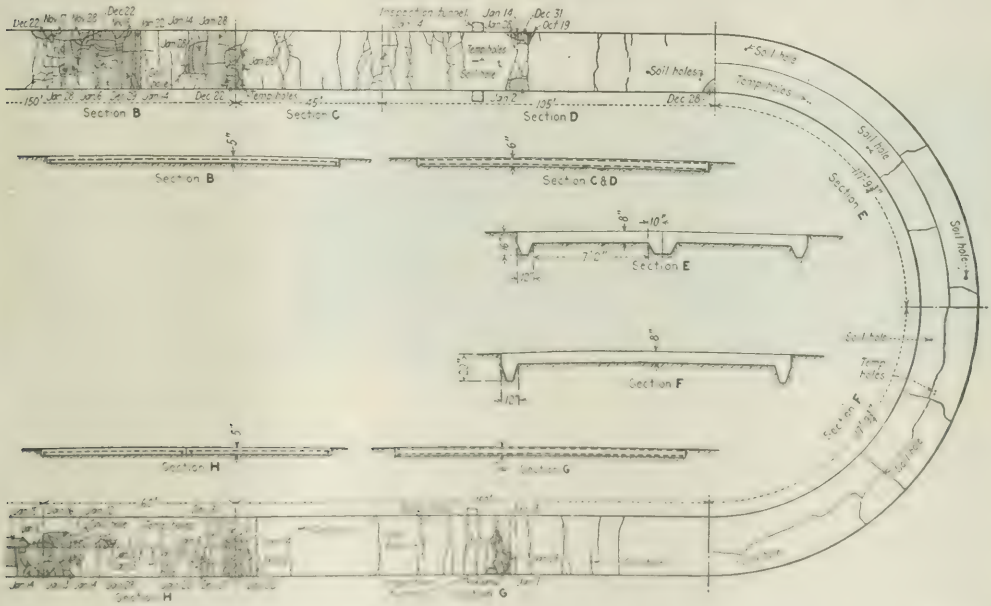
The continuous traffic of loaded trucks was started on the pavement Nov. 9, 1921. From then until Nov. 21, when the first rain came, the edges of all slabs were without support. In most of the slabs the unsupported width at each edge was about 2 ft. Subsequent to Nov. 21 intermittent rains caused a swelling of the subgrade under the edges of the pavement and the slab deflections under traffic were decreased.

Under this condition, however, the edges of the slab

were on wet subgrade while the center was comparatively dry, as was shown by subgrade samples taken through test holes in the slab. In order to saturate the subgrade and thereby increase the pavement deflections the side ditches were flooded Dec. 21, there being no change meantime in the traffic.

With water in the side ditches standing only a few inches below pavement level and with a rainfall during the traffic totaling 7½ in., traffic was continued for a month. At the end of this period tests showed no considerable saturation of the subgrade under the slabs except at the edges. When traffic was stopped Jan. 28, to be resumed when the subgrade became thoroughly saturated, a total of 3,688,000 tons had passed over the pavement. The weights of the trucks varied from 14,500 to 27,400 lb. gross and the total distance traveled on the pavement by trucks of all weights was 96,000 miles.

Slow Percolation Into Subgrade.—Subgrade samples



SECTION AFTER TRAFFIC TOTALLED [illegible] TONS
hatched and stippled areas, these being used to [illegible]
date sections which failed at different [illegible]

are taken through test holes in the slabs by means of a 2-in. auger, 56 in. long. Rain water, of course, has had access to the subgrade where cracks and breaks have occurred, but even at these points there has been no penetration of moisture into the subgrade exceeding 2 ft. in depth, nor has the moisture from the side ditches penetrated the 4 ft. of horizontal distance from the edge of the slab to the test hole. Analyses of samples taken from the test holes—and this condition holds for the entire length of the roadway—showed no increased moisture content under central portions of the slabs after water had been standing in the side ditches for three months.

The fact that the adobe subgrade is almost impervious, or at least that the penetration of moisture is exceedingly slow, was a surprise to those in charge of the work and is regarded as an important discovery. If further moisture tests show a continuation of the very slow rate of percolation it is believed that a valuable means will have been developed for decreasing the destructive effect on pavement of expansion and contraction in adobe subgrades. Special importance, therefore, attaches to the method of preparing the subgrade, which was as follows:

The concrete pavement was laid for its entire length on a fill about 3 ft. high, the fill material being the black adobe common to the bottomland of California valleys and noted for its excessive expansion and contraction with changes in moisture content. The fill was placed in 6-in. layers, each layer being 30 ft. wide, thus extending 6 ft. beyond the edge of the slab on each side. Each layer was lightly sprinkled and then rolled with a 14-ton roller which gave a compression of 450 lb. per inch of tire. This pulverized all clods and compacted the surface, which was finally scarified slightly so as to give a surface that would readily blend with the next 6-in. layer. This method of compacting the subgrade is estimated to add less than $1,000 per mile to the cost of preparing the roadbed.

Truck Causes Deflection Wave.—A series of static deflection readings was taken with a truck approaching and passing over one of the observation tunnels. These readings were then plotted as contours by connecting points of equal deflection with a smooth curve. Without going into the question of why the diagrams differ it may be noted that they have one common characteristic in that they show a wave effect ahead of and behind the truck, with the slab returning to its normal position more slowly than it was deflected. The slow return to normal position was made the subject of a separate study.

The difference between the amount of shear carried across construction joints at the warmest and the coldest times of day was made the subject of a series of

tests on eight construction joints at which the pavement deflections were measured on the surface with micrometer gages reading to thousandths of an inch. For this work a truck was brought up with its front wheels very close to the construction joint and its weight entirely on one slab, near the edge. Deflections were measured at 6:15 a.m. and 2:30 p.m., these hours being taken to represent the daily maximum and minimum temperatures. Measurements were made at the corner of each slab, *i.e.*, at the edge of the pavement and near the end of the construction joint. The truck used had a gross weight of 14,560 lb. with 5,360 lb. on the front wheels and 9,200 lb. on the rear wheels.

During construction of the pavement a ½-in. redwood board was put in at each construction joint to separate abutting slabs, no tar or other filler being used. These boards were loose when the morning readings were taken. The average morning deflections were 0.022 in. on the corner of the slab under the truck and 0.001 in. for the corner of the adjoining slab. In the afternoon measurements the slabs had expanded enough to develop considerable pressure on the board and due to shear being carried through the joint the deflection of both slabs was about the same. The average deflection for all of the joints tested in the afternoon was 0.005 in. for the corner on which the truck stood and 0.004 in. for the adjoining corner.

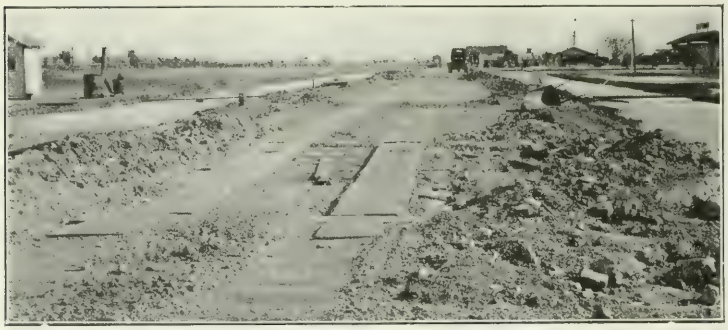


FIG. 2. REPAIR OF BREAK 90 FT. LONG IN SECTION A
In foreground are transverse 12 x 12-in. timbers. Beyond them is the 3 x 12-in. grillage-type of patch.

Maintenance and Repairs.—During continuous traffic tests the trucks were stopped at 10 a.m. and 3 p.m. for 15-min. intervals and at these times, as well as at noon and at night, every effort was made to protect the concrete, where breaks were developing, with hot asphalt and screenings, precast concrete slabs, oil macadam on brick and plank base, etc.

Except for triangular breaks at construction joints and cracks that did not interfere with traffic, there were no serious breaks that required patching until about Dec. 20. On Dec. 27 breaks in several sections were so bad that four timber grillages were put in. It was not thought advisable to make these wide enough for two lines of traffic and hence after this date only a single line of trucks could operate.

Where large breaks occurred several means of making temporary repairs were tried, but the most satisfactory was found to be 12 x 12-in. transverse timbers extending over an 8-ft. width of the roadway. The section to be patched was first excavated to a depth such that the upper surface of the 12 x 12-in. timbers would be about 1 in. above the adjoining pavement. This excess height was found to be about right as after a very little traffic the timbers were forced down to the same level as the adjoining concrete surfaces. Steel plates were placed on the surface of the concrete at both ends of such patches to bridge the joints and reduce impact.



FIG. 3. TEST ROAD WITH SIDE DITCHES FLOODED
By thoroughly compacting fill on which pavement was laid, water standing in side ditches three months did not saturate subgrade.

In patches made as above described no longitudinal timbers were laid. In another type of patch (Fig. 2), which was cheaper but less satisfactory, this method was used: After removing the broken concrete and excavating the subgrade to just the right depth, 3 x 12-in. stringers were laid, on these 3 x 12-in. plank were placed transversely and finally, 3 x 12-in. rails or surfacing was laid longitudinal with the roadway and at the same level as the adjoining pavement surfaces. Three-eighth-inch steel plates were also used with this 3 x 12-in. patch, held in place by spikes driven through holes in the plate and into the timber. In the absence of any basis for making an exact comparison of conditions in the several slabs at the time traffic was stopped a plan or map was used to record the cracks in the various sections. In the drawing reproduced herewith (Fig. 1), shading represents area in which the pavement was so badly broken up that it had to be patched in some way in order that traffic might continue.

The four sections which had failed to the extent that they were rated as being incapable of carrying more traffic were *A*, *B*, *H* and *I*. Considerable portions of



FIG. 4. REPAIR OF BREAK AT CONSTRUCTION JOINT
Between Sections G and H; 12 x 12-in. timbers with crushed rock at edges to decrease impact.

the concrete in these sections were replaced with unreinforced 6-in. concrete patches. Some portions of these sections, however, were still sound and these are being used in the continuation of the tests.

In pouring new concrete in the several repaired sections means of strengthening the construction joints—the weakest points—are being applied. Sketches showing several of the special joints which are being tried out appear in the article following this one.

Another feature of the reconstructed road will be the measurement of pressure intensities between the slab and the subgrade at various points. This is expected to show where there is arch action in the slab and to what degree temperature changes affect pressures on the subgrade. For these measurements twelve Gold-

TABLE OF ESTIMATED COSTS PER MILE OF THE 13 PAVEMENT SECTIONS USED IN THE PITTSBURG TEST ROAD

Sections	Thickness (Inches)	Concrete Cu.Yd. Per Mile	Concrete Cost Per Cu.Yd.	Concrete Cost Per Mile	Tons Steel Per Mile	Steel Cost Per Mile	Rock Ballast Per Mile	Total Cost Per Mile	Unity Comparison
"A"	5	1,467	$13 40	$19,658	20	$1,400	$5,475	$26,533	1 26
"B"	5	1,467	13. 40	19,658	20	1.400		21,058	1 00
"C"	6	1,760	13. 05	22,968	55	3,850	.....	26,818	1 27
"D"	6	1,760	13 05	22,968	55	3,850	.....	26,818	1 27
"E"	8	2,695	12. 35	33,283		.....	.....	33,283	1 58
"F"	8	2,608	12 35	32,209		.....	.....	32,209	1 52
"G"	6	1,760	13. 05	22,968	69	4,830	.....	27,798	1 32
"H"	5	1,467	13. 40	19,658	24	1,680	.....	21,338	1 01
"I"	5	1,695	13. 05	22,120	24	1,680	.....	23,800	1 13
"J"	6 &9	1,858	13. 05	24,247				24,247	1 15
"K"	5	1,467	13 40	19,658	69	4,830	.....	24,488	1 16
"L"	5	1,467	13. 40	19,658	55	3,850	.....	23,508	1 11
"M"	7	2,401	12. 70	30,493		.....	.....	30,493	1 44

Total cost is given for pavement only, no subgrade work included. All sections 18 ft. wide. Cost of reinforcing steel was $70.00 per ton in place; cement 2 75 per bbl., delivered; common labor $4 per 8 hr.

Unit costs of plain concrete were figured as follows:

From 1,001 cu.yd. to 1,500 cu.yd. per mile @ $13 40 per cu.yd.
From 1,501 cu.yd. to 2,000 cu.yd. per mile @ $13 05 per cu.yd.
From 2,001 cu.yd. to 2,500 cu.yd. per mile @ $12 70 per cu.yd.
From 2,501 cu.yd. to 3,000 cu.yd. per mile @ $12 35 per cu.yd.

beck soil cells are to be used, nine being put over a tunnel and three at slab corners.

The interests of the Bureau of Public Roads in the tests are represented by Dr. L. I. Hewes, deputy chief engineer, who is stationed at San Francisco. For the California Highway Commission, Austin B. Fletcher, chief engineer, is giving personal attention to the tests. Lloyd Aldrich and John B. Leonard, consulting engineers of San Francisco, have charge of the engineering staff. Harold Hamill is in charge of field observations.

All Old Dams in New Jersey To Be Inspected

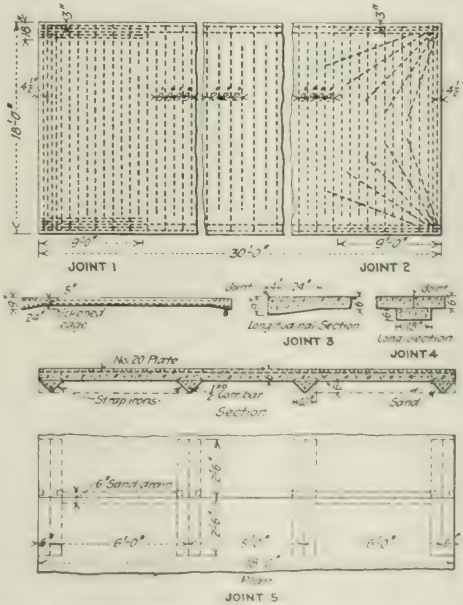
An investigation of some 500 old dams in the state of New Jersey is to be made by engineers of the State Department of Conservation and Development. The first work to be done will be on dams which are thought by the county boards of freeholders to be most dangerous. It is expected that it will take two or three years to complete the entire survey. The department has power to order owners of dams to repair them if it things that life and property below the structures are imperiled. The department was given supervision over the erection and maintenance of dams and reservoirs within the state in 1912, but because of lack of funds it has heretofore confined its supervision to new structures. Plans for all proposed dams which will raise the water level more than 5 ft. or which have a drainage area of more than one square mile must be approved by the department.

Experiments With the Construction Joints in Concrete Pavement

Eight Special Joints in Pittsburg (Cal.) Test Road Show Means of Strengthening Slab Where Breaks Usually Start

BECAUSE of the high percentage of breaks that started at construction joints in the Pittsburg (Cal.) test road special joints designed to strengthen the slab at these points are being used in the new concrete poured to replace portions of the pavement that had been broken down. Eight types of special joints were used as shown in the accompanying illustrations.

Joints 1 and 2 involve no change in the cross-section of the slab, which is 5 in. thick in the center and has



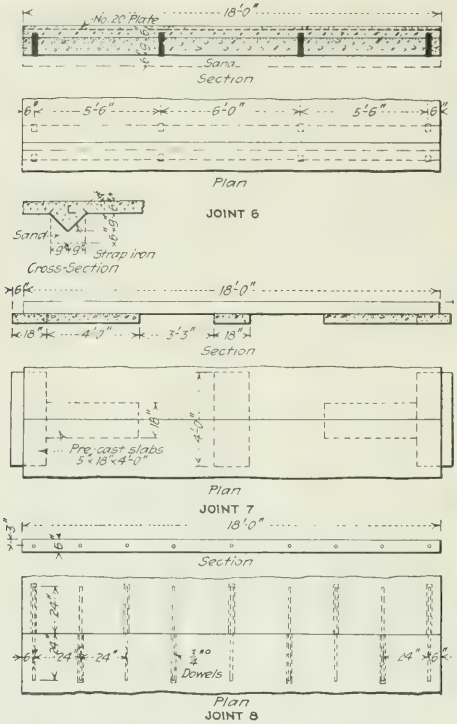
TYPES OF EXPERIMENTAL JOINT FOR CONCRETE SLABS USED IN PITTSBURG TEST ROAD

1 and 2, show reinforcing in opposite ends of same slab; 3, thickened end of slab; no steel used; 4, foundation for abutting slab ends; 5, V-shaped concrete stringers under joint.

thickened edges. All reinforcing in this section is ⅜-in. round bars. The extra bars which are placed transversely and diagonally at the corners have 4-in. hooks on each end, while the extra longitudinal bars have 4-in. hooks on one end. All are placed 1 in. or 1½ in. from the top of the slab. The extra transverse bars at the joints bring the spacing down to 4½ in. on centers. The extra longitudinal bars are placed so that the spacing becomes 3 in. on centers. The steel used is a special silicon steel of high tensile strength.

Joint 3 involves no reinforcing steel and is simply a thickening of the end of the slab. The dimensions of the thickened portion are shown in the sketch. This very much resembles the thickened edge used in some slab designs.

Joint 4 is a transverse beam of the same thickness



TYPES OF EXPERIMENTAL JOINT

6, V-shaped beam transversely under joint; 7, precast slabs laid in subgrade under joint; 8, dowels to carry shear from slab to slab.

as the slab and is laid under the joint to give equal support to both the abutting ends.

Joint 5 consists of longitudinal V-shaped beams or stringers of concrete with 1½ x ¼-in. iron straps projecting up into one of the slabs so as to bond the beam to that slab. Tar paper is laid on the other half of the beam to prevent bonding to the adjacent slab. Sand drains are provided to take away any water that might collect under the central stringer. A 20-gage metal plate bent into the shape of an angle iron is set on the joint transverse to the roadway. This is painted with oil before being laid to prevent bonding to the concrete and is intended to form a concealed joint that will break evenly across the pavement.

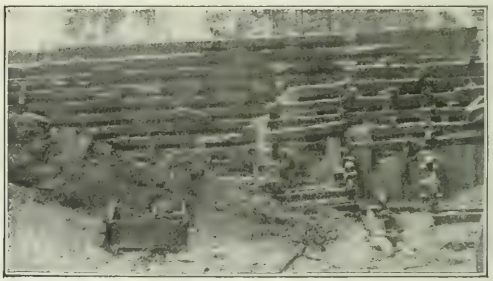
Joint 6 consists of a transverse V-shaped concrete beam placed under the joint and attached to the concrete on either side by means of 1½ x 1½-in. strap irons similar to those used in joint No. 5. This joint has an angle iron along the line of the joint similar to that used in joint No. 5. It is also drained by a sand-filled ditch excavated below the beam.

Joint 7 consists of precast slabs laid in the subgrade, as shown in the sketch, before the concrete was poured. These were standard size slabs already on hand which were formerly used in patching. In placing these slabs it was suggested that because of the labor cost in handling the unwieldy pieces it would ordinarily be cheaper to pour the concrete in place.

Joint 8 consists of steel rods serving as dowels to carry shear from the end of one slab into the one abutting, without bonding the two together. To prevent bond each dowel was wrapped with tarred paper for half its length.

Cofferdam Sheeting Stands After Cribwork Is Removed

WATER 22 ft. deep at the deepest place stands behind the barrier of vertical sheeting and waling timbers shown by the accompanying illustration. Originally this sheeting and waling formed the face of a stone-filled, timber-crib cofferdam. When the construction for which the cofferdam was provided had been completed a derrick was used to take out the stone and to tear out the cribwork. The dismantling was done without attempt to preserve the sheeting as the only object was to let water quickly into the space



SHEETING OF CRIB COFFERDAM HOLDS 22 FT. OF WATER

since it was a needed extension of the fore-bay of a water-power plant. But the sheeting and waling remained standing and J. T. McLellan, construction manager says: "We should be glad to have explanations from engineers who are interested in hydraulics."

The cofferdam was required in an operation to extend the municipal power plant on the Winnipeg River at Kenora, Ontario. It was about 100 ft. long, and sustained a head of water of 22 ft. at its deepest section. At this point the crib was made 30 ft. wide. It was built of 6 x 8-in. timbers drift-pinned together, filled with rock, sheathed with 3-in. T. & G. plank and toe-filled on the water side. The design was based on the assumption that at the deep part it would require 900 cu.yd. of rock to resist the pressure. The contractors were the Backus-Brooks Co., International Falls, Minn., with J. T. McLellan as construction manager.

Highway System to Comprise 180,000 Miles

It is estimated by the U. S. Bureau of Public Roads that the 7-per cent system of interstate and intercounty roads provided for by the Federal Highway Act will comprise 180,000 miles. Proposed systems have been received by the bureau from all but eight states. They are plotted on a large map of the United States and carefully examined as to co-ordination with the roads of adjacent states and service to all sections of the country. Where co-ordination is not satisfactory conferences are held with all interested state highway officials and routes adjusted.

Hydraulic Design of Bridge Waterways

Each Opening Requires Individual Design—Formulas Are Makeshifts—Cloudburst Data—Applying 1913 Flood and Pueblo Flood Figures—Scour Velocities—Other Considerations

By Ivan E. Houk
City Engineer, Dayton, Ohio
Formerly Hydraulic Engineer with Miami Conservancy District

Permanent bridges require permanent, i.e., correctly-proportioned, waterway areas if the risk of heavy loss in floods is to be avoided. Highway engineers have felt the need for better information on waterway proportioning, as shown by requests to "Engineering News-Record" for data and comparisons of flood formulas. Mr. Houk's article is prepared in answer to these requests. His experience makes it authoritative. The emphatic statement that run-off formulas should not be relied upon in bridge proportioning is likely to be influential in raising the level of practice.—Editor.

HYDRAULIC design of bridge waterways should be based on engineering judgment, not on ancient formulas. In other words the design should be made by a rational method, similar in principle to the rational method used in sewer design, rather than by the blind application of run-off formulas developed in other localities.

The design of each opening is an individual problem, and the designer will find it important to give careful consideration to all the various affecting factors. These include not only the topographic and geological data of the site, but also the frequency and magnitude of floods, the velocities of flow, the cost of the structure, and the probable damage resulting from failure. He requires a fair understanding of rainfall and run-off conditions throughout the areas under his supervision, of the velocities and conditions under which scour occurs, and of the general hydraulic principles involved in the flow of water through open channels and through contracted openings. As a general rule the more complete his knowledge of the above matters is, the better will be his designs.

The main questions to be answered in designing bridge waterways for flood flow are: first, what maximum rate of run-off should be provided for; and second, what maximum velocity should be allowed or will exist through the opening. There are, of course, many other matters to be considered, such as the shape of the opening, the shape and alignment of piers where more than one span is necessary, the permissible ponding, and so forth; but these are really of secondary importance. Knowing the maximum amount of flow to be cared for and the greatest mean velocity through the bridge a simple division of the former by the latter gives the minimum area of the opening to be provided below the high water line. The details of shape, spans, and so forth may then be worked out.

Formulas at Best Makeshifts.—There may be, and probably are, locations where some one formula will give satisfactory values of run-off to be used in designing bridge waterways. But even in such cases it is believed that a rational consideration of each individual problem will give better results. The studies of the Miami Conservancy District showed that for the smaller areas, say of less than 500 square miles, the [illegible] formula gave fairly satisfactory results. Yet when it came to designing bridge waterways each problem was considered separately, without recourse to any formula. Certainly no formula should be used unless its limitations are understood and unless it has been proven to be fitted to the given conditions.

Maximum Rate of Run-off.—The determination of the maximum rate of run-off to be designed for is not an easy matter, especially in the case of the smaller drainage areas, where the problem is most often met. For the larger rivers, such as the Susquehanna, or the Mississippi, the problem is not so difficult. Fairly reliable long-time records of discharge and stage are generally available on such streams; moreover, there are not the wide variations between maximum recorded discharge and maximum possible discharge which generally exist for the smaller watersheds.

Cloudburst Floods.—Maximum rates of run-off on small drainage areas are caused by the rather erratic cloudbursts which occur here and there during the summer months. Consequently one drainage area may have experienced in recent years a cloudburst flood of 1,000 sec.-ft. per square mile, while an adjoining area of similar size and characteristics may not have experienced one of as much as 100 sec.-ft. per square mile within the memory of the oldest inhabitants. In July, 1918, a cloudburst near New Carlisle, O., caused a run-off of about 2,200 sec.-ft. per square mile from an area of about 6.7 sq.mi. (*Engineering News-Record*, Sept. 22, 1921, p. 480); in the drainage area next east, however, a run-off rate as great as 200 sec.-ft. per square mile has never been known. Other similar cases might be cited.

What discharges to provide for in such instances must necessarily be decided by engineering judgment after careful consideration of the various affecting factors. No simple or exact solution is possible. To blindly design bridge waterways for all such areas by using a run-off formula which would give either of the above values would be absurd.

If a relatively great factor of safety can be obtained at only a slight increase in cost, the extra expenditure probably would be justified; if not, it would be better to design for a smaller maximum run-off rate and take the risk of damage by a greater flood. It is believed that in the great majority of cases it will not be necessary to design for the maximum possible cloudburst rates. Local conditions will determine the procedure in each instance. The writer recently designed a bridge waterway to care for a maximum run-off of about 0.4 in. per hr. from an area of about 8 sq.mi., 260 sec.-ft. per square mile, believing it better to take the risk of damage at some future date than to go to greater expense at the present time.

Cloudbursts Infrequent.—Cloudbursts such as the one that occurred at New Carlisle are comparatively infrequent as regards a given area due to the facts that notices of such storms having taken somewhere are printed in the newspapers every week or so during the summer months, and that there are probably some cloud-

bursts each year which are not heard of owing to their having fallen where no serious damage could result. If the areas covered by such storms are compared with the areas on which they might just as easily have fallen it will be seen that the expectancy of occurrence for a given area is remarkably small.

For instance, in the Miami Valley during the nine years since 1913 there have been two cloudburst floods of unusual proportions: the New Carlisle flood mentioned above and one other, for which no description has ever been published. No detailed surveys were made of the latter, but personal inspection within a few days of its occurrence showed that the runoff rate from an area of 6 sq.mi. was comparable with that at New Carlisle. Either of these storms might just as well have fallen on any other six-square-mile area in the 3,600 sq.mi. contained in the Miami Valley above Hamilton. Consequently it may be said, roughly, that the chance of a

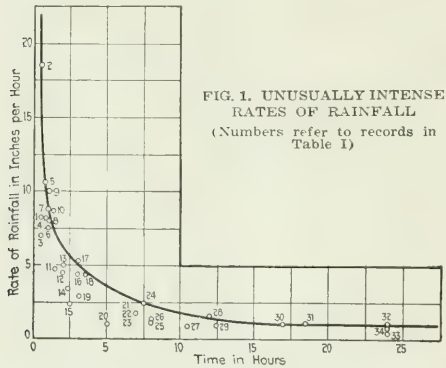


FIG. 1. UNUSUALLY INTENSE RATES OF RAINFALL

(Numbers refer to records in Table I)

similar cloudburst falling on a particular 6 sq.mi. of the Miami Valley once in 4.5 years is about 1 : 600, or, in other words, that one storm of such proportions may be expected on a given area of that size once in 2,700 years. If it is assumed that two additional storms occurred in remote sections of the Valley and were not noted by the Conservancy engineers, the expectancy would be once in 1,350 years, still comparatively infrequent.

This simply shows that in the case of unusually small drainage areas it is not at all necessary to design bridge openings for the maximum possible floods. Of course such reasoning does not apply to locations where the topography and atmospheric conditions are of a kind to cause the formation of cloudbursts, "thunderstorm-breeding spots," as R. E. Horton terms them (see *Monthly Weather Review*, April, 1921, pp. 193 and 202).

Cloudburst Rainfall—The collected climatological data published by the United States Weather Bureau contain but little on cloudburst rainfall, owing to the fact that such storms, being comparatively small in size, generally fall between the regularly maintained rain gaging stations. During recent years, however, the Weather Bureau officials have done some valuable work in securing data on cloudbursts from local residents such as depths of precipitation from measurements in pails, tubs, and the like. The results of these investigations have been published in various issues of the Monthly Weather Review.

Table I gives a few of the most unusual rainfall records found in the Weather Bureau publications, together with a few secured from other sources. Asterisks are used to designate those not measured in standard rain gages. Records are included in which the duration of the precipitation varied from 30 min. to 24 hrs., although the storms of the longer durations are not generally termed cloudbursts. It is quite likely that during each storm, especially the longer ones, there were periods of shorter duration in which the rates of rainfall were much higher than the average given in the table. Unfortunately, none of the cloudbursts listed fell where recording gages are maintained.

The records included in the table show that cloudbursts are not limited to any particular section of the United States but may fall in practically all parts of

TABLE I—UNUSUALLY INTENSE RAINFALLS FOR DURATIONS OF 24 HOURS OR LESS

Ref. No.	Location	Date	Amount, Inches	Duration Hr.	Duration Min.	Rate in In. Per Hr.
1	Biscayne, Fla.	Mar. 28, 1874	4.10	0	30	8.20
2	Guinea, Va.	Aug. 24, 1906	9.25*	0	30	18.50
3	Logansport, Md.	July 7, 1879	3.50	0	30	7.00
4	Newton Square, Pa.	Aug. 5, 1843	5.5*	0	40	8.25
5	Fort Mohave, Ariz.	Aug. 28, 1898	8.00*	0	45	10.67
6	Tridelphia, W. Va.	July 19, 1888	6.90	0	55	7.53
7	Palmetto, Nev.	Aug. 1890	8.80	1	00	8.80
8	Cincinnati, Ohio	June 3, 1921	8.0*	1	00	8.00
9	Catskill, N. Y.	July 26, 1819	10.0*	1	00	10.00
10	Campo, Cal.	Aug. 12, 1891	11.5	1	20	8.63
11	Cambridge, Ohio	July 16, 1914	7.09**	1	30	4.73
12	Taborton, N. Y.	Aug. 10, 1920	8.95*	2	00	4.47
13	Brandywine Hundred, Del.	Aug. 5, 1843	10.00*	2	00	5.00
14	Roney's Point, W. Va.	July 19, 1888	8.0*	2	20	3.43
15	Fort Meade, S. Dak.	June 13, 1907	6.01	2	30	2.40
16	Catskill, N. Y.	July 26, 1819	13.0*	3	00	4.33
17	Concord, Pa.	Aug. 5, 1843	16.0*	3	00	5.33
18	Newton Twp., Pa.	Aug. 5, 1843	13.0*	3	00	4.33
19	Alton, Ill.	July 13, 1912	9.22*	3	10	2.91
20	Albuquerque, N. Mex.	Oct. 9, 1865	5.20	5	00	1.04
21	Quanah, Tex.	June 4, 1891	12.25	7	00	1.75
22	Boggs Flats, Colo.	June 3, 1921	12.0*	7	00	1.71
23	York Pa.	June 25, 1864	12.0*	7	00	1.71
24	Catskill, N. Y.	July 26, 1819	18.0*	7	30	2.40
25	Flatbush, N. Y.	Aug. 22, 1843	9.0	8	00	1.12
26	Griffin, Ga.	Aug. 8, 1883	10.38	8	00	1.30
27	White Plains, N. Y.	Oct. 9, 1877	9.70	10	30	0.92
28	Taylor, Tex.	Sept. 9, 1921	19.5	12	00	1.63
29	Larrabee, Iowa	June 23, 1891	12.95	12	24	1.04
30	St. George, Ga.	Aug. 28, 1911	18.0	17	00	1.06
31	Montell, Tex.	June 29, 1913	20.6	18	30	1.11
32	Hearne, Tex.	June 28, 1899	24.0	24	00	1.00
33	Beaulieu, Minn.	July 20, 1909	10.75	24	00	0.45
34	Altapass, N. C.	July 15, 1916	22.2	24	00	0.92

** Greater part of the rainfall fell in less than 30 minutes.
* Believed reliable although not measured in a standard rain gage.

the country. There may be, and probably are, differences in the areas covered by the intense precipitation and in the frequency of occurrence of cloudbursts in the different regions; but the data readily available at present are not sufficient to determine this definitely. It is believed that *cloudbursts are fully as frequent and as intense in the eastern states as in the Rocky Mountain regions*, if not more so; and that the conclusions to the contrary which have been drawn by some people are the result of the more rugged topography in the west, rather than the result of actual differences in the occurrence of cloudburst phenomena.

Fig. 1 shows the rates of rainfall plotted against their duration, for the various records of Table I. A curve has been drawn through the higher points to indicate, for the different periods of time, about what intensity may possibly occur sometime in the future.

Discharge Rates from Small Areas—Table II gives some of the more unusual maximum rates of discharge which have been observed for areas smaller than 200 square miles. No rates less than 200 sec.-ft. per square mile are included. Most of the records were determined from measurements of cross-section and high-water slope after the flood had passed and consequently cannot be relied upon absolutely. The records are shown graphically in Fig. 2, rates of discharge being plotted as ordinates against drainage areas as abscissas. Curve A has been drawn through the higher points.

TABLE II.—MAXIMUM RATES OF DISCHARGE FROM SMALL AREAS

Ref. No.	Stream	Location	Drainage Area, Sq.Mi.	Date	Max. Rate In Sec.-Ft. Per Sq.Mi.	Authority
1	Doker's Hollow	Pa.	0.6	June, 1917	4,000	Unpublished data
2	Mad Creek	Le Roy, N. Y.	1.5	June, 1916	2,000	Eng. Rec. 6-24-16
3	Arroyo	Near Pueblo, Colo.	1.8	June, 1921	1,060	Pr. A. S. C. E. Dec. '21, p. 772
4	Cherryvale Creek	Cherryvale, Kan.	2.0		930	Tr. A. S. C. E. 1905, p. 200
5	Moraine Run	Morsine City, Ohio	2.6	Sept., 1916	346	Eng. News-Rec. 5-1-19
6	W. Fork Honey Creek	New Carlisle, Ohio	3.5	July, 1918	1,000	Eng. News-Rec. 9-22-21
7	Mill Brook	Sherburne, N. Y.	5.0	Sept., 1905	262	Tr. A. S. C. E. 1914, p. 564
8	E. Fork Honey Creek	New Carlisle, Ohio	6.7	July, 1918	2,210	Eng. News-Rec. 9-22-21
9	Blue Ribbon Creek	Near Pueblo, Colo.	6.7	June, 1921	1,360	Proc. A. S. C. E., Dec. 1921, p. 772
10	Cameron Arroyo	Near Pueblo, Colo.	7.3	June, 1921	1,900	Proc. A.S.C.E., Dec., 1921, p. 772
11	Sawpit Canyon	Los Angeles, Cal.	7.4	1889	550	Los Angeles Flood Control Rep.
12	Osteen Arroyo	Near Pueblo, Colo.	7.8	June, 1921	1,160	Proc. A.S.C.E., Dec., 1921, p. 772
13	Mill Creek	Erie, Pa.	9.3	Aug., 1915	800	Eng. Rec. 8-14-15
14	Mill Brook	Sherburne, N. Y.	9.4	Sept., 1905	241	Tr. A. S. C. E. 1914, p. 564
15	E. Fork Honey Creek	New Carlisle, Ohio	11.8	July, 1918	1,290	Eng. News-Rec. 9-22-21
16	Eaton Wash	Los Angeles, Cal.	12.5	1914	367	Los Angeles Flood Control Rep.
17	Arroyo	Near Pueblo, Colo.	15.6	June, 1921	619	Proc. A.S.C.E., Dec., 1921, p. 772
18	Alazan Creek	Near San Antonio, Tex.	16.9	Sept., 1921	1,950	Proc. A.S.C.E., Nov., 1921, p. 454
19	Ridley Creek	Sycamore Mills, Pa.	20.0	Aug., 1843	750	Unpublished data
20	Willow Creek	Heppner, Ore.	20.0	June, 1903	1,800	W. S. P. 96, U. S. G. S.
21	Apache Creek	Near San Antonio, Tex.	22.0	Sept., 1921	704	Proc. A.S.C.E. Nov. 1921, p. 454
22	Cane Creek	Bakersville, N. C.	22.0	May, 1901	1,341	Eng. News 8-7-02
23	Crum Creek	Delaware Co., Pa.	22.0	Aug., 1843	410	Unpublished data
24	River des Peres	St. Louis, Mo.	23.4	Aug., 1915	410	Eng. News 10-14-15
25	Boggs Creek	Near Pueblo, Colo.	25.0	June, 1921	600	Unpublished data
26	Pinal Creek	Globe, Ariz.	25.0	Aug., 1904	560	Tr. A.S.C.E. 1914, p. 564
27	Spring Creek	Piqua, Ohio	27.0	Mar., 1913	210	M. C. D. Tech. Rep. Pt. 4
28	Olmos Creek	Near San Antonio, Tex.	32.4	Sept., 1921	1,000	Proc. A.S.C.E. Nov. 1921, p. 453
29	Olmos Creek	Near San Antonio, Tex.	41.0	Sept., 1921	580	Proc. A.S.C.E. Nov. 1921, p. 453
30	Elkhorn Creek	Keystone, W. Va.	44.0	June, 1901	1,360	Eng. News 8-7-02
31	Olmos Creek	Near San Antonio, Tex.	45.0	Sept., 1921	333	Proc. A.S.C.E. Nov., 1921, p. 453
32	Peck Creek	Near Pueblo, Colo.	46.0	June, 1921	283	Unpublished data
33	Darby Creek	Delaware Co., Pa.	48.0	Aug., 1843	580	Unpublished data
34	Lost Creek	Troy, Ohio	52.0	Mar., 1913	571	M. C. D. Tech. Rep. Pt. 4
35	Tawawa Creek	Sidney, Ohio	54.0	Mar., 1913	239	M. C. D. Tech. Rep. Pt. 4
36	Chester Creek	Bridgewater, Pa.	62.0	Aug., 1843	1,000	Unpublished data
37	Ludlow Creek	Ludlow Falls, Ohio	65.0	Mar., 1913	266	M. C. D. Tech. Rep. Pt. 4
38	Rock Creek	Near Pueblo, Colo.	67.0	June, 1921	348	Unpublished data
39	Dry Creek	Near Pueblo, Colo.	71.0	June, 1921	225	Unpublished data
40	Sweetwater River	California	100.0	Jan., 1916	330	Eng. Rec. 2-19-16
41	Devil's Creek	Viele, Iowa	143.0	June, 1905	650	Rec'd. estimate

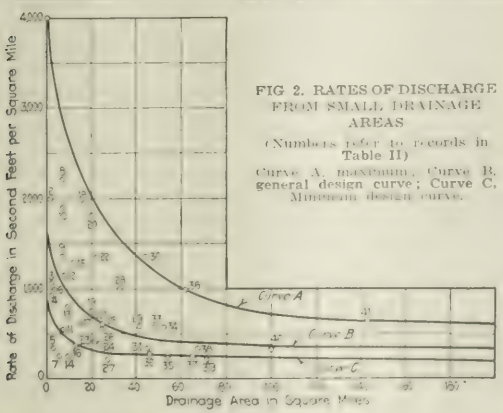


FIG. 2. RATES OF DISCHARGE FROM SMALL DRAINAGE AREAS

(Numbers refer to records in Table II)

Curve A, maximum; Curve B, general design curve; Curve C, Minimum design curve.

Rates for Designing Bridge Waterways—It is manifestly impracticable to design bridge openings for the runoff rates indicated by Curve A, except in rare instances where the channel cross-section is unusually large, or where the damage which would result from the failure of the structure would be so great as to warrant the unusual cost. The proportion of the maximum possible rate which should be used in design varies with the relative cost of the structure, the extent of the damage in case of failure, and the size of the drainage area. Other things being equal, the larger the drainage area the larger the proportion of the maximum possible flood rate to be considered. The reason for this is that while the maximum flood of a thousand years is not more than a third or a half larger than the maximum of a hundred years in the case of the larger drainage areas (see Miami Conservancy District's Technical Report, Part V, page 273), it may, in the case of the extremely small areas, be several times as great.

Curve B on Fig. 2 indicates the rates of discharge which it would be well to design for whenever it is financially possible to do so. Curve C indicates the minimum rates to be used.

1913 Flood A Safe Datum—For drainage areas of from 200 to 5,000 sq.mi. in the northeastern section of the United States it is believed that the maximum rates of runoff which occurred in the Miami valley during the great flood of March, 1913, represent about the maximum that will occur on areas of similar size about once in a hundred years (see Miami Conservancy District Technical Reports, Part IV, Calculation of Flow in Open Channels, p. 61). If bridge waterways are designed for such rates, using reasonable factors of safety, it is doubtful if the structures will ever be seriously damaged by floods. Slightly higher rates might be used in the lower Mississippi Valley and southeastern United States, and slightly lower rates in the areas extending northwest from the Ohio River valley.

The rates which occurred near Pueblo last June are indicative of what may be expected at long intervals of time in that part of the United States. Careful hydrographic surveys made by the writer for the Morgan Engineering Co. shortly after the flood showed the following flood discharges on the main streams. The rates determined for the smaller streams are given in Table 2.

Stream and Location	Drainage Area, Sq.Mi.	Max. Runoff, Sec.-ft. Per Sq.Mi.
Arkansas River, Fountain to Pryor Creek	[illegible]	75,500	80
Fountain River, Colorado	[illegible]	40,000	43

Of course if overflow can occur around the ends of the bridge during the more unusual floods it will not be necessary to provide bridge waterway for the entire amount of the maximum flow. In such cases it will be sufficient to make the waterway the same size as the main channel above and below, keeping the clearance line well above the high-water elevation so as to avoid accumulations of drift.

Scour Velocities—The maximum velocity to be allowed

through the bridge will vary with the length of time the flood continues, with the depth and character of the foundations, and with the conditions of flow in the approach channel. If the channel is straight, if the piers are parallel to the thread of the current, and if the footings extend well below the bed of the stream and rest on piles or rock, a mean velocity as high as 10 ft. per sec. may be permissible for a short time, even where the river bed consists of gravel. The Miami Conservancy District based its designs on a velocity of 10 ft. per sec. where the river bed is composed of gravel, although observations showed that 6 ft. per sec. caused considerable scour. Wherever velocities higher than 10 ft. per sec. will occur the bridge foundations were protected by a line of steel sheet-piling across the river just below the piers.

The actual velocity that will occur through the opening may sometimes be greater than what would be considered the maximum allowable velocity. In such cases the bridge foundations must be protected against the velocities to be expected. Such cases would be where the slope of the stream above the bridge is so steep that the velocity is greater than is desirable. Simply enlarging the opening will not bring about the necessary reduction: the high velocities will continue through the central spans, leaving dead water or cross current areas in the enlarged portions at the ends. In order to decrease the velocity at the bridge site it is necessary to enlarge the channel for some distance upstream as well as at the bridge. Of course such channel enlargements are not feasible in ordinary highway or railroad bridge work.

What Determines Scour—The amount of scour that will take place is not dependent entirely on the mean velocity of the water. The direction of the current also has an important effect. If the current is directed against the pier the scour will be greater than where the current is parallel to the pier even though the mean velocity is the same. Of course what happens is that where the current is deflected by the pier the velocities at the pier are higher than where the currents are parallel to the pier. The partial collapse of the Third St. Bridge in Dayton about a year ago was due to scour caused by deflected currents in which the mean velocity did not exceed 6 ft. per sec. The same bridge safely withstood the great flood of 1913, when the mean velocity was about 10 ft. per sec. but was parallel to the piers. This illustrates the importance of proper alignment of piers with respect to the channel of approach.

Observations in a small cut-off channel in the Miami River at Dayton a few years ago showed that in a gravel section no scour at all took place when the mean velocity was 5.5 ft. per sec., while in a clay section just below, where the velocity was the same, considerable scouring was going on. A few days later, when a small rise in the river increased the mean velocity to 6 ft. per sec., extensive scour occurred in both sections. Of course the bottom velocities were considerably lower than the mean velocities. The channel was comparatively shallow, being only 2 to 3 ft. deep (see Miami Conservancy District Technical Reports, Part IV, Calculation of Flow in Open Channels, p. 102). Careful hydrographic surveys made in the Miami Valley immediately after the 1913 flood showed that velocities as high as 10 ft. per sec. occurred in several places without causing serious damage.

Scour Protection—Velocities greater than 10 ft. per sec. may be allowed if the river bed through the opening, and just above and below, is protected against scour. It must be remembered, however, that when the velocity through the opening is greater that the velocity of approach, there must be a drop in the water surface just above the bridge sufficient to create the necessary increase in velocity. The writer recalls one instance where a so-called hydraulic engineer, retained by a trunk-line railroad, figured on lining the channel under a bridge with concrete so that a velocity of 20 ft. per sec. could be allowed, without figuring on any drop-off whatever to produce the high velocity. Since the velocity of approach for a bank-full stage was only about 5 ft. per sec., his plans, if carried out, would have meant a backing up of about 5 ft., enough to have flooded several hundred acres of very valuable farm lands.

Effect of Ponding—The principal effect of pondage above a bridge, as far as the design of the waterway is concerned, is to increase the velocity through the opening. Of course there is some reduction in the rate of flow, since the principles involved are the same as in a flood-detention reservoir. However, the detention effect is seldom important. Cases where it might be appreciable would be where the watershed is exceptionally small and the backing up comparatively great. Ordinarily the only consideration which need be given to ponding is to determine how high the water can back up without overflowing valuable property and what such an elevation means in the way of velocity increase through the opening. Railroad engineers seldom figure on any backing up at all, since such conditions probably would result in damage suits even though there were no actual damage.

Retarding Effect of Bridges—The retarding effect of a bridge is made up of the increased friction along the piers, the loss due to impact at the ends of the piers, the reduction in area of the waterway, and the disturbances produced when the piers are not parallel to the direction of flow (see Miami Conservancy District Technical Reports, Part VIII, Hydraulics of Miami Flood Control Project, p. 274). The increased friction along the piers is not, as a rule, of appreciable magnitude, especially if the piers are built of smooth concrete, as most of them are nowadays. Generally 0.2 to 0.3 ft. additional drop in the water surface through the opening will be sufficient to overcome this retarding influence. However, the fact that it exists should be kept in mind and the piers designed so as to reduce it to as small a value as possible. Piers of cellular or columnar structure are less desirable from a hydraulic standpoint than smooth continuous concrete piers.

End Effect—The losses due to impact at the ends of the piers can be reduced to negligible quantities by rounding the ends with smooth curves of not too small radii. Circular or elliptical curves are satisfactory. The ends should never be square. Angles should be avoided whenever possible. Triangular ends are better than square ends, but cause greater retarding effects than where curves are used. Losses occur at the downstream ends as well as at the upstream ends, as is shown by the boils and eddies which can be seen below the piers during any flood.

The heading up caused by a reduction in the area of the waterway has already been mentioned. However, it should be pointed out that not all of this head is lost.

The greater part of it is regained below the bridge, where the velocity decreases to its orginal value, the liberated velocity head being used in overcoming the ordinary channel friction.

It is desirable, whenever possible, to make the area of the waterway under the bridge the same as the area of the channel above and below, even though some heading up can occur without flooding valuable property and without causing undesirable velocities. In such cases the fact that backing up can occur constitutes an additional factor of safety against damage by unusual floods.

Pier Alignment—The alignment of the piers with respect to the thread of the current is one of the most important matters to be considered in working out the details of design. The ideal condition, naturally, is where the sides of the piers are exactly parallel with the currents. If not parallel, or practically so, the effective area of the opening is reduced, the piers are more likely to be undermined by scour, and the disturbed and deflected conditions of flow result in an increased loss of head through the bridge.

Data Needed—In order to design a bridge waterway for a given location the following data should be secured:

1. A cross-section of the channel and flood plain along the center of the roadway.
2. One or two typical cross-sections of the main channel a short distance above the bridge site.
3. One or two typical cross-sections of the main channel a short distance below the bridge site.
4. Elevations and locations of top of banks and low-water edges for a short distance above and below the bridge site. These data, together with the cross-sections, should determine the slope of the channel within reasonable limits.
5. Formation of channel and bed, whether clay, loam, sand, gravel, or rock.
6. Elevations of extreme high water and extreme low water at the bridge site.
7. Extent of flooding and damage caused by flooding to different elevations.
8. Photographs of the bridge site and of the channel above and below.
9. The area drained by the stream above the bridge site.
10. The general topography, geology, proportions of timber land and of farm land, and other pertinent facts pertaining to the drainage area.
11. General information regarding other bridges in the immediate vicinity.
12. Any available stream-flow data from gaging stations in that locality.

The survey at the bridge site need not be elaborate or of great precision. Stadia methods are sufficiently accurate. An experienced instrument man with a couple of rodmen can generally secure all the data needed in a day's time. Distances need not be determined closer than to the nearest foot, or elevations closer than to tenths, except on bench marks and turning points.

The area drained by the stream can generally be determined from some available map, especially if the stream is comparatively large. If the stream is small, uncertainties in the extent of the area drained are not particularly important, considering the magnitude of the question as to what rate of discharge should be provided for. It makes no practical difference whether the drainage area is 6.0 or 6.5 sq.mi. when it is necessary to determine by engineering judgment whether to provide for 200 or 2,000 sec.-ft. per square mile. A cursory reconnaissance of the area should furnish the necessary data regarding the topography, geology, and so forth. The Geological Survey maps are of great value in such work and should be consulted whenever they can be secured. Any available stream-flow data will probably be found in the Geological Survey water-supply papers; the designer should have a complete file of the numbers containing such records for his locality.

If no gaging stations have been maintained on the stream in question, in the vicinity of the proposed bridge, the velocities for different stages may be calculated by the Kutter formula, using the cross-sections and other data obtained in the survey. While such calculations are only approximate, they do indicate about what can be expected in the way of velocities.

Having obtained the data outlined above, the designer, considering the various factors involved, can come to some conclusion as to the best design.

Railway Maintenance-of-Way Affects Fuel and Operating Economy

Relations of the maintenance-of-way department to the general policy of fuel conservation on railways were outlined briefly at the recent annual meeting of the International Railway Fuel Association by W. S. Burnett, engineer of maintenance-of-way of the Cleveland, Cincinnati, Chicago & St. Louis Ry. The following abstract of his paper shows the close relation of maintenance work to operating economies.

On this road the maintenance-of-way department handles the coaling stations, but there is not much opportunity at these stations to conserve coal, except to see that tenders are not overloaded, that coal spilled is kept picked up and that all coal is cleaned out of the cars. Men in charge of coaling stations should keep an accurate record of cars unloaded and make daily reports so that the actual fuel consumption can be known and the cost determined. They should keep a sufficient supply of coal in the dock or hoppers so that the breakage of coal will be reduced to a minimum. The cost of operating coal stations should be continuously checked in order that it may be kept at a minimum consistent with good service. Co-operation of the transportation department is required in keeping a plentiful supply on the unloading tracks, so that the bins can be kept filled to capacity and in case of a breakdown of the hoisting apparatus there will be no delay to trains.

Although the maintenance-of-way department is not so interested in fuel conservation as the transportation and mechanical departments, nevertheless by co-operation with these departments considerable saving can be effected. Work in connection with maintenance of tracks and bridges, rail renewals and reballasting in many instances requires slow orders for the safety of trains. These orders mean greater fuel consumption, especially if the speed is restricted below 30 m.p.h. The program of the work should be carefully considered so as to prevent the stopping or slowing up of trains. In laying rail on double-track this can be avoided partly by single-track operation while the work is in progress. On single track the best time between trains should be selected, so that a considerable stretch of track can be laid in a short time and full spiking and bolting can be carried on under traffic. When reballasting, care should be taken not to strip too far ahead of the gravel supply, so as to avoid skeleton track. Track should be in shape for the passage of all scheduled trains during the work period, and if filled with ballast the track should be left in condition for full speed during the night. Where slow orders are placed on bridges for the protection of workmen and not for the safety of the structure, these orders should be maintained during working hours only.

Location and maintenance of signals and switches are important in fuel conservation. Signals should be so located that they can be readily seen from a distance, and if possible at points where passage trains can be easily started. Operating economies to be effected in the installation of interlocking plants should be given attention.

Power Company Makes Extensive Triangulation Survey

Details of Methods and Instruments Used by Southern California Edison Company in First Season's Work on Large Area Survey—Government Standards Followed

By W. Mussetter
Southern California Edison Co., Big Creek, Cal.

THE Southern California Edison Co. has completed the first season's work on a triangulation control for the San Joaquin River hydro-electric project which, to the writer's knowledge, is the most extensive and accurate control survey ever attempted by a private organization in the United States. The purpose of this survey is to correlate the different units of the project and to furnish starting points for surveys for local engineering work and topography and to control the accuracy of such surveys.

The work was governed by the U. S. Coast and Geodetic Survey's instructions for primary and secondary triangulation. These instructions call for a mean triangle closing error of not more than 3 sec. for primary and 5 sec. for secondary work, a maximum closure of about 8 sec. and 15 sec. for the two grades, and prescribe base lines of an accuracy consistent with these results.

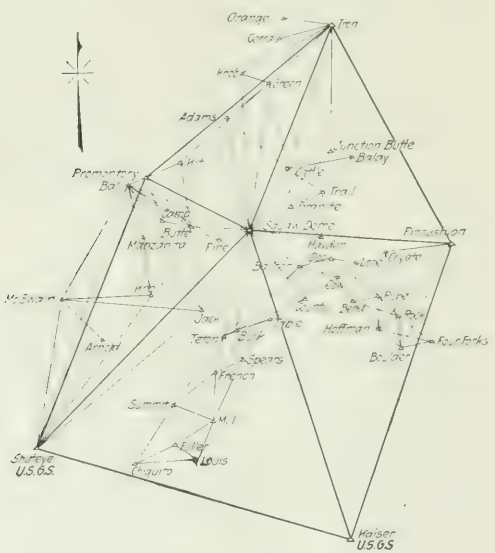


FIG. 1 TRIANGULATION SYSTEM NORTH OF U. S. BASES KAISER-SHUTEYE

The system as completed to date covers approximately 600 square miles of mountainous region in Fresno and Madera counties, Cal. Seventy stations varying in altitude from 2,590 to 10,313 ft. have been permanently marked. The maximum length of line observed is about 15 miles.

In the greater part of the area covered there are no roads of any kind, making necessary the use of pack animals almost exclusively. Several points were reached only after difficult ascents on foot, the building materials, tools and instruments being carried on the backs of the members of the party.

Stations Observed—Main scheme stations were placed in the best locations afforded by topography, consistent with their utility as controls for subsidiary figures, so as to keep the quantity ΣR a minimum. Secondary stations were placed in compromise with the above conditions and conditions of accessibility, proximity to projected work, etc. Following is a summary of the system:

Number of primary stations	14
Number of secondary stations occupied	54
Number of secondary stations unoccupied	2
Number of auxiliary stations occupied	8
Number of intersection stations	2
Total points determined	80

The triangulation was tied into the U. S. Geological Survey triangulation stations Kaiser and Big Shuteye, thereby placing it on the North American Datum.

Scheme, Marks and Signals—The system in general consists of several chains of secondary triangulation, controlled and tied together by a main scheme of primary accuracy. For the main scheme five- and six-sided central point figures were chosen as best fitting the topography and area to be covered. For secondary work quadrilaterals, central point figures, and in a very few instances, single triangles were used. Wherever possible a figure affording double determination of length was employed.

Permanent stations of both classes were marked by a ¾-in. x 6-in. galvanized iron pipe with cap, sulphured in a drill hole in solid rock or a large boulder. In one instance where no rock was available a 1¼-in. pipe 4 ft. long was driven 3 ft. into the ground. A cross on the cap marks the true center. Targets were made of a 1¼-in. galvanized iron pipe-mast bearing at their tops two heavy-gage galvanized-iron vanes set one beneath the other and at 90-deg. angles so as to be visible from any direction. The masts were made in 4-ft. sections for convenience in packing and any desirable number could be coupled together. A 12-ft. mast was standard. Eight-foot masts were used on sharp bald peaks and short lines. Two sizes of vanes, 18 in. x 36 in. and 12 in. x 24 in. were used according to length of time. The vanes were painted red and white by alternate quadrants. Flags were secured in position by three guy wires anchored to eyebolts sulphured in rock, and drawn tight by turnbuckles. The eyebolts were also used as reference marks by recording their azimuth and distance from the station. The targets were readily removed for occupying the station. On a few lines a heliograph was used.

Instruments and Methods—The instruments used were 7-in. Berger repeating theodolites, reading by opposite verniers to 10 sec. directly and to 5 sec. by estimation. The telescope had a 13-in. focal length,

was inverting in type, and was supplied with 29- and 40-power eyepieces. A 6-in. vertical circle, reading to 20 sec. by opposite verniers was fitted to the instrument and was used for trigonometric levels and for time observations. The vernier frame carried a bubble of 10-sec. sensitiveness per 0.1-in. division. A striding level of 8.5-sec. sensitiveness was applied to the telescope trunnions whenever the altitude (+ or —) of a signal was greater than 10 deg. Fixed microscopes were applied to all verniers and electric illuminating provided for night work. A three-screw base was used. Besides its inherent advantages for precise work this permitted the use of a heavy framed wooden tripod loaded with rock to be used on all primary stations, adding greatly to the accuracy. On secondary stations the instrument was mounted on its own tripod. In use the theodolite was protected from sun and wind by a hexagonal tent of light canvas supported by a steel frame to avoid use of a center pole. The instrument was packed in two boxes fitted with harness for backpacking.

Six measurements of the horizontal angles were taken direct, followed immediately by six readings of the corresponding explements with telescope reversed. The alidade was always turned in increasing azimuth. The circle was read on the initial, first, third and sixth, direct and sixth reverse readings. The horizon was closed in all cases. For primary work three sets were taken, and on secondary, two sets. The maximum residual from the arithmetical mean of sets permitted



FIG. 3. STATION IS FOREST SERVICE LOOKOUT

was 3 and 4 sec., respectively. In both classes the maximum horizon closure allowed was one second times the number of angles. If these limits were exceeded more sets were taken. Initial circle settings were made at or near 0 deg. 0 min. 40 sec., 60 deg. 03 min. 50 sec., and 120 deg. 07 min. 20 sec. for 3 sets, and 0 deg. 0 min. 40 sec. and 90 deg. 05 min. 30 sec. for two sets, so as to use different parts of both the circle and verniers.

No attempt was made to set off these [illegible] readings exactly. Very little difficulty was experienced in keeping within the limiting errors. The average time for observing a set was about 10 minutes.

Adjustment and Analysis of [illegible]—A rigid least-square adjustment was made of all the figures. This adjustment requires the [illegible] of all angle and side equations and length equations when such are involved. The main scheme was first adjusted and then held as fixed and the secondary system was fitted to that. A study of the corrections introduced by the adjustment has been made and tabulated below. To the writer's belief the most rigid test of accuracy is the probable error of an angle. The probable error of an angle is computed from Peter's formula:

$$\mu = \frac{1.2533}{\sqrt{N(N-1)}} V$$

where V is the sum of errors without regard to sign and N is the total number of observations. The mean-square error of an angle is given by the formula, m.s.e. $= \sqrt{\frac{\Sigma\Delta^2}{3N}}$ where $\Sigma\Delta^2$ is the sum of the squares of the closing errors of the triangle, and N is the number of triangles. (See table on page 1078 as an indication of the accuracy of the triangulation.)



FIG. 2. CHARACTER OF COUNTRY INCLUDED IN SOUTHERN CALIFORNIA EDISON CO. TRIANGULATION WORK

Base Measure—One base line only was measured, about 1½ miles long, in the vicinity of Shaver Lake. The location was in cut-over timber land, and quite rocky in character. The line was cleared and 2 x 4-in. stakes 4 ft. long were driven 1½ ft. into the ground at 50-m. intervals, with 1 x 4's set halfway between, and at more frequent intervals when needed to keep the tape clear of the ground. Where rock was encountered a frame was nailed to the stake and heavily loaded with rock. A lead strip ½ in. wide was nailed on each 2 x 4 parallel to the base for marking tape ends. A nail was driven horizontally into the intermediate stakes in line both vertically and horizontally with the end stakes to support the middle of the tape. The apparatus used was standard invar base tapes and stretchers borrowed from the Coast and Geodetic Survey. Thermometers were taped to the end of the tape and read after each application. A party of six was employed consisting of a front and a rear contact, a front and a rear stretcher, a man to carry and place the middle of the tape, and a recorder. The tape was given a tension of 15 kg. indicated by a spring balance on the front stretcher, and the tape end transferred to the lead strips by a very fine scratch. The base was measured forward and backward, different tapes being used for the two measurements. The time consumed in measuring was but four hours.

STATISTICS SHOWING ACCURACY OF TRIANGULATION

PRIMARY SYSTEM

Number of stations	14
Number of triangles	23
Triangles with plus closure	13
Triangles with minus closure	10
Average closure of a triangle	1″.64
Maximum closure of a triangle	3″.50
Mean square error of an angle	1″.06
Average correction to an angle	0″.79
Maximum correction to an angle	2″.38
Probable error of an observed angle	1″.00

SECONDARY SYSTEM

Number of stations	56
Number of triangles closed	93
Triangles with plus closure	50
Triangles with minus closure	43
Average closure of a triangle	4″.22
Maximum closure of a triangle	15″.97
Mean square error of an angle	3″.23
Average correction to an angle	1″.65
Maximum correction to an angle	8″.50
Probable error of an observed angle	2″.06

Inclination corrections were found by running wye levels in both directions over the stakes and applying the correction necessary to reduce the tape length to the horizontal.

A probable error of 4.6 mm., corresponding to one part in 549,000, was obtained. The base was reduced to sea level by the formula, $L = 1 - lh/r$. For the purpose of computing co-ordinates this length has been raised to the 4,000-ft. plane.

The base net of primary accuracy was developed so as to avoid any distance angles less than 30, and to keep ΣR a minimum.

Astronomic Azimuth—Astronomic azimuth observations were taken at station Long Ridge. Time was determined by the method of altitudes of stars near the prime vertical. Four double altitudes each on a star in the east and one in the west were taken both before and after the horizontal observations. The horizontal angle between Polaris and the mark was measured by the same method as horizontal angles, 72 readings being taken. The time of observation and readings of the stride level in direct and reversed position were taken at each pointing on Polaris.



FIG. 5. OBSERVING TENT



FIG. 4. SETTING A STATION

The mark was an ordinary flashlight centered over another station 10 miles distant. This azimuth was tied into a line of the U. S. Geological Survey triangulation, with which it checked to 1.6 sec.

Triogonometric Leveling—Vertical angles were observed at all stations. A double altitude consisted of a pointing direct followed by a pointing in the reverse position. Three double altitudes were taken on each signal. This is the same method as that of double zenith distances, except that the circle was so graduated as to give plus and minus altitudes instead.

The difference in elevation of each pair of stations was computed by the formula: $h_2 - h_1 = s \tan \frac{1}{2}(a - a_2)(ABC)$, in which h_1 and h_2 are elevations of the stations, a_1 and a_2 are the measured altitudes corrected for height of instrument and object observed, s is the horizontal sea level distance, and A, B and C are factors for correcting the difference of elevation for mean height above sea level, and for distance on the Clarke spheroid.

The discrepancies in computed elevations indicate the probable error of the trigonometric leveling to be $\pm$ 2 ft.

The entire work, field and office was executed by the engineering department of the Southern California Edison Co. at the head of which is H. W. Dennis. The work was under the immediate supervision of Dr. A. B. Pierce. Twenty-two stations were set and occupied by C. L. Randolph and the remainder, together with the base-line measurement, were placed and occupied by the author.

Plans for 1,170 Miles of Forest Roads

A program of national forest highway construction involving an outlay of approximately $10,000,000 for 1,170 miles of road in 23 states has been approved by the Secretary of Agriculture to be financed largely from the forest highway fund of the Federal Highway Act.

Cast-Iron Pipe Problem and Centrifugally Cast Pipe

Abstract of Committee Report and Papers
Before American Water Works Association

Report of Committee on Specifications for Cast-Iron Pipe

ON the question of specifying the chemical quality of the metal and a definite relation between breaking load and flexure, the outstanding event of the year was the submission to the committee of the report of Dr. Richard Moldenke, who had been employed by the manufacturers to make an extensive investigation. This investigation involved the casting of some 800 test bars at eight different foundries—one-half of which were cast according to the present water-works standard 1x2-in. flat bar, and the other half according to the A. S. T. M. standard 1¼-in. circular "arbitration" bar. All bars were broken transversely and in the case of the round bars one or more of those showing a transverse strength nearest to the average transverse strength were taken for complete chemical analysis and tensile test.

Chemical Tests of Pipe Metal—As to the feasibility of a specification for chemical quality of the metal, Dr. Moldenke finds strongly in the negative, except in the case of sulphur for which he suggests a maximum limit of 0.12 per cent in lieu of the 0.10 per cent recommended by the committee in the tentative revision issued several year ago. His reasons for opposing the specification of chemical quality is that no constituent has an effect which is not dependent upon the amount of other constituents; that the analysis of a test bar may be quite different from the analysis of the same metal when cast in the pipe; and that the final value of the metal is dependent on many other conditions than are disclosed by chemical analysis of a sample taken from the ladle.

Your committee has reached no conclusion in reference to the adoption of specifications of chemical qualities. We are impressed by Dr. Moldenke's argument and also by the expense and time required to make analyses as a day-by-day part of the work of inspection, and it is not improbable that the final decision will be that such specifications, with the exception of sulphur, are impracticable. It is of interest, however, to note that by a very slight widening of the limits set by the chemical specifications included in the tentative revision of the committee, all the bars analyzed by Dr. Moldenke would pass and that, on the other hand, practically all the freak irons which have been found by F. A. McInnes in pipe, broken in use and which he is to describe to this convention [see accompanying abstract.—EDITOR] have analyses which would have thrown them into the discard, if subject to the chemical specifications suggested by the committee.

Relation Between Load and Flexure—In reference to the specification of a relation between breaking load and flexure in test bars the manufacturers have accepted the principle involved as sound and a reasonable means of checking the possible development of strength at the expense of resiliency. At the first conference with the manufacturers in January it was agreed that the chairman of the New England and American committees prepare a tentative draft of a revised test bar specification. As submitted to the manufacturers, this draft called for a transverse breaking load of not less than [illegible] deflection for bars breaking at 1,900 lb. of not [illegible] lb., and for bars breaking at higher loads a deflection of 0.10 in. plus 0.025 in. for each 200 lb. of load [illegible] lb. When this specification was applied by Dr. Moldenke to the bars broken by him, it was found that a [illegible] would be rejected. As these bars were [illegible] of present practice, this result at once raised questions as to whether a more resilient iron is necessary and as to whether such an iron can be economically produced.

At a meeting with the Test Bar Committee on April 15, your committee took the position that the revised specifications should lead to the development of the best metal which is economically possible and should not be framed on the assumption that the present irons are as good as can be produced at reasonable cost. It was admitted that the percentage of scrap used—owing to high freight rates and war residues—is now and will be for years to come abnormally high, and while the manufacturers insist that they are making as good pipe as at any time in the history of the industry, it was the judgment of the committee that a further investigation should be undertaken to determine whether a better material than that tested by Dr. Moldenke is economically possible. Accordingly the manufacturers generously undertook to finance further work by Dr. Moldenke and he, in co-operation with W. R. Conard of the joint committee, was authorized to determine by actual variation of the mixture of pig iron and scrap, at one or more foundries, whether an iron which will more nearly meet the tentative specifications for relation between breaking load and flexure can be economically produced. This work is already begun and it is hoped that the report will be available before the end of the year.

One of the interesting recommendations of the Moldenke report is that a new test bar, 20 in. long, with a diameter of 1⅜ in. to be broken between supports 18 in. apart, should be substituted for the present water-works standard 1 x 2-in. flat bar which is broken between supports 24 in. apart. The committee is not convinced that the circular bar is an improvement, but it has subscribed to Dr. Moldenke's recommendation to the manufacturers that parallel tests on the present and suggested type of bars should be carried on for six months.

Improved Coating—In the problem of developing an improved coating no definite progress has been made during the year, and in the absence of any available funds there appears to be little prospect of being able to undertake the work.

Present methods of coating pipe have small regard for the present specifications. The material used is generally crude coal tar, or inferior water gas tar and not a "pitch"—as required by the specifications—except so far as the crude tar is refined to a pitch by the distillation which takes place in the dipping tank. Temperatures are not accurately controlled and overheating, particularly in the case of heavy pipe, is responsible for thin brittle coatings of little value as a protection to the metal.

The manufacturers will furnish just as good a coating as the users of pipe demand, and it is the present feeling of the committee that the most direct road to the development of a better standard is for those engineers and superintendents who appreciate the economy of maintaining the carrying capacity of pipe lines, to adopt a specification which will guarantee the use of a straight coal tar pitch and such control of the heating of the pipe and bath as will prevent injury to this material in its application to the pipe. The tentative specifications for tar issued by your committee in 1916 will insure the use of coal tar pitch. [See *Engineering News-Record*, May 31, 1917, p. 449, for tentative specifications.—EDITOR]

Your committee believes that, in view of the possible fundamental effects of certain [illegible] of making pipe on the problem of standardization, it is perhaps fortunate that we have made progress enough to [illegible] any definite revision of existing specifications.

[Reference is apparently made to centrifugal casting, which gives a pipe of high tensile strength and has a bearing on the mooted question of outside diameter. See brief summary of this same committee report, *Engineering News-Record*, May 25, p. 882, also abstract of Prof. Gillespie's paper on centrifugal casting, herewith.—EDITOR.]

The committee is composed of Frank A. Barbour, chairman; Walter Wood, Edward E. Wall, N. F. S. Russell, William C. Hawley, William W. Brush.

* * *

Centrifugally Cast Iron Pipe

BY PETER GILLESPIE
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THE problem of employing a revolving mould in the process of casting is one that for generations has appealed to the inventor, and it is indeed astonishing that developments along this line have been so long delayed. The history of early attempts to solve it is one marked mostly by failure in which the names of Eckhard, Taylor and Wailes, Huth and others appear. No significant progress in the application of the method to commercial production in the metal industry seems to have been made until quite recently and although it is now employed in the production of articles of non-metallic and non-ferrous composition, it is with the manufacture of cast-iron bell-and-spigot pipe with which this paper is primarily concerned.

The de Lavaud Process—For the manufacture of cast-iron by the de Lavaud process, a plant consisting of a cupola, a revolving water cooled molding machine, an annealing furnace and a dipping vat is required. The molten metal is first transferred from the cupola to a tilting ladle at one end of the machine. This ladle holds slightly more iron than is required for a single pipe of the size to be cast. By an ingenious and perfectly controlled hydraulic device, this ladle can be made to discharge its contents into a cantilevered water cooled trough which projects into the interior of the revolving mold and from the forward end of which iron is permitting to discharge in a stream lying nearly in the plane of revolution.

Revolving Hollow Water-Cooled Mold—The machine includes an accurately made hollow cylindrical mold whose inner dimensions are identical with the outer dimensions of the finished pipe, including the enlarged bell end. This mold is revolved on its axis by an impulse water wheel integral with it, inside a cylindrical stationary casing, the annular space between the two cylinders being filled with cooling water which is continually changing under a moderate pressure maintained at the inlet end. Escape of this water at the ends of the machine between the moving mold and the stationary casing is prevented by the use of gland-like rings somewhat similar to collar thrust bearings employed in marine work. The revolving mold is supported at two points in its length by two sets of friction rollers which have bearings on the inside of the casing and are lubricated by grease cups accessible from the outside. To shape the inside of the bell a single small core is used—the only one employed. This provides an annular shelf for the centering of the spigot and the undercut chase in the bell for the reception of calking lead when the pipes are jointed in service. No bead is provided at the spigot end, this feature being omitted in order that the pipe may be drawn from the mold after solidification of the iron has taken place. The casing and its contained mold are made to travel back and forth on horizontal ways by means of a hydraulic cylinder installed beneath the casing.

Pouring and Spinning—Assume the tilting ladle filled with the necessary quantity of molten iron and the movable casing run forward so that the extremity of the cantilevered trough registers even with the remote end of the mold, which is always the bell end. The turbine is started and when the mold has acquired its proper speed, the tilting ladle is tipped forward discharging its contents into the cantilevered trough. The observer at the bell end signals the first appearance of the molten metal at his end of the pipe whereupon the operator in charge of the hydraulic cylinder immediately starts the backward movement of the casing on its ways. The fluid iron is thus supplied to the mold continuously right out to the spigot end. In contact with the cool revolving mold it solidifies in a few seconds and shrinks from the mold slightly but sufficiently to be withdrawn therefrom by a special hook that engages the spigot end when the casing is again moved on its way in the forward direction. The pipe is then passed directly to the annealing furnace in which case its residual heat is conserved or is allowed to cool in air. The normal output from a machine is 14 6-in. pipes per hour, the operating gang numbering seven men.

Annealing—The process of annealing comes next. The furnace is oil-fired. In it the equivalent of five 6-in. pipes may be treated simultaneously. By a mechanism, these pipes are slowly revolved as the blast plays on them so that all portions are equally heated. This prevents warping and secures uniformity in quality in all parts of the pipe. The temperature is controlled by optical pyrometers.

Comparative Weights—Class C pipe, manufactured for water-works service in accordance with the specifications of the American Water Works Association, has for 4, 6 and 14-in. sizes weights of 23.3, 35.5 and 116.7 lb. per lineal foot respectively. De Lavaud pipes of the same nominal sizes have weights of 15, 24 and 62.5 lb. per lineal foot respectively.

Tests of Pipe Material—The metal in de Lavaud pipe is a fine grained gray iron, uniform in appearance and texture, remarkably free from blowholes and slag pockets and having a wall of thickness surprisingly uniform. From time to time the writer has conducted tests on these pipes and on samples of metal cut therefrom for the purpose of comparison with material cut from sand mold pipes poured from the same heat. In one instance, the two materials when analyzed gave the following results:

Constituent	Machine-Made Pipe Per Cent	Sand Cast Pipe Per Cent
C	3.45	3.67
Mn	.49	.61
S	.053	.044
P	.563	.654
Si	2.48	2.00

The tensile strength of the machine-made cast-iron was 37,000 lb. per square inch; that of the sand mold iron was 16,000 lb. per square inch.

The modulus of rupture in cross-bending for the former material was 64,000 lb. per square inch; for the latter, 34,000 lb. per square inch.

The resilience in inch pounds per cubic inch, determined from cross-bending, was 20 for the former and 10 for the latter. The modulus of elasticity, determined also from cross-bending, was 15,400,000 lb. per square inch for the former and 8,600,000 lb. per square inch for the latter. Roughly, therefore, *the strength both in tension and cross-bending, the resistance to shock and the stiffness are about twice as great for machine-made iron as for the sand-cast product.*

In another and more recent series, the tensile strength of the machine-made product averaged 40,000 lb. per square inch; that of sand cast iron, 18,000 lb. The modulus of rupture averaged 59,000 lb for the former and 37,000 lb. for the latter, each item being the average of four determinations. A 6-in. pipe tested by the writer recently sustained an internal hydrostatic pressure of 2,100 lb. per square inch without failure. As the walls were 0.32 in. thick and the internal diameter was 6.25 in. the circumferential tensile stress in the metal shell was practically 20,000 lb. It was the intention to test this pipe to destruction, but the end gaskets gave out at the pressure indicated.

Accurate determinations of the weight per cubic foot showed that the two materials differed but little in this respect. This weight was 433 lb. per cubic foot for each class.

The chilling of the outer layer of metal in pipes made by the de Lavaud process results in the formation there of a thin annulus of white iron. To convert this to a gray iron, the pipes are annealed, as stated above. The molecular

structure after annealing is however different from that of sand-cast iron. The graphite is more finely divided than in the latter where large flakes of that material are in evidence. In this the explanation of the greater strength of the machine-made material probably lies.

Long Life and Other Possibilities—Further, in the fact that smooth metal rusts more slowly than rough (machine molded pipe is unusually smooth, especially on its outer surface), an indication as to long life may be found. Recent researches in the field of electro-chemistry have established pretty well the principle that a metal which is homogeneous in its structure and properties is not likely to develop those differences of electric potential that make for corrosion in service. May not, therefore, the homogeneous structure characteristic of de Lavaud metal be also an indication of its capacity to resist well common influences tending toward corrosion?

The de Lavaud process is one that has great possibilities for usefulness and economy. To the manufacturer it means less metal, less labor, and less foundry space since areas for storage and mixing of sand and for flasks are not required. Moreover the number of rejections at the point of inspection is remarkably low. These circumstances favor an increased output. To the shipper and the customer the lessened weight is an important consideration. The user finds the absence of imbedded sand grains a matter of much importance when he comes to machine the metal, which he finds of uniform texture, free from blowholes, easily worked, and capable of taking a clean steel-like thread when tapped for house connections. To him also the smooth interior and greater cross-section of bore for a given outside diameter are circumstances of some account, favoring increased carrying capacity. All in all the development marks a significant advance in the replacement of manual labor by the machine so characteristic of the industrial achievements of the present century.

Manufacturing rights for de Lavaud pipe within the British Empire, exclusive of Canada, are held by the Stanton Iron Work, Nottingham, England, one of the largest manufacturers of cast-iron pipe in the world. The rights for the United States of America are held by the United States Cast Iron Pipe & Foundry Co., and those for the Orient, including Japan, China and Siberia, by Tsuda & Co., Osaka, Japan. The Canadian company, the National Iron Corporation of Toronto, is to day supplying its product to users distributed throughout Canada from Halifax on the east to Vancouver on the Pacific Ocean.

* * *

Causes of Failure in Cast-Iron Pipe

By F. A. McInness

Engineer Water Division, Public Works Department, Boston, Mass.

THE quality of the metal put into cast-iron pipe is not sufficiently safeguarded in the standard specifications of the water-works associations. Test bars are required to support center loads of 1,900 lb. in the New England and 2,000 lb. in the American specifications and to show a deflection of 0.3 in. before breaking. Because no direct connection is made between the loading and the deflection, 0.3 in. deflection is not shown in many cases until the load is in excess of 2,000 lb., oftentimes largely in excess. Of 2,183 test bars broken by the Metropolitan Water Board of Massachusetts in the past nine years, 905 or 41.5 per cent showed less than 0.3 in. deflection at 1,900 lb., the range being from 0.18 to 0.43, and about 20 per cent [illegible] from 0.18 to 0.24, with 389 or 18 per cent between [illegible] and 0.24. [The figures are given in more detail in the original paper.]

The question naturally arises, "Why not specify the composition of the iron, stating just what percentage of the different elements will be allowed, as is done in the manufacture of steel?" There are practical objections to this course based on the differences in ores and coke throughout the country, on the necessarily different [illegible] of thick and thin pipe, on the practical difficulty of making such a provision effective, on the possible [illegible] of specifying both physical characteristics and composition of metal, etc. The writer, however, believes that the permissible sulphur content at least should be specified; with this provision, together with a logical relation between flexure and breaking load fixed in the test bar requirement, a long step forward towards uniform and satisfactory iron will have been taken.

Metal Analyses—Analyses of metal from some of the pipe in the Boston water-works that has been found broken or cracked during the past twenty years, and from broken pipe at St. John, N. B., and Hartford, Conn [reported in detail in the original paper] show some "horrible examples." Witness the 48-in. Boston pipe, laid in 1869, on which there were six breaks between Oct. 19 and Dec. 5, 1900, following a 15-lb. increase in working pressure. This pipe showed combined carbon of 0.04 and silicon of 4.05. A 24-in. pipe at Hartford, Conn., which broke in 1921, showed combined carbon of 0.03 and phosphorous of 1.86. Omitting extremes, the remaining analyses, particularly those in which the sulphur is abnormally high, warrant the conclusion that the quality of the iron was a contributing if not a direct factor in the failure of the pipe. As a rule, two specimen pieces taken from different parts of the broken pipe, were submitted for analysis and in no case was a substantially different result obtained from the bell-and-spigot end of the same pipe.

Higher Standard Suggested—Cast-iron pipe is not a homogeneous material; when pig iron and scrap iron are melted and made into water pipe, the resulting cast iron must vary to some extent in its physical characteristics, owing to differences in the material used in the cupola and to the methods employed in moulding, cooling, etc.; the process of manufacture demands a high degree of skill and oversight if the product is to maintain the uniform quality desired. That this condition does not always exist is apparent to those familiar with the output of cast-iron water pipe. There are notable exceptions, but on the whole it would appear that the general standard of manufacture might be raised to the advantage alike of maker and consumer, to the end that a well coated pipe of uniform and sufficient strength, equal at least to the best of the present product, may be absolutely depended upon.

The writer is one of those who believe in cast-iron pipe for water-works distribution and supply systems, recognizing it to be best suited to meet the conditions usually found; and as its friend, advocates the application of more scientific method in its manufacture than now obtains in many cases.

North Carolina Highway Contracts and Costs for March

During the month of March the North Carolina State Highway Commission let contracts for 138.25 miles of highway at a total cost (exclusive of the usual 10 per cent for engineering and contingencies) of $2,322,975. Of this mileage, 32.62 miles were of the standard types of hard surface construction, i.e., plain and re-inforced concrete and various asphaltic types, costing $1,040,800; 53.35 miles were of waterbound and penetration macadam, and two-course gravel construction, costing $902,660; and 52.28 miles were of sand-clay, topsoil, or one-course gravel construction, costing $379,515. The widths of all surfacings were about equally divided between 16 and 18 ft. The average cost per mile of the hard-surface types was $31,907; of the macadam types, $16,920; and sand-clay and topsoil types, $7,259.

The foregoing figures include all necessary clearing, grubbing, draining, overhaul, reinforced-concrete bridges, and all other work incidental to the proper completion of the projects. The total cost of bridges and culverts (included in the above) amounted to $274,145, making an average cost for these structures, per mile of road, of about $1,983.

Pennsylvania R. R. Will Extend Lines to Detroit

Project Now Under Way Includes 20-Mile Cut-Off and Large Terminals—Gravity Yard and Double-Deck Freighthouses

RENEWAL of active construction work on the Detroit extension of the Pennsylvania R.R., including a new line and extensive terminal facilities, is an important feature in railway development which was authorized in May and will cost about $16,000,000. This new extension of the Pennsylvania R.R. System has been proposed for some years, since its Toledo terminal is within sixty miles of a great manufacturing and shipping center at Detroit. Work was commenced shortly before the World War and was resumed when the railways had been returned to private ownership after the war, but owing to unsettled and unfavorable conditions little progress has been made until the recent order for the completion of the work. The line is being built under the name of the Pennsylvania-Detroit R.R.

Since the general route is already traversed by several existing lines it was found economical to utilize these as far as possible by obtaining trackage rights; but a new line will be built for about one-third of the distance. For the past two or three years the Pennsylvania R.R. has been operating passenger trains between Toledo and Detroit over the Père Marquette R.R. and Wabash R.R. by way of Romulus, Mich.

Toledo-Detroit Line—Starting in Toledo at the junction of the Pennsylvania Lines with the Ann Arbor R.R. near Galena St. this latter road will be used to Alexis Junction, 4.37 miles, and will be double-tracked by and at the expense of the former road. From Alexis Junction the Pennsylvania Lines have secured joint trackage and industrial rights on the double-track line of the Père Marquette R.R. to Carleton, a distance of 25.33 miles.

A new 20-mile line now under construction will extend from Carleton to a junction with the double-track line of the Wabash R.R. just west of its bridge over the River Rouge. Ultimately this will be double-track but only a single track will be built this year. The new line will reduce the distance by about 4½ miles as compared with the present route through Romulus, Mich. From this new junction trackage rights have been secured from the Wabash R.R. for about one mile to Delray. Beyond this point both trackage and industrial rights have been obtained from the Wabash and Père Marquette railroads as lessees of the Detroit Union R.R. and the Fort St. Union Depot Co. Thus the Pennsylvania R.R. will have joint use of the passenger terminal at Fort and Third Sts. which is within a half-mile of the city hall.

The Carleton cut-off or new 20-mile line will branch from the Père Marquette R.R. with a light curve and continue as a long tangent to the west end of the Ecorse yard, where a slight angle will be made and the two main tracks will encircle the yard. The one track now being built passes on the north side of the yard. Between Toledo and the Ecorse yard the maximum grade will be 0.3 per cent. On the passenger tracks there will be grades of 1 per cent around the yard and on the approach to the viaduct leading to the Fort St. union station. Grading for the new line and for that part of the Ecorse yard to be built this year will amount to about 350,000 cu.yd. The only important bridges are a double-track reinforced-concrete arch bridge having four 40-ft. spans and the steel bridges over the Ecorse freight yard. The former bridge was partly built in 1918-1919 at which time the substructures for the other bridges were built. All main line junctions and grade crossings will be equipped with interlocking switch and signal plants.

Terminals and Yards—A large terminal freight yard with gravity switching will be built at Ecorse, at the

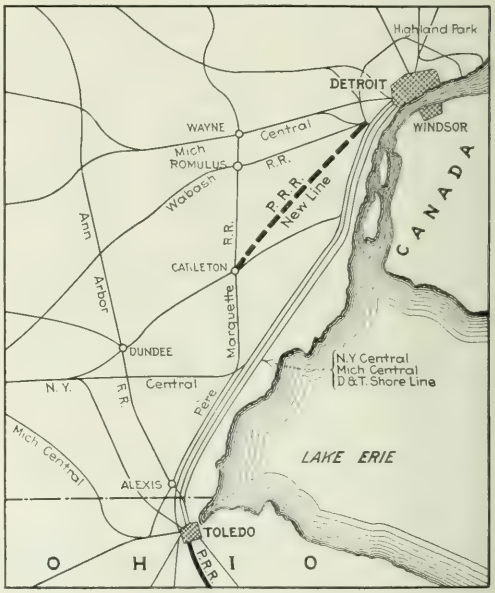


FIG. 1. DETROIT EXTENSION OF PENNSYLVANIA R.R.

east end of the new line, about 300 acres having been obtained for the site. There will be two hump yards for northbound and southbound service, together with an engine terminal for freight locomotives. The combined capacity of these yards will be about 12,000 cars and the partial development carried out this year will provide for about 1,100 cars. At present only temporary engine facilities will be provided as it is intended to have the freight engines make round trips from Toledo.

An extensive city freight station will be built, the Pennsylvania lines having purchased all the property between Congress, Larned and Third Sts. and Brooklyn Ave. The tracks will branch from the viaduct of the Union Depot line and will enter the second-floor level of the freight station. An inbound freight house 80 x 1,060 ft. fronting on Congress St. will have three storage floors above the track floor. An outbound freight house 60 x 700 ft. will front on Larned St. Between these two buildings and at the upper or track level will be four team tracks with standing capacity for 95 cars, this yard having two driveways reached by an inclined approach from Second St. with a bridge over Third St. This year only the outbound house will be built and will serve temporarily for both inbound

and outbound business. It will be a steel frame structure with brick walls.

A city team-track yard within 2½ miles of the city hall has been provided for by the purchase of ten acres fronting on Fort St. between Summit and McKinistry Sts., extending about 1,000 ft. to the joint tracks. This yard will have a capacity eventually for about 250 cars and it is proposed to build trackage for about 90 cars this year. Passenger equipment will be provided for by a new engine house and coach yard to be built between 12th and 21st Sts. Part of the property to be improved is occupied by the roundhouse and coach yard of the Père Marquette R.R. but the old building will

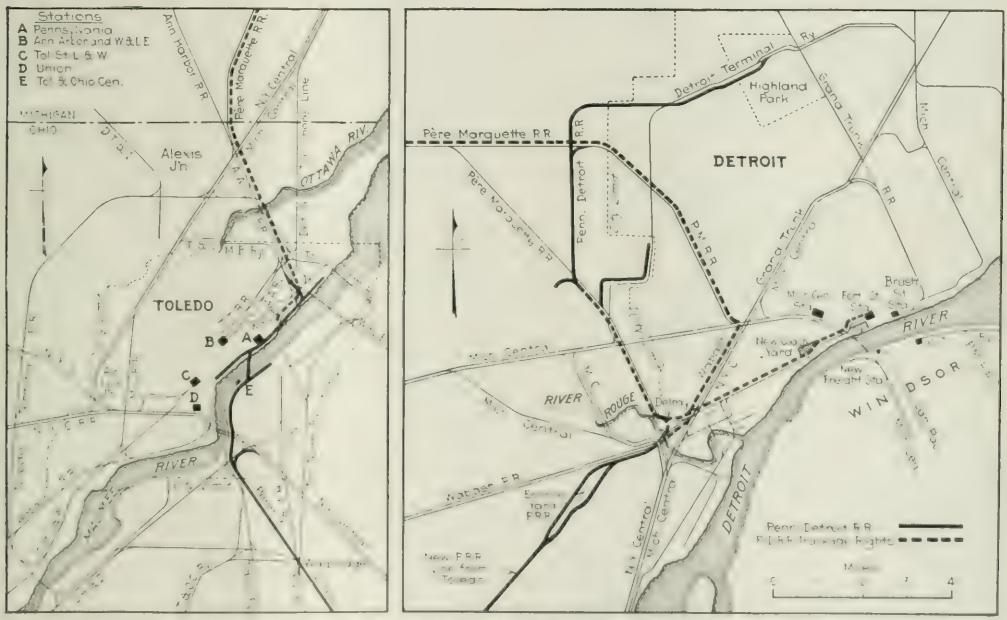


FIG. 2. TOLEDO AND DETROIT TERMINALS OF PENNSYLVANIA-DETROIT LINE

make way for a larger structure for the joint use of the two railroads.

Important industrial connections are included in the project. In addition to those connections along the present tracks from Delray to the passenger terminal the Pennsylvania Lines have secured trackage and industrial rights over all tracks of the Père Marquette and Wabash railroads east of the River Rouge, as indicated by dotted lines in Fig. 2. The Pennsylvania Lines have also constructed the industrial branches shown in solid lines. It is proposed to construct this year the wye connection between the Père Marquette and Wabash railroads just east of the River Rouge and also the extension from the present end of the line around Detroit to Highland Park, thus completing an industrial belt line. Other extensions to be built in the future by and at the expense of the Pennsylvania Lines are required by the agreement with the other two lines and will be subject to joint use by the latter at their option to an extent equal to half the values placed on their respective terminals in Detroit.

Engineer and Contractor—E. [illegible]ville is chief engineer of the Pennsylvania-Detroit R.R. (Pennsylvania Lines). Grading on the new line from Carleton is being done by Iliff Brothers, London, Ohio, and the Ferguson & Edmund Son Co., Pittsburgh. The former firm will also complete the concrete arch bridge and the steel bridges will be built by the American Bridge Co

Defective Buildings in Wisconsin Inspected

Recent special inspection of buildings by the Industrial Commission of Wisconsin, which administers the state building code, showed a sufficient amount of defective building to afford a strong argument for competent supervision of building design and construction. In the quarterly report of the state engineer, just issued, the situation is described as follows: "The combination of circumstances including the Knickerbocker Theater disaster and the unusual ice storm in the northern part of the state, resulted in a very large number of requests from various parts of the state for inspection of buildings which were suspected of being unsafe. In most cases the conditions were not alarming. In several instances yielding had taken place because of the load and of construtcion not in accordance with standard practice, chiefly in the case of buildings erected ten to fifteen years ago, before the state building code was in effect. Improper setting of well designed roof trusses, omission of members in trusses, and substitution by contractors who did not understand fully the mechanics of materials, as well as faulty building up of roof supports and floor supports, were some of the defects noted. The conditions emphasize the need for supervision of building design and construction, and the careful checking of plans and field inspection." John G. D. Mack is state chief engineer, and R. M. Keown is engineer of the Industrial Commission.

The American Construction Council—Its Field for Service

Vital Need for the Establishment of Aggressive Business Honesty and Co-Ordination of all Elements Voiced in Two Addresses at Washington Organizing Conference, June 19-20

Need of a Vital Code of Ethics in Business

By F. M. Feiker
Vice-President, McGraw-Hill Co., New York City

IN accepting at short notice an invitation to speak before this body I am presenting the views not of one who has been active in the construction industry but of an interpreter and observer over the last fifteen years of a trend in our industrial life which seems highly significant.

There are distinct indications today of forces at work in business life which can re-create the purposes of commerce and set high standards for the conduct of business not only for America but for the world. In hundreds of meetings, across scores of luncheon tables, men are discussing the necessity for a new industrial leadership and the opportunity for that industrial leadership in America. The fine thing about these discussions by thoughtful men is that each sees in his own profession that opportunity for leadership. The lawyer, the engineer, the economist, the statesman, the industrialist, the banker, the manufacturer, the merchant and the salesman—men in all fields of professional and commercial activity, are thinking in new terms of their work, and each in a different way is giving expression to a universal desire. Each is really trying to answer the question, old as civilization, which was phrased by Dean Kimball of Cornell, "What is mine and what is thine?"

Opportunity for Leadership — America above all other nations offers the most fruitful opportunity for a new leadership. Our social structure is not laid up in a stratification of classes. It is still possible for a newspaper publisher to become President of the United States and for a steel-mill hand to head the works. We are, as Americans, idealists. Business to us is an end in itself and not merely a means to an end. The novelist in interpreting the social responsibilities of industry, usually to its disparagement, is prone to overlook this fact. There is something truly American in the possibility that a man, only twenty years old, may come to our shores from Egypt and in ten years become owner of a factory and two retail stores.

The ferment for a new leadership of industry may all be considered from the viewpoint of the professionalizing of commerce. We are, as a nation, strong individualists. As Secretary of Commerce Hoover has put it, we have a very high individual efficiency in industry, but a very low collective efficiency. Creative business men are seeking for new measures of value. Service as a basis for profit-making is coming to be recognized as the true motive for creative industry. Business men are establishing codes of practice in all lines of industrial activity. Men in business are as human as artists or lawyers or chemists, and the ethical standards of men of business are no higher and no lower than the ethical standards of our people as a whole. What is apparent in industry, however, is a conscious effort, a definite attempt to make its standards known, to put commerce on a high plane, and to base creative industry on high ethical principles.

Ethics and Business Conduct—Perhaps the most complete single contribution recording the professional trend of industry, which in a word is the blending of the service motive and the profit motive, is found in the *Annals* of the American Academy of Political and Social Science for May, 1922. Clyde L. King, the editor of this most complete summing up of the status of codes of ethics in the professions and in business, points out in his foreword that codes of ethics are important agencies of social control. "Until recently," says Dr. King, "business was looked upon solely as a means to a selfish end. The ethics of business were those of the barter market. The buyer could beware. The sole test of the seller was what he could get away with. But modern transportation systems have changed all this. Oranges grown in California must now be marketed in Philadelphia and automobiles are made in Detroit to be sold in the Orient. The manufacturer sells to distant unknown customers through advertising. Even contracts to buy and sell are let by word of mouth. Selling prices must now be announced before goods are produced. Business hangs more and more on good faith. The old adage 'A man's word is as good as his bond' acquires new meaning as a business asset."

Within a few days we have also the testimony of a man recognized as a maker of industrial opinion in this country—Judge Gary of the U. S. Steel Corp. In a commencement address at Northwestern University, Judge Gary said: "It may be asserted with absolute confidence that within the last twenty years or more there has been a decided change in the standards and conduct of business. To my personal knowledge many of the most intelligent managers of business affairs, some very large and others smaller, who have laid down the cares and difficulties of this life, before their final departure completely changed their opinions and reversed their methods concerning ethical questions.

"This applies also to many who are still living. Hundreds upon hundreds, yes, thousands upon thousands of business men, all over this country, who twenty years ago believed that the subject of ethics had little if any rightful place in business conduct, now assert and insist that it is essential and controlling. A man of high intelligence and probity about ten years since, while testifying in court, alluding to a large business concern, said: 'He introduced new rules into the business game.' I think it properly may be claimed multitudes of leading business men during the last two decades have voluntarily devoted more and more time and energy in a conscientious desire to conduct their business in accordance with the rules of propriety and honesty.

"Business throughout the United States is today transacted on a higher plane than ever before, though of course, there is always need for further improvement.

"There is another convincing reason for the noticeable changes resulting from the adoption of ethics in business. While the motives are not equally worthy with others, they are very practical and influential with many who would not otherwise be converted. Ethical management brings additional profits to business. Sooner or later it pays in dollars and cents.

"If by honesty and fair treatment we satisfy our patrons they will show it in all their dealings. They will be less disposed to be hypercritical. They will be reasonable in all their transactions with us and insist upon only what is practical and proper under all existing conditions and circumstances; and if the producer, or one who renders service, professional or otherwise, is assailed by outsiders they will champion his rights. This is of much value in times of stress or of unjust criticism.

Analysis of Code of Ethics—Thus we have stated both from the broad point of view of society as a whole and the practical advantages to those activities of society by which it works and earns—business—the value of codes of ethics as a base.

A consideration of the practical accomplishments of such codes of ethics as have been established can be found in the Proceedings of the American Academy already referred to.

A review of codes of ethics which have been developed

in industry and the professions suggests two broad generalizations as a basis for the development of a code of ethics on the fact of this organization. The first generalization is this:

Develop your code of ethics in such a way that the principles it communicates will be *"seven-day standards of operation and not seventh-day standards,"* and second;

Provide some machinery for their enforcement and review—make them principles of action; not passive platitudes.

Aggressive Honesty Needed—I have had two or three personal experiences in the development of codes of ethics that have brought the truth of both these generalizations home to me. I would suggest the preparation of a code of ethics into two divisions. In the first put the fundamental statements of what constitutes right or wrong in the relations between members of the organization, and in the second, develop ethics in parallel with economics. To state that "honesty is the best policy" is a fundamental; but more essential is it, to make this statement of passive honesty a fighting weapon of truth by shaping it in terms of business practice such for example as who shall receive commissions and on what basis for sales of goods and of services.

It is not fair to the principles of ethics or of economics to assume that a passive policy of honesty will produce business. What we need is policy of aggressive honesty in creative business. Business is a flowing river not a placid lake or stagnant pond.

Take a business of manufacturing and distributing goods. A code of ethics may be established in which the manufacturer agrees that it is wrong to do engineering; the jobber that it is wrong to retail goods. This static ethical agreement might stagnate completely the development of an industry in its service to the public.

If a code of ethics can be devised in which the facts of the numerator are the elements in the industry and the common denominator is the public, the quotient of this fraction will be an aggressive principle of ethics.

Nor does mere statement of an ideal code of ethics suffice. Machinery is needed to put the code into action; to promulgate and develop the truth. I would think it most practical that some system of local non-partisian boards of review be established as the working basis for such an aggressive code of ethics in the great industry which this council represents. Out of such local boards will come the development of principles of accepted business practice grounded on the sound basis of ethics and economics.

Forces to Be Put at Work—To make an aggressive policy the great industrial educational forces of the country need to be put into active co-ordination. There are in my opinion five such great educational forces so constituted and organized that they can be made available:

1. The industrial press.
2. The technical press.
3. The engineering and professional schools.
4. The specialized trade and technical associations.
5. The Government and especially the Department of Commerce.

The Integrity of American Business—Business needs no apologies. American business at heart is sound in the same degree and for the same reasons that the nation itself is sound. Individually, American business men set high standards for themselves in a very practical way. Specifically, if you ask any so-called successful business man what he looks for first in hiring his associates, he will either answer directly in terms of character or picture his specifications in such a way that character is very evidently the thing he is trying to get at. That the essential quality of individual integrity and character is vital basis for creative business enterprise is shown by the fact that once a man stumbles in full view of the public, the whole structure of business he may have reared tumbles to the ground because he will no longer be trusted. There are legendary tales of so-called big business men whose "private morals and personal ethics were their own business," but we have had many illustrations of the fact that masterfulness in business can be attained and held only by the sweetness and soundness of personal morality.

It is the collective expression of high ethical standards for the individual which is the foundation for the professional standards of men acting in groups. The structure of business itself rests on credit, which is nothing in the world but a collective appreciation of character.

American industry of the future, with a new vision of service expressed in the practical terms of the professionalizing of industry, is the hope of a reconstructed social and industrial fabric. The United States of America may leave an impression on civilization different in character from that made by any other nation and moving the world forward in a way that no other nation has done. America's expression in civilization must be essentially commercial. We are a commercial nation. But there is nothing cheap in this conception. We have high ideals for commerce We are creators and dreamers. Rome left its imprint on civilization in war; Greece, in art. America can leave its imprint in the new sense of service which finds expressions through commerce and industry.

* * *

Co-Ordinating All the Elements of a Great Industry

By Willis H. Booth
Vice-President, Guaranty Trust Co., New York City

THERE are so many kinds of business which, broadly speaking, enter into the construction industry, and these in turn are affected by so many divergent interests, that it is a really great task to gather them co-operatively together. But the very fact that the component parts of construction are scattered in interest and direction emphasizes the importance of an effort to assemble them so that they may function to good purpose.

Differing from most easily determined industries and, at the same time, touching or comprehending practically all industry, construction has been a hard line of business to get into intense co-operation. It is so widely scattered in its character that it has been obliged by force of circumstance to gather itself into a great many groups, each representing a phase of the business. This was one of the steps in the evolution that has brought us by perfectly normal stages to this meeting this morning. It would be entirely impossible to accomplish what measures up to the ambition of this meeting if we had not previously organized national trade associations of one character and another, which, in the main, comprehend the entire industry.

Obstacles to Complete Accord—I appreciate full well that it is not going to be an easy thing for any council of men, no matter how intelligent or how fair the method of selection, to gather together at any time and be able to guide all of the factors in such a great industry as this. There are so many branches of the business. Construction materials, broadly speaking, are but raw materials; and construction equipment but tools. And then the contractor comes in and, whether it be a building or a bridge, a highway or an ocean liner, by assembling the raw materials and equipment and furnishing labor and executive direction, he produces the ultimate structure. It is only necessary to recite these component parts of raw material, labor, equipment and executive direction to emphasize again their mutual dependency. The executive direction implies the business management of the contractor associated with the highly technical skill of the architect and the engineer. As the matter now stands these component elements are thinking of construction largely in the light of its particular interest to them. This is natural. But in forming this council we appeal to a more enlightened selfishness and feel confident of support on the basis of a more intelligent service to the public. It is this intelligent co-operative service which we hope to demonstrate will be of great practical value to every individual whose contact reaches to the construction field. This council is designed to be primarily a practical thing. The construction industry

in not devoid of vision. No one who builds anything can do so without vision. We know that if this movement can be worked out to its ultimate that the entire standards of construction operation will be bettered and relationship with the public be even greater increased in confidence and respect.

Harmony of All Interests Paramount—But just as we had to reach to the council over the road of trade associations, in the same way this council must reach its ultimate ambition over the road of quietly and gradually developing co-operation between labor, material, equipment and management. In setting up the organization we are only doing a roughing-in job. We are perfectly familiar with the fact that as matters now stand the manufacturer of any of the various materials entering into a job has little or no direct responsibility to the owner. The professional advisers have the aloofness from both the manufacturing and contracting branches which naturally comes from the contrast between professional and commercial standards. The contractor is not a free agent of the owner, but works under the direction of the architect and the engineer. In some cases he is forced to undertake a contract which, while appealing to professional direction, is not mutually advantageous as between the contractor and the owner.

Up to this time there has been no clearing house for these differences of viewpoint. No place where the representatives of each line of effort could sit down and talk the matter over, fully confident that he would be not only accorded a fair hearing, but that he would be properly represented in any decisions that might be reached. Of course, no judgments can be reached except on matters of policy. It is these great matters of policy that make the framework of all our industrial relations.

When we think about policies and want to cast our judgments we must ascertain the facts. And so we find that before we can make a judgment covering a policy in the construction business, or in any other business, we must have before us the statistical information which coupled with our practical experience, gives us the groundwork upon which conclusions may be based. This council, then, naturally becomes a clearing house for the information contained in the industry as a whole. Theoretically this is simple. Practically it is not going to be so easy. But I have every confidence that step by step it will prove its value, will develop the support and co-operation of the component parts of the industry, and ultimately will be so equipped as to have first-hand information on all the elements of vital importance in every phase of the construction business. If this council endeavored to do no more than would be contemplated by this effort, it would, it appears to me, offer every reason for its existence.

Accurate and Full Data Needed—There is nothing more dangerous than half truths. When this council endeavors to compile the statistics of an industry it must be very sure it has gathered every possible bit of information available, and then must give the same out frankly and completely, whether it affects the industry advantageously or not. This is the only way that confidence will be developed, and this council will rise or fall in its effort entirely upon the confidence which is engendered and the value which the public, no less than the component parts of the industry, places upon its observations and recommendations. This statistical information, if properly compiled and gathered as it must be from the trade associations and the departments of the government directly associated with these matters, can be of inestimable value to those manufacturers, especially the smaller ones, whose business it is to provide the supplies for the construction industry. I am fully aware that this situation has been well cared for, particularly in specific lines, but I am advancing the hope that the council will be able to develop itself into a clearing house of statistical information for the whole industry that will be of inestimable value to everyone connected with it.

Development of Business Consciousness—This council, too, representing so completely all of the various phases of industry, should be powerfully instrumental in having the construction business appreciate its own magnitude and importance and its effect upon the prosperity and well being of the nation. This would have the natural result of inspiring at least a portion of those engaged in the business to a kind of dual business patriotism, a patriotism on the one hand which would make them take pride in and be loyal to the business which makes their daily occupation and, on the other hand, be conscious of and loyal to a sense of general public service and public responsibility.

I am not speaking as an altruist, nor dreaming dreams of intangible things. We must learn in this business, if we have not already done so, that all large corporate interests have learned in their specific fields. The old days of figuring that we can operate our businesses without regard to the public have passed away, and the large corporations that are doing the best are those which are working in sympathetic co-operation in the enforcement of laws which recognize the public rights and in operating their businesses in full accord, four-square, with rational public sentiment. Of course this would naturally develop a business consciousness, a sense of obligation, in the wake of which would come more reasonable co-operation throughout the entire business.

At this point the public would come in. The abuses which have beset this industry, as they have beset all other industries, would be gradually cleaned out from within and a permanent set of business morals established which would prevent a repetition of practices which seemed to give temporary advantage, but which, in the long run, are, from a strictly business point of view, unprofitable. In the last analysis the public pays the price. Of that public we are all a part. We like to criticize the other fellow's business but we don't like him to criticize ours. We can't prevent such criticism, no matter how we try, if it is warranted by the facts. The clear common sense of the situation, then, is to put our own house in order to clear ourselves of criticism, and then to criticize the other fellow's business as freely as we wish until he in turn has done exactly the same thing.

Channel Tunnel Again Considered

Another attempt to secure government authority for the long-projected 27-mile railway tunnel under the English Channel was predicted at a recent meeting of the Channel Tunnel Co., in London, at which a number of representatives of foreign governments were present. The project dates back to 1874. At first there were two rival schemes, of which the respective engineers were Sir John Hawkshaw and Francis Brady, but all their bills were rejected by Parliament. The former considered that the tunnel would be secure in the regular chalk formation, but the latter favored a stratum of chalk marl composed of about 80 per cent carbonate of lime and 20 per cent of clay, the clay making the material impervious. Two test headings were driven some years ago, one of which is 7 ft. in diameter and extends 1¼ miles under the sea, at a depth of about 160 ft. There would be a curve in the alignment to keep within this stratum, the terminal points being at Dover and Sangatte, near Calais, about 27 miles apart. Tunnelling machines of different kinds have been tried in this soft rock and the most economical way of handling the muck appears to be its conversion into a slurry or grout which can be pumped. No work has been done in recent years. To insure rapid prógress it was proposed to drive a separate pilot tunnel with lateral drifts to a number of working chambers so that the two main single-track tunnels 18½ ft. in diameter could be driven from numerous headings. The pilot tunnel would be utilized for drainage and ventilation. In 1907 the promoters of the two schemes combined on a bill for the Brady project, but this bill also was defeated, mainly for military reasons as in the case of all previous bills. The French drove a short test heading years ago.

Trolley Deck of Manhattan Bridge Converted to Roadway

Highway Traffic Facilities Increased by Removing Abandoned Surface-Car Tracks and Laying Pavement

RAPID increase of vehicular traffic crossing Manhattan Bridge over the East River recently led to the decision to construct an additional roadway on the easterly upper bridge deck. This space had been used by a trolley car line, but as the line ceased operation some time ago the space was available for an additional roadway. The improvement will make it possible to separate the various types of vehicles crossing the bridge, diverting the light, rapid traffic to the new upper-deck roadway and confining the heavy, slow traffic to the main bridge roadway. The work is now about completed.

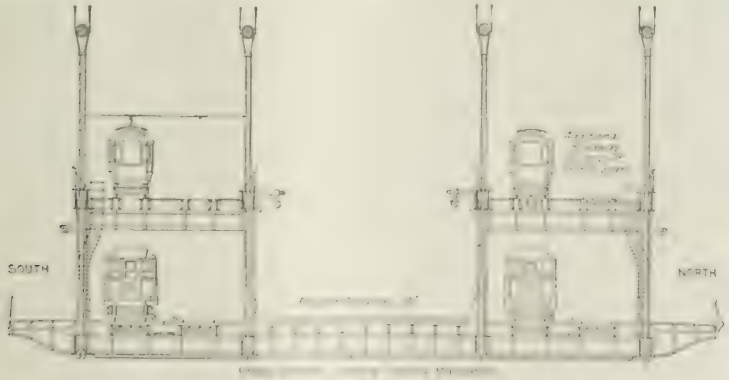
In the original bridge construction each of the two upper deck sections comprised four double lines of stringer girders seated on transverse floorbeams. Trolley car rails were laid on these stringers. The easterly pair of tracks was equipped with slot rails for the cars, which were the subsurface-contact type, while the pair on the westerly deck was equipped with overhead trolley wires. The openings in the flooring were covered with metal gratings.

In the conversion of the easterly upper deck the slot-rail construction was removed and the framing reinforced by a central longitudinal stringer, located in the space formerly between the tracks of the car line. Transverse 6½-in. tees were placed in the former track space, a ½-in. floor-plate was riveted over this framing and a 3-in. wood-block pavement with steel curbing was laid on the plate.

The width of the main roadway is 35 ft. The new upper-deck roadway will for the major portion have a clear width of 23½ ft., while at the anchorages the width will be from 19 ft. to 24 ft. 11 in., at the towers 21 ft. 2 in., at the Manhattan Plaza 25 ft. 8 in., and at the Brooklyn Plaza 25 ft. 7 in. The new roadway will increase the total bridge roadway width 67 per cent, but the carrying capacity will probably be increased in greater ratio because of the separation of slow and rapid vehicles.

The length of the Manhattan Bridge along its center line from Canal St., Manhattan, to Nassau St., Brooklyn, is 6,855 ft.

Grover A. Whalen is commissioner of the Department of Plant and Structures and Edward A. Byrne is chief engineer. These officials planned and are directing the work.



TRAFFIC FACILITIES ON [illegible] BRIDGE AND NEW CONSTRUCTED DECK

Concrete Pipe Piles in Tasmania

It is reported in the London "Times" that 600 concrete cylinders, constructed by the centrifugal process, are being used in place of timber piles in building a deep-water wharf inside the new breakwater at Burnie, Tasmania. The cylinders are made in 10-ft. lengths, 4 ft. 6 in. in diameter, and the concrete is 12 in. thick. To obtain the requisite height, the cylinders will be placed on top of each other, cemented together, and each joint, completed by an 8-in. steel band. The interior of the cylinder will be filled with sand. The method generally appears to be a variation of the Mouchel cylinder pier system, where reinforced-concrete piles are first driven in clusters to provide a secure foundation, and a hollow cylinder of the same material is built up around the piles, the bottom section having a steel cutting edge and the other sections having spigot and socket joints. The interior of each cylinder is filled up with concrete, binding the whole together to form a solid, continuous pier. One disadvantageous feature of the pipe piling described, according to the "Times," is the doubtful stability of the foundation, and another is the probable lateral weakness of a pier [illegible] in the manner stated, and with nothing better than sand as a central core.

Factors Affecting Fire Resistance of Building Columns

Useful and Ultimate Resistance Periods—Effect of Length—Load Taken by Covering—What Is "Best" Covering?

By S. H. Ingberg

Physicist, Bureau of Standards, Washington

In the interests of sound engineering conclusions concerning the fire resistance of columns in buildings it seems desirable to discuss a little further certain details of the extensive series of tests of full-size columns conducted jointly by the Associated Factory Mutual Fire Insurance Companies, the National Board of Fire Underwriters and the Bureau of Standards, reports upon which were published last year. The following comments refer to the article of R. E. Wilson on the results of these tests, published in *Engineering News-Record* of July 21 and 28, 1921, pp. 106 and 145; to the editorial comment thereon, July 21, p. 91; and to the letter of George E. Strehan, Aug. 18, p. 292.

Information on Fire Action Needed—The editorial comment referred to contains an implied criticism of the report on the tests, on the ground that direct applications of the test results to building construction were not made in the sense of recommending certain types of columns, coverings or covering thicknesses for given building conditions and occupancies. The unit in which the results are expressed, the fire-resistance time period, is a quantitative measure chosen with reference to the most direct application possible, pending the acquisition of more knowledge on intensity and duration of building fires as they affect given structural members. Present knowledge is generally limited to the total duration of fire within the building, or a given portion thereof. Some idea of the severity of the exposure may be obtained, as indicated in the editorial, by comparing effects of actual fires on materials and constructions with those obtaining in fire tests, and perhaps the most reliable source of information at present available is of this nature. However, before dependable generalizations can be made, a greater fund of information must be obtained by more systematic observation of fires and fire effects aided by such experimental research as can be made.

There are a number of errors and misconstructions in Mr. Wilson's article, the more important of which should be corrected.

Ultimate and Useful Resistance—In deriving ultimate resistance periods from the time to failure of the individual columns in the fire tests, the former was taken as two-thirds of the average time to failure of columns within a given group, the factor accounting for variations in the results obtained for comparable columns in the tests, with some margin for the greater range that occurs with the larger number of actual building columns to which the results may be applied, and the greater range in quality of material and workmanship incident therewith. The period obtained, however, is *the ultimate and not the useful period* as given in the article.

The important function of columns in fires consists in supporting the building and preventing general collapse, and the test results are interpreted in terms of this ultimate function. The useful resistance period, within which the column is not damaged to such an extent as to require replacement after the fire, is discussed in the reports ("Fire Tests of Building Columns," Bureau of Standards edition p. 169, Underwriters' edition p. 184), and the apparent close relation for metal columns, between the period of expansion and the useful limit is noted. The method is indicated wherby the useful resistance period can be derived, but the results as finally interpreted, and the values given in Mr. Wilson's table, which is a near copy of Table 46 of the full report, are those pertaining to the ultimate function. This is premised on severe fire exposure, with the quality of material and methods of application somewhat below the average obtaining with the test columns. Under less unfavorable conditions it is recognized (reports p. 202, 216) that the resistance beyond the useful limit may not be developed, but this does not obviate the necessity for distinguishing between ultimate resistance, and useful limit, the difference between which is decided for all but the lower resistance periods.

Effect of Column Length—Limiting the slenderness ratio to 80, as is suggested in the article, is not warranted by the test results, and no decided assurance is had by so doing that a column will come through fires of duration and intensity comparable with its resistance period without permanent deflection of amount requiring replacement of the column. While some of the columns with the higher slenderness ratios attained larger lateral deflections than those of more rigid section, the difference was not general or large. Nothing developed in the tests to indicate that columns within the limit of slenderness ratio considered safe from other structural reasons, are unsafe under fire exposure, when properly protected and loaded according to current design formulas.

Load Carried By Covering—The effect of the load-carrying capacity of the covering, while necessary to recognize (reports p. 201, 216), is easily overestimated. In only one case was the time to failure increased 100 percent, or any figure approaching it, due to this cause. In this case, partly protected latticed angle column No. 22, there was only a thin covering on the lattice and angles, which soon reached temperatures causing yielding of the steel, with consequent transfer of load to the concrete filling. For the metal columns, due to higher rate of expansion of the metal, particularly under load, there appeared to be little effect before the point of maximum expansion was reached, subsequent to which the covering took load in proportion to its strength and rigidity at this stage of the test. It should be noted that a considerable time beyond the point of maximum expansion is required for the temperature rise in the metal of about 100° C. necessary to cause failure in the steel if assumed unsupported by the covering. The remainder of the interval between maximum expansion and failure, if attributed to the load-carrying capacity of the covering, will seldom equal 30 per cent of the time to failure for concrete protections, and generally very much less.

The "Best" Covering—Quoting Mr. Wilson's article: "Concrete is considered the best covering material, not only because it gave the highest degree of fire resistance of any of the coverings tested but also for reasons based on other points of view. The necessary materials

are usually readily obtained, the placing of the covering is subject to lesser variations due to workmanship than in the case of materials not applied integrally, the cost is in most cases appreciably less than of any other material giving the same degree of protection, and concrete covering can usually be readily repaired after moderate fire exposure, whereas with most other materials partial or complete replacement is necessary."

The greater stability of the cast-in-place coverings is conceded, and voids and imperfections can be minimized with proper workmanship. The relative cost is a matter that can be determined only for each particular case. In the case of column protection it is dependent upon a number of related conditions, such as type of floor and partition construction used, and the interior finish to be applied. The relative economy of repair or replacement after fire is equally open to question, and the point can be made that a covering permitting ready removal of damaged portions would have its advantages. It is perhaps best to let the results speak for themselves. The tests show that intelligent selection is necessary in using any material if a given degree of fire resistance is to be attained.

The effect of proportion of mixture on fire resistance was not definitely determined in the tests. The 1:2:4 proportion was generally used, and the periods derived hold strictly only for this mixture. Some decrease in resistance with leaner mix was noted, but not enough to exclude their use if some allowance is made.

Comparing Different Materials—Some other generalizations do not accord with the test results. Unfilled protections of medium semi-fire clay tile are stated in the review to give the same resistance as single-layer of plaster on metal lath, whereas the average time to failure with the former was 1 hr. 45 min. and with the latter 1 hr. 15 min., the respective resistance periods being ¾ hr. and 1 hr. The plaster thickness applied to the test columns, 1 in. and 1½ in., are heavier than ordinarily obtaining in building construction. Again, 2-inch solid gypsum coverings are stated to give the same resistance as hollow tile coverings of semi-fire clay and surface clay tile with concrete filling, as against respective average test durations of 2½ hrs. and 3¾ hrs. respectively, and resistance periods of 1½ hr. for 2-inch gypsum, 2 hours for tile with outside wire ties, and 2½ hours for tile with ties imbedded in the joints.

Lastly, quoting the article, "A covering of common clay brick laid flat with brick filling to give a nominal protection of 4 inches in thickness was found to afford a fire resistance equivalent to 2 inches of concrete with aggregates of trap, granite, sandstone, or hard-coal cinders." The time to failure with the brick protection was 7 hours, 13 minutes, and the average for the given concrete protections 4 hours, 7 minutes, the resistance periods being 5 hours for 4-inch brick protection, and 2½ hours for the 2-inch protection of the given type of concrete.

Tests of Small Specimens—Mr. Strehan in his letter refers to certain tests of column protections made by subjecting relatively small areas of the covering material to fire for 2 hours and observing the temperature rise in a metal plate or other construction representing a column on the unexposed side, the acceptance of the material being determined by whether the final temperature in the metal exceeded 550° F. (288° C.). The recent fire tests were made with columns of dimensions in common use under working load in order to bring in the various elements that are concerned in the efficiency of column protection, of which heat insulation is only one. Stability, the ability of the covering material to remain in place, the size of the covered column, interaction of column and covering, unit load applied, and the strength of the metal at given temperatures, enter as related factors. In the case of gypsum, the failure was due to lack of stability caused by shrinkage of the material when exposed to fire, the temperature in the column steel being hardly above 100° C. when the blocks began to fall off (Reports p. 190; 205 and Figs. 127 to 131). That the results should compare in all respects with the heat insulation tests referred to above, or with fire tests of unloaded columns can hardly be expected. In the case of concrete covering, the part of the resistance attributable to the load-carrying property of the covering has already been discussed.

Before the method of applying the coverings was decided upon, a field study was made of methods of placing column protections from which the following conclusions were reached: (1) The coverings are generally applied before the columns receive a large portion of the building dead load; (2) the tile or block protections are set on the structural or lower floor and make fair connection with the floor above; (3) in the case of concrete protections with concrete or a combination concrete and tile floor filling, beams or beam protection, the column covering is continuous with the floor concrete both at top and bottom; (4) with hollow tile or other floor filling, there are likely to be imperfections in concrete column coverings at the floor lines, that can be largely avoided with a little more care or made good by patching with a suitable mortar. Since concrete column protections were most likely to be used with similar floor material, it was decided to place all coverings on the bearing plate at the base, and against or continuous with the head protection at the top, as simulating most nearly the condition likely to hold, and a condition not difficult to obtain even with floor materials other than concrete. Beam brackets were introduced near the top of the columns to simulate conditions and introduce some of the difficulties encountered in placing column coverings in buildings. The load from the ram was applied only to the steel or cast iron section of the head of the column shaft (reports, Fig. 9), the load carried by the covering being transferred to it by the bond and bearing developed in the 3-foot long extension of the column above the furnace chamber. As far as could be ascertained, after test no slip had occurred, and this furnished in part the basis for the statement made in the report (p. 202, 216) in discussing the load-carrying property of concrete coverings, that bond between concrete and a number of forms of metal sections will distribute load to the covering even if the continuity at the floor lines is impaired. That the effect was much smaller generally than Mr. Strehan infers, has already been indicated.

The relatively higher heat insulating value that cinder concrete has developed in some cases has been due largely to the larger amount of water present, which is necessarily introduced in mixing in order to give proper consistency, and which retards the heat flow when the concrete is tested before the excess has been given off. When more fully cured, cinder concrete

does not give as high insulating value as trap rock, sandstone, or limestone concrete. This is shown in tests made with concrete cylinders (Technologic Paper No. 130, Table 1) also in the column tests, in the time required for comparable columns covered with the different kinds of concrete to reach a given critical temperature, as 500° C. (reports, Figs. 150 to 153).

Aggregate Strength No Measure of Concrete Strength

Tests Show That for Texas Materials Compression Value of Concrete Is Independent of Coarse Aggregate

By F. E. Giesecke

Head, Engineering Research Division, University of Texas, Austin, Tex.

IT IS generally believed that the strength of concrete depends partly on the strength of the matrix, partly on the bond between the matrix and the aggregate, and partly on the strength of the aggregate. In order to ascertain the extent to which the strength of concrete is determined by the strength of its coarse aggregate, a series of tests has been undertaken by the Engineering Research Division of the University of Texas. The results of the 28-day and 3-month tests of this series indicate that, for the materials tested, the strength of concrete is almost independent of the strength of its coarse aggregate.

Speaking generally, the coarse aggregates studied in this investigation cover practically the entire range from the hardest to the softest aggregates available in Texas for concrete construction.

The characteristics of the coarse aggregates studied are shown in Table I. The test specimens were 2 x 4-in. cylinders. The aggregates were Colorado River sand, and crushed rock of two sizes, the smaller size passing a ¾-in. mesh sieve and retained on a ⅜-in. mesh sieve; the larger size passing a ½-in. mesh sieve and retained on the ¾-in. mesh sieve.

TABLE I—CHARACTERISTICS OF COARSE AGGREGATES

	Name	Crushing Str. Lb./Sq.In.	Spec. Grav.	Per cent Wear	Hardness	Toughness
A.	Trap Rock	33,600	3.13	1.00	18.34	32
B.	Porphyry	27,800	2.66	1.94	18.9	16
C.	Dolomite	25,500	2.8	2.98	14.65	12
D	Medium Limestone	19,000	2.62	3.3	11.3	6.5
E.	Medium Limestone	10,300	2.58	4.92	11.34	6.5
F.	Soft Limestone	4,400	2.03	8.72	0	? 0

The aggregates were compounded, by weight, so that one volume of sand was used with every two volumes of crushed rock; the crushed rock was composed, by weight, of one part of the smaller size to two parts of the larger size.

The cement was a blend of Texas cements which passed the standard specifications and had a tensile strength of 282 lb. at seven days and 360 lb. at twenty-eight days. The cement was proportioned so that the richness of the mixes varied from about eight to about fifteen sacks of cement per cubic yard of concrete.

The two principal reasons for using such rich mixes were that the hard rocks are better able to develop a strong concrete in a rich mix than in a lean one, and that aggregates of the small sizes need richer mixes to develop ordinary strengths than larger aggregates.

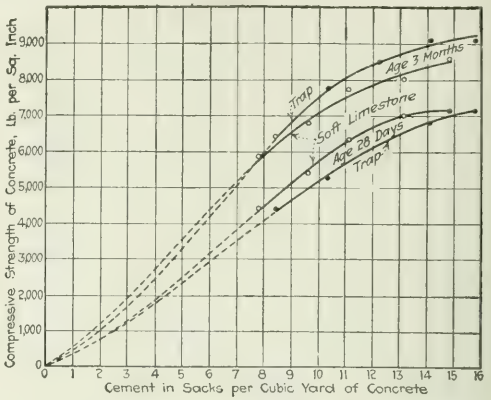


FIG. 1. STRENGTH CURVES FOR TWO AGGREGATES

The total mixing water used was equal, by weight, to 23 per cent of the cement, plus 8 per cent of the sand, plus 4 per cent of the crushed stone. In order to make proper allowance for the difference in the quantity of water absorbed by the different kinds of crushed stone, the following method was used: Immediately before preparing a mix, the crushed stone was immersed in water for 15 minutes and then centrifuged in a Rotarex Extractor for 70 seconds. By this method the crushed stone had no surplus water on the surface and was saturated sufficiently not to extract water from the mix. As well as could be judged by the appearance, the consistency was the same for all mixes.

The series consisted of 300 test specimens: it included six different aggregates and five different proportions of cement for each aggregate, ten specimens were made for each aggregate and each proportion of cement, five to be tested at 28 days and five at 3 months. The five specimens constituting a group were made on five different days in order to avoid accidental variation which might affect the whole group.

The average of the 28-day and 3-months tests are shown in Table II and for two of the materials are given in Fig. 1 and from curves such as these for all the specimens the strengths for mixes of 6, 8, 10, 12, and 14 sacks of cement per cubic yard of concrete were obtained and plotted against the ultimate compressive strength of the coarse aggregate (Fig. 2).

FIG. 2. RELATIVE CONCRETE STRENGTH FOR DIFFERENT AGGREGATES

TABLE II—COMPRESSIVE STRENGTHS OF CONCRETE WITH DIFFERENT AGGREGATES.*

	(7.81)	(9.60)	(11.12)	(13.15)	(14.84)
A.	5,871	6,828	7,704	8,004	8,536
	(8.04)	(9.95)	(11.70)	(13.64)	(15.23)
B.	6,307	7,051	7,845	8,135	8,070
	(8.01)	(9.87)	(11.66)	(13.59)	(15.21)
C.	6,306	7,358	8,116	8,458	8,625
	(7.99)	(9.83)	(11.68)	(13.47)	(15.15)
D.	5,970	7,189	8,104	8,603	8,721
	(7.85)	(9.73)	(11.55)	(13.35)	(14.9)
E.	6,003	7,574	8,488	9,035	9,378
	(8.44)	(10.36)	(12.25)	(14.12)	(15.80)
F.	6,408	7,733	8,467	9,049	9,072

* The figure in the parenthesis is the cement in sacks per cubic yard of concrete. The lower figure is the strength of concrete in pounds per square inch.

It is evident from this figure that, for the materials tested and for the proportions of cement ordinarily

employed in practice, the strength of concrete varies only slightly with the strength of its coarse aggregate. For very rich mixes and high ages the strength of concrete increases slightly with the strength of its coarse aggregate, but for ordinary mixes and an age of 28 days, the strength of concrete made with comparatively weak limestone aggregate is as high or higher than that of similar concrete made with the strong igneous rock aggregates.

The explanation of this remarkable result may be that as the strength of the stone increases, its surfaces become smoother, and, consequently, the bond between the matrix and the aggregate becomes weaker: and that the loss in strength of the concrete due to the weaker bond is about equal to the increase in strength due to the higher strength of the coarse aggregate.

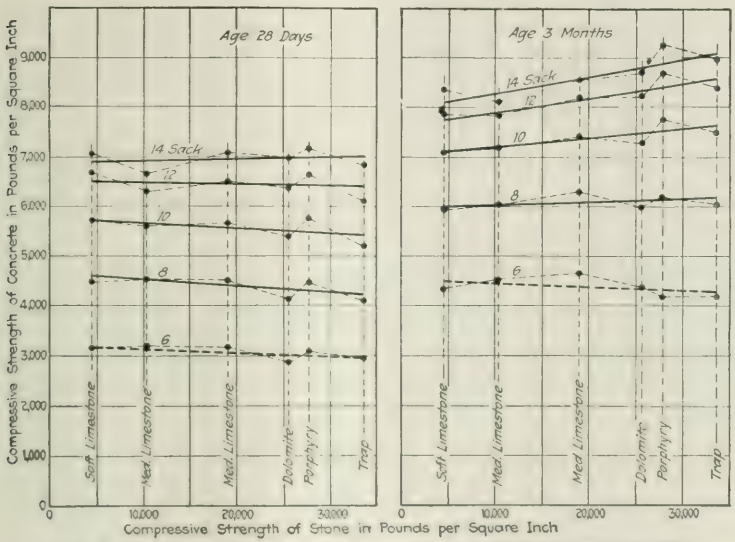


FIG. 2. RELATIVE CONCRETE STRENGTH FOR DIFFERENT AGGREGATES

However, since in this investigation the maximum size of the coarse aggregate was only ¾ in., the relative volume of the coarse aggregate was less than it is in ordinary concrete, and it is possible that the strength of the coarse aggregate had a correspondingly smaller influence on the strength of the concrete. This phase of the problem will be studied in another series of tests.

The reader should understand clearly that this investigation relates only to the compressive strength of concrete and not to the resistance to abrasion.

Sewer Pipe Specifications and Alkali Action

A co-operative study of sewer pipe and specifications therefor is to be carried on by the City of Los Angeles, the U. S. Bureau of Standards, and various manufacturers. The object of the study will be to discover whether present standard specifications insure a sufficiently durable pipe for the alkali conditions of that region. A meeting on April 11 formulated a program for the investigation.

Britain Fears Water Shortage

(London Correspondence)

THE water outlook in Britain is again giving rise to anxiety. Although the rainfall for the first five months of this year is above normal in all districts of the British Isles except northern Scotland, the 1921 rainfall rarely exceeded 60 per cent of the average, and was in many parts under 50 per cent, so that the country has begun with a handicap. In London, for instance, the rainfall for the last twelve months has amounted only to 16 in. or about 66 per cent of the average.

The following figures indicate the percentage excess of rainfall in the various districts for the first five months of this year: England, N. E., 14; E., 28; Midlands, 31; S. E., 29; N. W., 5; S. W., 18. Scotland, N., 0; E., 7; W., 15. Ireland, N., 15; S., 3. Channel, 30.

A survey of the national water resources undertaken by the Ministry of Health is being pushed forward as rapidly as possible. Of 1,100 water undertakings over 200 are already suffering from shortage in varying degrees. From the figures available it is shown that it has taken nearly four months' rainfall of this year to make good the 1921 shortage. Thus only the May fall can be counted toward the 1922 supply, and while the early part of the month promised well, the latter part was very dry.

In many parts of Britain the smaller streams have already ceased to flow and the reserves of water in the upper chalks are practically dry. Those districts which draw their water from the lower chalks are better off and can manage at a greatly reduced consumption provided that the fall for the rest of the year is normal—which is unlikely.

It is estimated that the normal amount of water available in England and Wales from underground is 342 U. S. m.g.d., of which 167 is derived from the chalky areas.

The authorities do not intend to be caught unawares this year and conferences of the various experts have taken place. Unfortunately, however, Britain has no reserve supplies of any magnitude to help her out. Among the measures contemplated by the Ministry of Health are: (1) Arrangements for grouping water authorities to pool the available resources. (2) The use of additional sources of supply, including the supplementing of domestic supplies from sources which in normal circumstances would not be used, subject to chlorination under the supervision of officers competent to do such work.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Five-Year Courses at Missouri

Sir—I notice in *Engineering News-Record*, May 25, 1922, p. 888, the news report of the proposed five-year courses for engineers and also your editorial on "Remodeling Engineering Education," on page 894 of the issue of June 1.

Other engagements prevented my attending this conference of deans in Chicago May 19. I was, however, much interested when I received a report of the conference and a copy of the resolutions, to find that the recommendations made as to the plans agreed upon conform closely to what has been in effect at the University of Missouri since 1916.

In regard to the first resolution relating to remodeling the four-year curricula, our curricula in civil, mechanical, electrical, chemical and agricultural engineering were so arranged in 1916 that at least two and one-half years' work is the same for all students, so that the final choice of specialty may be left until the student begins junior year without any loss of time. The five-year curricula are made up so that approximately two-thirds of the time is devoted to technical subjects, the remaining one-third to be chosen from any field of university study under the advice of some one of the engineering faculty. Our four-year courses lead to the degree of Bachelor of Science in Engineering, and the completion of the fifth year entitles the student to the professional degree of mechanical engineer, civil engineer, etc.

Referring to the theme of your editorial, an examination of our curricula will show that what we have already accomplished provides for a larger cultural content in the courses, and gives more attention to engineering fundamentals. It is quite clear that Professor Burr's paper before the Society for the Promotion of Engineering Education last year had no influence in guiding our faculty to their decision, but I have no doubt that the same facts that impressed Professor Burr and led him to the preparation of the paper were, more or less, determining factors with our faculty members when considering the revision of curricula six years ago.

In 1913 a plan was adopted requiring students to have two years' training in arts and sciences before entering the Engineering School. The engineering courses were made three years in length leading to the professional degrees. However, students failed to take advantage of these conditions, and our attendance dropped from over 500 to about 142 in the course of three years. The scheme was abandoned and our present plan adopted. In the new curricula we have included practically the same work that the student was expected to pursue under the other plan in the College of Arts and Sciences, but he is now allowed to enter directly into the School of Engineering as a freshman. It is quite apparent that the student has little discrimination regarding the subject matter presented, but that he objects to the plan of entering for a two-year course in a College of Arts and Sciences to prepare for engineering studies. On the other hand, he offers no objection to spending the same two years in the School of Engineering pursuing practically the same subject matter.

Personally, I am much impressed with the essence of the last paragraph of your editorial, and I believe our plan meets admirably the problem that is there stated. Many men enter engineering courses with intellectual equipment and tastes that debar them from signal success as leaders or in the acquirement of broad culture, but who are of a type indispensable in the prosecution of engineering works, and who must be prepared in some way for carrying on such work. I see no reason why university schools may not by the plan we have already adopted "place emphasis on the training for leadership" while at the same time preparing the less competent for the minor positions in the profession.

I feel that it is due the engineering faculty of the School of Engineering, University of Missouri, that the above facts be made a matter of public record since the actual accomplishment of the curricula revision in 1916 was not brought about without heroic effort on the part of some, and a broadminded outlook on the part of all.

E. J. McCAUSTLAND,
Columbia, Mo., June 9. Dean, Faculty of Engineering
University of Missouri.

Plain Talk from Another Engineer's Wife

Sir—I realize that your columns should not be used as a forum for disgruntled wives of civil engineers. However, the letter published in your issue of May 25, p. 883, signed "An Engineer's Wife," touches an important question; the claim by unqualified men that they are civil engineers. There can be no doubt but that civil engineers as a body should take decisive steps to eliminate imposters in their profession. This action should be taken not only to protect the dignity of one of the most important of professions but also to safeguard the public welfare.

The apathetic attitude of the general public toward the engineering profession, as well as the lack of understanding of its fundamental principles, is probably largely due to the fact that the average engineer is more interested in achievement than in advertising. My experience has been that many capable engineers suffer from a form of ingrowing modesty, which laudable virtue leaves the masses unimpressed. Wake up, Engineers, and protect your interests! If not for yourselves, for humanity generally and incidentally your families.

Recently I had occasion to talk with a mechanic, who, upon learning that my husband was a civil engineer, patronizingly remarked: "Well, I guess I know pretty nearly everything there is to know about civil engineering, but I had to give the job up; it was too unprofitable." He had acted as chainman on a survey party at one time. This boastful ignorance should be completely and deliberately squashed.

Another pest is the correspondence school "expert." Granted everyone cannot attend an accredited university and obtain one or more degrees; but the competent man can *prove* his ability. Let engineers establish a high standard of requirements for those claiming admission to their ranks. See that this standard is maintained by engineers of known ability passing upon the applicants for admission to the profession before the term "civil engineer" can be used. Back up the necessary examination with actual experience, but don't sell a license as you might for a pet dog.

A high standard of ethics is desirable, but don't be too proud or tolerant to protect it. After all, I am almost inclined to believe that an association of civil engineers wives might not be such a bad bodyguard.

ANOTHER ENGINEER'S WIFE.

Let the Mississippi Overflow

Sir—Your editorial in the May 18 issue entitled "Mississippi Flood Facts Needed," states, "His" (Col. C. McD. Townsend's) "disposition of reservoirs, reforestation, parallel channels, outlets and cutoffs leaves no doubt as to the inadequacy of the only suggested competitors of the levee, which, by elimination at least, justifies the adopted method of control."

When the above "competitors" of the levee have been discussed and rightly turned down, have we exhausted possible alternatives? The writer can not see it that way.

Let us go back to the beginning of levee history. When there were no levees on the Mississippi or its tributaries, the river overflowed its banks to a height of possibly 3 ft over a wide area of land, anywhere from twenty to a hundred miles in width. It is this annual overflow with its

accompanying deposit of silt that has made one of the most fertile sections of our country.

Then came the beginning of the levee system. Individual planters threw up low levees around their property, (the writer has seen the remains of many of them) 3 to 4 ft. high and representing an almost infinitesimal expenditure compared with the present necessarily high and expensive structures. How high present levees are the writer does not know, but when he left Mississippi River work in 1909, there were many 30-ft. levees with a wide banquette. Comparison of quantities in a 4-ft. levee and a 30-ft. levee with banquette shows the 30-ft. levee to have 5,870 per cent the cross section of the 4-ft. levee.

From the above modest beginning, the independent levee systems were gradually joined together, and levee systems were made on tributaries, the United States got into the game and carried the work along, and at every progressive step, topping was necessary along the entire system. Four-foot levees became 10-ft. levees, 15-ft. levees, 20 and 30 ft. levees successively. Levee taxes were instituted and constantly mounted up. Land held long behind the levee system missed its annual enrichment of silt and became increasingly less rich, and always the flood menace grew.

There are, or at least there were in 1909, many planters on high land outside the levee system, whose lands were subject to an overflow of three to four feet. Did they bewail their lot and move heaven and earth to get a levee between them and the river? They did not. The writer failed to find one of these planters who did not consider himself fortunate in having richer land than his neighbor behind the levee, and in being exempt from the burdensome levee tax.

Does not the answer seem to be to get back, if possible, to the early conditions? Let the individual planter have a low mound for his stock. Let the leveeing be restricted to low levees around towns only, and let the river and its tributaries overflow the land to the full extent that topography permits. The only objection that the writer can see to this solution is that since 1909, the automobile has probably established itself in the valley to a much greater extent than in 1909 and that good roads have spread in consequence. Would not the interruption to automobile traffic and the necessary extra work on roads be a small price to pay for the immense saving of money, the enrichment of the land, and the absence of the menace to life and home gained by letting the river overflow as nature intended?

FRAZER C. HILDER.

Washington, D. C.,
June 10.

Coefficient Curves for Small Venturi Meter

Sir—The accompanying curves of coefficients of a 3.971 x 2 in. Venturi Meter may add some light to the excellent discussion of "Anomalous Results in Venturi Meter Tests," by William J. Walker, in your issue of May 11, p. 797. The Gibson experimental curve given in the article is correct; the other or "orthodox equation" curves never were correct. When a meter shows a falling coefficient with increasing velocities, the writer is sceptical of the experimental work. Errors in the measurement of head are easily made at these low velocities, unless the most precise instruments are used.

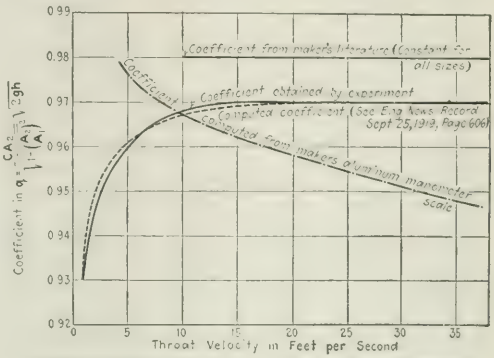
If a frictional term be included in the Bernoulli theorem, $m \frac{V_2^n}{2g}$, in which m is constant and $n =$ about 1.75 for smooth pipes, the lost head may be expressed as $\frac{m V_2^n}{2g V_2^2}$, and the discharge obtained is

$$q = \frac{A_2}{\sqrt{1 - \left(\frac{A_2}{A_1}\right)^2 + \frac{m}{V_2^{0.25}}}} \sqrt{2g(h_1 - h_2)}$$

$$\therefore C = \frac{\sqrt{1 - \left(\frac{A_2}{A_1}\right)^2}}{\sqrt{1 - \left(\frac{A_2}{A_1}\right)^2 + \frac{m}{V_2^{0.25}}}}$$

As long as n is less than 2, C will increase with V_2.

Accurate tests, made by the writer, of more than thirty meters, ranging in size from ⅝ x ⅛ in. to 16 x 8 in., have always given a rising coefficient with increases in velocity.



COEFFICIENTS OF 3.971 IN. x 2 IN. VENTURI METER

Heads were measured as follows: 0 to 2 ft., by a special hook differential gauge reading to 0.001 ft. and interpolating 0.0001; from 2 ft. to 6 ft. on a 1 in. air differential gauge; above 6 ft., on a mercury differential gauge. The discharge was weighed in tanks on scales. The time was taken with a split second stop watch.

W. S. PARDOE,
Professor of Hydraulic Engineering.
University of Pennsylvania,
Philadelphia, May 23.

I. C. C. Holds Tie-Treatment a Betterment

Sir — Referring to the article in *Engineering News-Record*, June 1, 1922, p. 921, Earl Stimson, chief engineer of maintenance, B. & O. R.R., and F. S. Schwinn, chief engineer, International & Great Northern Ry., and also *Engineering News-Record* may be interested to know that the Interstate Commerce Commission has recognized the fact that there is an element of betterment in the chemical treatment of ties.

What is more, any railroad that carries ties in the track at actual cost in the investment account, keeps a record of the original cost of individual ties and credits the investment account with the cost of the individual ties when retired, may capitalize the actual cost of the tie laid in replacement including the cost of treating.

Portland, Maine, June 9. J. N. SUNDERLAND,
Rodboy, Sandy River Railroad Company.

Accident at Vicksburg Waterworks

Two steel smokestacks of the city waterworks plant at Vicksburg, Miss., were blown down during a heavy storm on May 20. Both stacks fell into the clear water basin but without damaging the wall. This was specially fortunate since the flood water of the river was only about a foot below the top of the wall, and even a small break would have resulted in a muddy and contaminated water supply. It is stated by J. A. Steele, Jr., manager of city waterworks, that the 52-ft. steel extension, 3 ft. in diameter, on top of the original 80-ft. brick stack, struck close to the wall and penetrated the ground to a depth of 12 ft.

NEWS OF THE WEEK

New York, June 29, 1922

Civil Engineers Convene at Portsmouth

No Business Transacted, but Nine Technical Papers Presented With Little Discussion

(*Engineering News-Record Staff Report*)

All of the action in this years annual convention of the American Society of Civil Engineers at Portsmouth, N. H., June 19-20, was confined to the meeting of the Board of Direction, reported in last week's issue. The business meeting of the convention lasted about ten minutes, exclusive of formal addresses, and consisted only in announcing the action of the board in appointing Prof. J. H. Dunlap as secretary, electing five honorary members, and establishing the technical divisions. Calls for unfinished or new business brought no response from the floor. A continual downpour of rain prevented any participation in excursions or sports, so that a full afternoon and evening were devoted to the technical papers. On Thursday the weather brightened sufficiently to encourage about 100 of the 200 members and guests to take the excursion to Portland and Casco Bay. The projected White Mountain trip was cancelled on account of bad weather.

PRESIDENT FREEMAN'S ADDRESS

President John R. Freeman divided his presidential address into two sections, the first covering the society and its progress, and the second the progress of hydraulic science, in which Mr. Freeman has specialized in his many years of professional experience. In the first part of his address the president emphasized the greater amount of interest displayed by the directors of the society than at the time of his connection as a director a number of years ago. He said whereas the board then spent an hour or so once a year in the formal acceptance of reports now at least four times a year it has to spend two full days in discussing the numerous matters which are brought before it. He insisted that, contrary to a number of reports, the board is not divided and that in his presidential experience there had been no acrimonious discussion in the board.

He named as hopeful signs of the future the tendency toward more technical work in the society, instancing the formation of the technical divisions just named and the coming activities of the Research Committee. He felt, however, that the society machinery is not sufficiently organized to scan the horizon for technical data and that there was need for more organized support of the local sections and of the student chapters and technical divisions. The monthly publications, he said, are now too much like cold storage warehouses where excellent material is stowed away for occasional future use. He thought that more current matter is

(*Continued on p. 1098*)

To Begin Work Soon on Moffat Tunnel Through Rockies

News dispatches from Denver announce that within a few months work will be begun on the Moffat tunnel through James Peak. This project was authorized by a bill passed at a special session of the state legislature (see *Engineering News-Record*, June, 1, p. 930), under which the counties to be most benefited by the tunnel will form a bonding district to underwrite its cost. The Moffat tunnel has been much discussed since the construction of the Denver & Salt Lake Ry., on which it is expected to improve traffic conditions materially, especially during the winter.

Trains probably will be operated by electricity. The tunnel will be six miles in length, will be at an elevation of about 9,000 ft. and will cost approximately $6,720,000. Two years and a half will be required to complete it, according to estimates.

Highway Tunnel Proposed at Antwerp

Construction of three reinforced-concrete tunnels under the River Scheldt connecting Antwerp with the districts on the east bank of the river is proposed by a Belgian engineer, according to the Engineering Supplement of *The Times*, London. The plan provides for two vehicle tunnels and one railway tunnel, the former to be about 1,300 ft. long and to be equipped with large terminal shafts in which elevators and spiral access inclines can be constructed, while the railway tunnel is to be about 10,000 ft. long.

Drawbridge Wrecked by Steamer

Colliding with the Miramichi River bridge at Newcastle, N. B., the steamer "Canadian Squatter" on June 12 wrecked the bridge, with resulting damage estimated at $60,000. The bridge, was built only a year ago. As the steamer approached the bridge it whistled for the draw, but the draw tender was ashore, and the steamer continued to advance and rammed the bridge. No one was on the structure at the time. River traffic has been interrupted until the debris has been removed and the draw repaired.

Codification of Drainage Laws Begins in Indiana

The Indiana drainage law codification committee has begun work in Indianapolis. Governor McCray appointed the committee by authority of a 1921 statute which provided that the state laws on ditches and drains be codified. Roscoe Kiper, of Boonville, is chairman, and Hyatt L. Frost, Connserville, secretary of the commission. It is not understood that the committee has authority to revise any of the laws on the subject, but they likely will recommend changes to the next general assembly.

Pennsylvania R.R. Announces Plans to Enter Detroit

Details of a $20,000,000 plan whereby the Pennsylvania R.R. will enter Detroit were announced by President Rea before the Board of Commerce of that city on May 25. The project includes a new union station to be built jointly with the Père Marquette and Wabash R.R. in the downtown district and a new belt line around the city that will open up a new industrial area. President Rea announced that the right-of-way for the belt line has already been purchased at a cost of about $8,000,000. Stations and other terminal facilities cost $12,000,000. It is contemplated that construction will be distributed over several years and that about $3,500,000 will be spent this year.

The Pennsylvania plans to use the tracks of the Père Marquette from Toledo to the village of Carleton from which it will build a new doube-track line to the west side of the city. Over the remaining five miles to the heart of the city it will operate jointly with the Père Marquette and the Wabash. New freight depots will be built on West Fort and at Fort St. and 3d Ave.

It is expected that the completion of these improvements will eliminate the costly and time-consuming congestion at Toledo where freight destined for Detroit must now be transferred from the Pennsylvania lines.

Chicago Terminal Facilities for New York Central R.R.

Purchase of the Chicago River & Indiana R. R. (50 miles) and lease of the Chicago Junction Ry. (179 miles) as authorized by a recent decision of the Interstate Commerce Commission will enable the New York Central R. R. to improve greatly its terminal facilities in Chicago. Permission to purchase the Chicago Junction Ry. was refused and the New York Central is required to maintain a separate corporate identity and organization for the combined new properties in order to preserve for shippers the present direct access to the railroad officials.

Both of these properties are neutral lines providing terminal facilities for all the 23 trunk lines entering Chicago, particularly in the stockyards and industrial district. Their acquisition by the New York Central was opposed strongly by several of the other trunk lines and by shippers on the ground of monopoly of terminal facilities and probable discrimination in the handling of competitive traffic. It was opposed also by the Chicago Railway Terminal Commission as an obstacle to the proper solution of the local terminal problem and on the ground that cooperative terminals are far superior to competitive terminals. For these reasons the Interstate Commerce Commission has imposed several restrictions, but the adequacy of these is questioned in the dissenting opinions rendered by individual members of the commission.

Western Society of Engineers Has Big Annual Meeting

The training of engineers was the subject of the principal address delivered by C. S. Richards, formerly dean of the college of engineering, University of Illinois, at the annual meeting and dinner of the Western Society of Engineers, held at the Hamilton Club, Chicago, June 5. Dr. Richards was recently appointed president of Lehigh University. Professional education on a broad basis was advocated, rather than vocational training or the inclusion of a variety of special subjects. At this dinner, attended by more than 200 members, a letter was read from the oldest living member of the society, John E. Blunt, who joined in 1869, was chief engineer of the Chicago & Northwestern Ry. in the "nineties" and retired from active practice in 1906. The society has 2,500 members.

Honorary membership was conferred upon Onward Bates and Capt. Robert W. Hunt, both of whom have long been identified with the active work of the society as well as with engineering progress. Mr. Bates was present but Capt. Hunt was kept away by illness. An annual $150 prize for the best paper on subjects dealing with the iron and steel industry was instituted last year by Capt. Hunt and the first award of this prize is to Gordon Fox for his paper on "Electric Motor Drive in the Steel Industry."

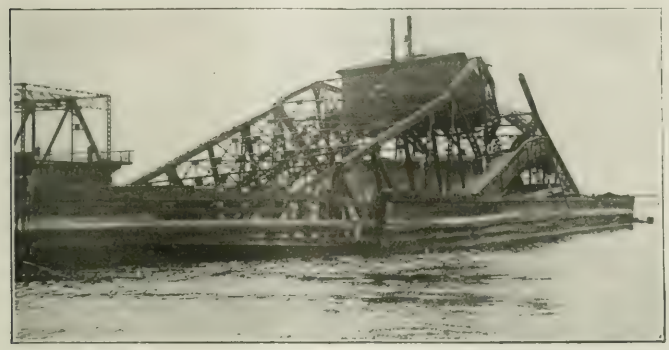
Technical and other activities of the society during the past year were reviewed by the retiring president, C. H. McDowell. The 28 committees aggregating 220 members cover not only technical affairs but also special activities. During the year ended May 31 there were 45 technical meetings, with an average attendance of 145, or 31 per cent higher than in the previous year. There were also seven non-technical or social meetings. Prospective work of the society and the advantages which engineers enjoy by society membership were the subject of remarks by J. L. Hecht, the new president.

Officers for 1922-1923 have been elected as follows: President, J. L. Hecht; vice-presidents, Frank F. Fowle, Charles A. Morse and E. T. Howson; secretary, Edgar S. Nethercut. The several sections have elected the following chairmen: bridge and structural, C. L. Post; electrical, F. E. Goodnow; gas, H. F. Bond; hydraulic and municipal, P. E. Green; mechanical, Horace Carpenter; railway, H. G. Clark; telephone, telegraph and radio, Burke Smith.

Revise Quebec's Motor Vehicle Laws

A recent revision of the motor vehicle laws of Quebec, Canada, increases licenses, makes 24,000 lb. the gross weight limit, (16,000 lb. on one axle) and rules vehicles with rated capacities exceeding 2½ tons off the road except in cities and towns. Commercial vehicles, according to the new act, can only be used on roads designated by the Provincial Roads Department.

The new license fees provide for payment of 90 cents per horsepower for passenger automobiles with a maxi-



Hackensack River Draw Wrecked By Steamer

Upper View, looking southeast (downstream). Vessel ran into far end and pushed draw about 10 ft. upstream. Lower view, looking west from Jersey City test pier. Top chords broken through just south of center panel. Drum and distributing girders crushed. *Copyright Underwood & Underwood*

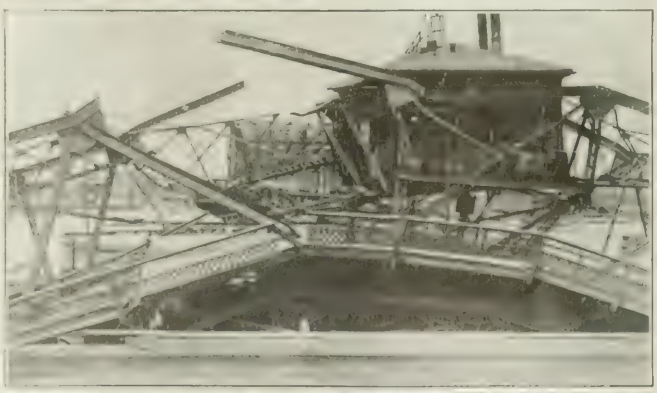
Steamer Wrecks Drawbridge on Traffic Artery

Swing Span of Lincoln Highway Structure Over Hackensack River Reduced to Scrap

Running endwise into the fender of the center pier and hitting the end of the draw squarely, a steamer wrecked the steel swing span of the Lincoln Highway bridge over the Hackensack River, between Jersey City and Newark, N. J., on June 22. The span, about 240 ft. long, was so extensively damaged that it is a complete wreck, with probably only scrap value. The views herewith give some idea of the appearance of the wreckage.

There was a strong tide running in at the time the vessel came up the river, and it is believed this had something to do with throwing the vessel off its course. The bridge was fully open, in position directly over the fender piling, which extends up and downstream from the center pier. The vessel, a steel steamer of several thousand tons capacity, hit the end of the fender structure, cut through it and struck the end of the draw, broke the end floorbeam and adjacent floor members, pushed the whole span 8 or 10 ft. longitudinally (northward, or upstream), crumpling up the drum and supporting girders, and caused the upper chords to break in two near the center panel, dropping the two halves of the span down onto the fender piling.

By good fortune the wreckage all remained within the limits of the fender structure, leaving the two channels either side of the center pier entirely unobstructed for navigation. Traffic on the road, however, is interrupted. The Lincoln Highway at this point carries a very heavy commercial traffic, including both local and long distance motor truck transportation in large volume. The principal trolley connection between Jersey City and Newark also runs along this road. There is only one other road connection between the two cities, the Harrison Turnpike, [illegible] a mile south. Plans for a third connection, south of the Lincoln Highway and crossing the head of Newark Bay by a [illegible] bridge, have been under consideration for some time by a joint engineering committee representing three counties and the state, but the project has lacked the support [illegible] little support in the city of Newark.



[illegible] fee of $10. For motor trucks a differential in favor of pneumatic tired [illegible] has been established, the rate for these being only one-half those for vehicles equipped with solid-rubber tires. In the latter, the scale of fees starts with $10 for trucks with a capacity [illegible] than 1 ton and goes upward by successive increments for each ½ ton to $150 for a 3-ton truck. Trucks exceeding a capacity of 3 tons pay $50 for each of capacity.

[illegible] trucks with pneumatic tires are charged half the above rates except in the case of capacities exceeding 3 tons where the fee is $40 per ton.

Ferry service was improvised immediately after the destruction of the bridge, and at the same time plans were developed for providing a temporary crossing, pending the construction of a new draw span. A timber trestle runaround with a single-channel movable span is under discussion. As there is a tidal rise and fall of 4 or 5 ft., it may be difficult to arrange to carry trolley traffic over this structure.

Back Engineer for U. S. Civil Service Commission

The American Association of Engineers is actively supporting A. B. McDaniel, educational specialist and consulting engineer to the General Staff of the War Department, for membership on the U. S. Civil Service Commission. Mr. McDaniel was principal engineer of the Construction Division of the Army during the war. Previous to that time he did consulting work and taught engineering both at Union College and the University of Illinois.

St. Louis Engineers Present Plan for Public Works Board

The Associated Engineering Societies of St. Louis, in conjunction with the St. Louis Chapter of the American Institute of Architects and St. Louis contractors have presented to the Missouri State Constitutional Convention, now in session, a provision for a State Board of Public Works to be included in the new State Constitution. The plan proposes the establishment of a board to be composed of a president and directors of utilities, highways, waterways, and conservation, who shall respectively supervise divisions of structures, utilities, highways, waterways and conservation. Members of the board are to be appointed by the Governor. The several divisions are to be charged with the supervision of activities as follows:

Division of Structures—Lands, natural resources, structures, equipments and improvements in which the state is interested, except as otherwise provided.

Division of Utilities—Maintenance, equipment, operation and service of all public utilities owned or operated by the State and the assessment of rates and charges therefor, subject to review by the State Public Service Commission, which may be authorized to have jurisdiction over rates and charges of privately owned utilities.

Division of Highways—Construction, reconstruction, maintenance and surveillance of all public highways and bridges for which state funds are used; the director to be chairman of any state highway commission authorized to direct improvement of state roads.

Division of Waterways—Waterways and watersheds within or bounding the State, including nevigable waterways, stream pollution, fisheries, waterworks, irrigation projects, flood control, water power developments, drainage and sanitary matters.

Division of Conservation—Conservation of resources, state planning and public safety.

It is proposed to secure as far as possible the united support of engineers, architects and contractors throughout the state in advocating the provision for the Board of Public Works in the revised constitution.

Award N. Y. Courthouse Contract to Fuller Co., at $4,139,000

Award was made June 23 to the George A. Fuller Co., at an estimated cost of $4,139,000, of the contract for the construction of the New York County Courthouse in New York City. The work includes the entire superstructure, which will be faced with granite, but does not comprise certain plumbing installations, which are to be let under a separate contract. Guy Lowell, architect, designed the structure. The present bid is about $2,000,000 less than bids for the same project opened in 1920.

Doctor Burgess New President of A.S.T.M.

(Engineering News-Record Staff Report)

Dr. George K. Burgess, chief of the Division of Metallurgy of the U. S. Bureau of Standards, was elected president of the American Society for Testing Materials at the annual meeting at Atlantic City, June 27. The meeting, which ends tomorrow, marks a milestone in the society's history, being the twenty-fifth since its formation in 1898. The retiring president, Charles D. Young, reviewed the growth of its work, outlining the present activities and the direction of progress. Dr. Burgess, in turn, suggested that future endeavors of the society should be centered on making its standards more generally applicable, adapting them to service here and abroad. Other officers elected were: Dr. William H. Walker, vice-president; D. M. Buck, W. M. Corse, Dr. W. K. Hatt and J. R. Onderdonk, directors.

Discuss Corrosion

Active discussion of the corrosion of iron and steel featured the opening session. Prof. W. D. Bancroft presented a dicidedly individual view of the subject in a paper and a committee report on the exposure of test panels at Pittsburgh, Port Sheridan and Annapolis, confirming previous indications of this test that copper-bearing steels resist atmospheric corrosion several times as well as low-copper steels. The discussion dealt largely with the distinction between chemical and electrochemical corrosion and with the nature of resistance to corrosion, especially the formation of protective films. Dr. Walker, referring to the fact that the cause for the passivity of iron is not yet known, emphasized the lack of knowledge on corrosion.

Water-pipe corrosion was discussed by F. N. Speller, who described the effect of protective films in pipes and the value of removing oxygen from soft waters.

Other active interest developed in pig- and cast-iron, car wheels and wrought-iron. A new specification for semi-steel and higher-strength figures for malleable iron were adopted. Sharply divergent views of grading pig-iron were expressed. Rawdon and Epstein showed that the nicked break test for wrought-iron is unreliable.

On account of the heavy program duplicate sessions are to be held during two days of the meeting which includes a symposium on impact testing and a discussion of the Joint Committee Report on Reinforced Concrete. Memorial resolutions were passed commemorating the death of the past presidents, H. M. Howe and A. W. Gibbs.

Waldo Smith and Merriman Honored by Associates

Four Hundred Attend Dinner Marking Retirement of Catskill Aqueduct Chief

Four hundred engineers paid tribute to J. Waldo Smith and Thaddeus Merriman at a dinner in the Hotel Pennsylvania, New York City, June 27, on the occasion of Mr. Smith's retirement, after 17 years of service, as chief engineer of the Board of Water Supply of the City of New York and Mr. Merriman's promotion as head of the engineering staff of the Catskill aqueduct. In the principal address of the evening the Hon. George B. McClellan, former mayor of New York, credited the "rugged honesty, the high ideals and the exceptional administrative and technical skill of J. Waldo Smith as the factors directly responsible for the successful completion of the Catskill project without scandal and within the preliminary estimates of time and cost. "His conduct of the work," said Col. McClellan, "was a constant inspiration to his subordinates and a part of his genius lay in his ability to bring together into his engineering organization the same type of American lad that won the war in France."

Merriman an Able Successor

Col. McClellan paid high tribute, also, to Mr. Merriman's share in the enterprise, emphasizing that he had grown up with the work since its inception 17 years ago and was the man best qualified by experience and technical attainments to succeed his former chief. At the conclusion of the former mayor's address mementos in the form of a watch for Mr. Smith and a cigarette case for Mr. Merriman were presented.

The retiring chief engineer accorded to Col. McClellan chief credit for initiating and carrying through the Catskill water supply project, in the face of persistent political interference. "There should be rotation in office in any organization," said Mr. Smith, in referring to his former deputy, "and Mr. Merriman has demonstrated his ability to carry on the work which I now turn over to him. His appointment as chief engineer follows the policy of promotion within the organization for which I have always stood."

The evening's session ended with an appreciation by Mr. Merriman of J. Waldo Smith's distinguished service and a plea for the maintenance within the ranks of the organization of the high ideals established under his predecessor's administration. "Every man must be a debtor to his profession," said Mr. Merriman, "and progress can be made, not through the efforts of a single individual but rather by a striving for better standards in every strata of the great mass of men who constitute the country's engineers."

Col. Merritt H. Smith, chief engineer of the New York Department of Water Supply, Gas and Electricity, acted as toastmaster and the arrangements for the dinner were in the hands of a committee headed by Robert Ridgway, chief engineer of the Transit Commission, as chairman and W. J. Buhrendorf, chief clerk of the Board of Water Supply as secretary. The attendance was thoroughly representative of both engineering and contracting interests in the metropolitan district.

S.P.E.E. Would Broaden Service to Engineering Education

Resolutions adopted by the council of the Society for the Promotion of Engineering Education, at its convention held at Urbana, Ill., June 20 to 23, directed the president, Prof. Charles F. Scott, to appoint a committee of five members, including himself, to study the development of the society and to formulate an answer to the question, "What can the society do in a comprehensive way to develop, broaden, and enrich engineering education?" This committee is to report to the council as soon as possible.

In his presidential address Prof. Scott emphasized the need of the technical industries for engineers competent to serve not only as trained technicians but also as leaders in production and in administration. He pleaded also for more effective means of checking up the effectiveness of present engineering instruction in fitting students to meet these requirements.

Among the papers of general interest were those by W. H. Rayner of the Univ. of Ill. on the "Cultural Element in Engineering Education"; J. Raleigh Nelson on the teaching of English in the engineering course; J. H. Dunlap, of Iowa State Univ., on "Some Problems in Engineering Education"; and Charles E. Chadsey, of Univ. of Ill., on "Teaching."

The Council of the society considered but took no action on 5-year engineering courses recently endorsed by the deans of the mid-west engineering schools. It voted to establish within the society a new section composed of deans and school directors.

The election of officers resulted in the re-election of Prof. Charles F. Scott of Yale University as president. New vice-presidents are D. S. Kimball of Cornell and F. G. Higbie of Iowa. New members of the council are M. W. Alexander, National Industrial Conference Board, Edward Bennett of Wisconsin, H. S. Evans of Colorado, E. A. Hitchcock of Ohio, H. J. Hughes of Harvard, C. E. Magnussen of Washington, and G. C. Shaad of Kansas State.

The convention next year will be held at Ithaca, N. Y.

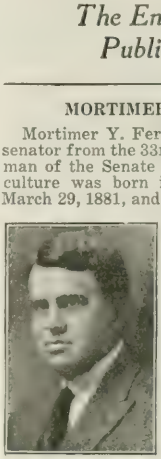
For Cleveland Improvements

Several prominent movements projected or under discussion in Cleveland have been reported upon by the civic committee of the local chapter of the American Association of Engineers. The river straightening project, under discussion for a number of years, is opposed, and its abandonment is recommended. The plan for a union station on the public square, as proposed by the New York Central R.R., is approved. The river crossing problem is dealt with in a general study relating to a number of the Cuyahoga Valley bridges, as a result of which the Brain-Huron viaduct project is opposed, the old Superior viaduct is recommended for reconstruction and addition of a branch crossing, vehicle traffic to be divided so that the old viaduct takes heavy trucking and the new Detroit-Superior viaduct carries only passenger automobiles, and construction of a new viaduct on Carnegie Ave. recommended. The thoroughfare plan of the city planning commission is approved.

The Engineer in Public Life

MORTIMER Y. FERRIS

Mortimer Y. Ferris, New York State senator from the 33rd District and chairman of the Senate Committee on Agriculture was born in Brookline, Mass., March 29, 1881, and was graduated from the civil engineering course of the Massachusetts Institute of Technology, Boston, in 1903. After a year's work at New Castle, Pa., as assistant in the engineering corps of the Pennsylvania Lines West of Pittsburgh, he moved to Ticonderoga, N. Y., and established an office for the general practice of civil engineering which he has maintained ever since.



He served on the Ticonderoga Board of Education for ten years, the last three years of which he was president. In 1916 and 1917 he was elected village president.

Mr. Ferris was first elected to the New York State Senate in the fall of 1918 and has since continued to represent the 33rd Senatorial District, comprising the counties of Clinton, Essex, Warren and Washington. He has been active in all matters affecting the engineering profession and introduced and was largely responsible for the passage of the recent legislation combining the engineering forces of the state in a single department under the state engineer and surveyor, and for the state registration of professional engineers and land surveyors. He has also been prominent in water-power, stream-regulation and conservation matters.

Federal-Aid Road Appropriations Cover Three Years

Appropriations for state highway construction in the 3-year federal-aid program referred to in *Engineering News-Record* of June 15, p. 1015, should have been stated as follows: $50,000,000 for the fiscal year ending June 30, 1923; $65,000,000 for the year ending June 30, 1924; and $75,000,000 for the year ending June 30, 1925.

Low Municipal Bond Interest Rates

The ruling interest rate for municipal and state bonds continues to be 4½ per cent or less. The yield rate for [illegible] of [illegible] reported by the New York Times as sold during the week ending June 17 was 4⅛ or under, with [illegible] issues of 4½ or less and several at 4¼ and 4.45. The Chicago South Park Commission sold $1,000,000 of 4 per cent 1-20-year bonds to yield 3.25 to 4 per cent, and $700,000 of Jersey City, N. J., general bonds bearing 4½ per cent sold to yield 4 to 4.25 per cent.

Hearing on San Francisco Bay Terminal Plan

Plan Advocated for Reclaiming 170 Acres of Shoal Land Adjoining Goat Island

A special commission composed of one representative each from the departments of war, Commerce and the Navy conducted a hearing in San Francisco on June 12 to give all interested parties an opportunity to present opinions and objections on the application of the San Francisco & Oakland Terminay Ry. for permission to reclaim 170 acres of shoal land adjoining Goat Island and to construct thereon a union terminal for the use of interurban systems, automobiles and transcontinental railroads.

Major General Lansing H. Beach, chief of engineers, U. S. A., was chairman of the hearing, Admiral A. S. Halstead, commander of the Twelfth Naval District, represented the navy and C. H. Huston, assistant secretary commerce, was the third member. Col. Herbert E. Deakyne, San Francisco office, Corps of Engineers U. S. A., served in an advisory capacity.

Review Traffic Situation

J. S. Drum, chairman of the board of the railway company, reviewed the transbay traffic situation and the advantages of the proposed terminal, pointing out that the company was quite willing to have other transportation companies join in the project. Edward M. Boggs, consulting engineer for the company, presented the engineering aspects of the plan. In his opinion bridge or tunnel projects that would supplant the ferry service for commuters was in the far distant future and meantime, at a reasonable cost, the present 18- to 20-min. ferry trip of 2.85 miles could be reduced to a 10-min. trip of about 1.6 miles. Last year the ferries of the Southern Pacific and Key Route systems combined handled 45,000,000 transbay passengers.

Since the greatest item of cost in connection with the proposed union terminal would be the crossing between the east shore and the reclaimed land near Goat Island, the application asks for as much concession on this point as can be granted. A solid fill 20 ft. wide was declared to be the most desirable. Such a fill would not exert any important influence on tidal flow. Mr. Boggs believed, nor interfere seriously with bay traffic since the alternative route around Goat Island is wide and deep and for most all the traffic is little, if any, longer. However, if permission to build a solid fill could not be granted, a combination fill and trestle was suggested. The requirement that the channel be kept open to navigation by the construction of a drawbridge or even a viaduct to allow clearance for comparatively small vessels would make the cost of the plan prohibitive, he thought.

Representatives from other commercial and civic bodies expressed interest in the plan but nothing tangible was raised in the form of objections.

Board on the Bearing and the Commission [illegible] after a firsthand study of [illegible] conditions, the committee is to make recommendation to Congress by which [illegible] action on the application must be taken.

Civil Engineers' Convention

(*Concluded from p. 1094*)

needed, more of what is going on in the engineering world, book reviews, pictures of men, and that if it were necessary there could well be twelve or even twenty-six issues a year carrying such features.

In his second section Mr. Freeman traced the history of hydraulic science from the time of the Romans to the present. He feels that we are at a point now where a more thorough and elaborate theoretical study of hydraulics should be made—such things as the control of rivers—and that now is the time to urge and promote a federal hydraulic laboratory.

Papers Many and Various

As reported in the advance program, nine technical papers were on the program. Thanks to the bad weather which would not permit any one to get far from the hotel, it was possible to complete the full program, in a damp and close little movie house, but it was obvious that the makers of the program were somewhat ambitious in their layout because had the projected excursions taken place, there would not have been any possibility whatever of getting through more than a quarter of the technical papers outlined. As it was, the papers were on so many different subjects that the audience apparently was unable to shift its mental attitude from subject to subject sufficiently quickly to start or continue any discussion. The program, therefore, consisted merely in the presentation of the papers. Practically no discussion followed them.

A further report on the well-known Aberthaw tests of concrete piles in sea water was included in a paper by L. C. Wason, president of the Aberthaw Construction Co., and read by a member of his staff. The paper added nothing to the earlier report except to give a few figures of strength tests of the concrete in those few piles which had failed. Col. W. G. Atwood, the director of marine piling investigations of the National Research Council, presented a most absorbing report of the activities of the marine borer which is infesting some Pacific coast waters and which is causing some apprehension in eastern waters. Col. Atwood indicated that the study now was largely a biological one, that protection of structures against the borers was at best temporary, and that the hope of the future lay in some biological attack. He was not able, however, to promise anything at the present time.

Prof. W. K. Hatt, the direction of the Highway Research Committee, Division of Engineering of the National Research Council, reported the various tests on highways now under way in the United States. The report was a longer exposition of the activities which have been recorded in this journal.

Three papers connected with wood pulp were considered together, the first by Prof. George C. Whipple of Harvard University, entitled "Pollution of Streams by Paper Mill Wastes," a study of the bacteriological conditions in waters downstream from paper mills; the second by H. W. Clark, chief chemist of the Massachusetts State Board of Health, on the same subject from a chemical standpoint; and the third by E. B. Wardle, chief engineer of the Laurentide Co. of Canada, on the wood pulp industry in general. Mr. Wardle's paper was presented mainly as a set of still and moving pictures.

Two papers on the Quebec stream regulation were read, one by O. Lefebre, chief engineer of the Quebec Streams Commission, on the problems in connection with the St. Maurice river regulation, a subject which has been discussed in this journal, and the other by J. H. Brace of the contracting firm of Fraser, Brace & Co., on the Gouin Dam which was built five years ago on that river.

In the evening Frank W. Hodgdon, chief engineer of the Division of Waterways of the Massachusetts Department of Public Works, showed a number of views of the minor shore protection work undertaken by the State of Massachusetts along the Atlantic Coast, and in a formal discussion Henry S. Adams of Boston showed the condition of failure of a number of old cribworks in the northeastern Atlantic Coast, Frederic H. Fay outlined the new development of the port of Portland, and Lt. Col. Wildurr Willing gave a formal statement of the amount of work done by the federal government in New England harbors. The last paper of the evening was an illustrated talk by J. W. Rollins of Holbrook, Cabot & Rollins Corp. on the foundation work at the Piscataqua bridge at Portsmouth, where pneumatic caissons were sunk in 80 ft. of water in a tide rip between the islands of the harbor.

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual Meeting, Atlantic City, N. J., June 26-30.

NEW ENGLAND WATER WORKS ASSOCIATION, Boston; Annual Convention, New Bedford, Mass., Sept. 12-15.

Personal Notes

WARREN C. EARLE, who has been consulting engineer for the city of San Diego, Cal., has taken the position of city engineer of Pasadena, Cal.

LEROY F. WERTZ, assistant chief engineer of maintenance of the Indiana State Highway Department, has been named chief of the division of auditing to succeed John D. Williams, who recently was made director of the state highway commission. Mr. Wertz has been in the department for about a year. He is a native of Anderson, Ind., and is a graduate from Purdue University. For six years he was an engineer in the department of parks of Indianapolis and then was an assistant engineer of the Indianapolis Water Co. Before joining the Indiana Highway Department, he was an associate of Morris Knowles, consulting engineer, of Pittsburgh.

JOHN T. HENDERSON, consulting engineer, Hartford, Conn., has been appointed inspecting engineer by the city of Hartford, on the $1,500,000 Weaver High School and the $1,000,000 high school to be erected on Maple Ave., that city.

MORTIMER G. BARNES, chief engineer of the Waterways Division, Illinois State Department of Public Works, has had the degree of master of engineering conferred upon him by the University of Michigan.

PROF. SAMUEL C. PRESCOTT, acting head of the department of biology and public health of the Massachusetts Institute of Technology since the death of Prof. William T. Sedgwick, has been made permanent head of the department.

R. G. WILSON has resigned as assistant division engineer of the Wyoming Division of the Erie R.R. and is succeeded by JOHN GRAVES, former assistant division engineer of the Rochester Division. Other changes in the engineering department of the Erie R.R. include the transfer of BLAIR BLOWERS from his position as supervisor on the main line to assistant division engineer at Rochester. FRED FISKE, supervisor of the Buffalo Division, takes Mr. Blowers' former position.

HENRY S. CHARRON has been appointed superintendent of the water department of Burlington, Vt. He succeeds J. FRANK KIDDER, resigned.

LLOYD APPLEGATE of Youngstown, Ohio, has been elected village engineer of McDonald, Ohio.

W. M. COTTON of Dayton, Ohio, has been appointed city manager of Ashtabula, Ohio, effective June 1. He will succeed M. H. TURNER who has been city manager since 1918 and who requested more than a year ago that a successor be appointed. Mr. Cotton has served as city manager of several Pennsylvania towns.

CHARLES H. DOWLER, city manager of Wheeling, W. Va., has resigned, the resignation to take effect July 1. He will at that time become a member of the West Virginia State Road Commission. Mr. Dowler succeeds N. P. Whitaker.

JOHN G. HIRSCH, formerly supervising engineeer for Lockwood, Greene & Co., and for Stone & Webster, is now associated with the Benham Engineering Co. of Kansas City, Mo., as principal assistant engineer.

Credit Schafer

R. B. PETTERS, who recently resigned as city engineer of Fond du Lac, Wis., has become associated with the Stein Engineering Co. of Milwaukee as superintendent of construction.

L. D. DAVENPORT, chief engineer of the Oliver Iron Mining Co., Duluth, Minn., has left for Fushun, a city on the South Manchurian R.R., to devise engineering means whereby that city can be moved for the purpose of developing a deposit of coal underlying it estimated to contain 800,000,000 tons.

GEORGE W. PUTNAM has been appointed state sanitary engineer of Missouri, to head the newly-created engineering division of the Missouri State Board of Health, the offices of which are at Jefferson City. Mr. Putnam has been connected with the engi-

neering work of the state boards of health of Minnesota and California, and during the war was engaged in water-supply work with the Sanitary Corps of the army.

MAJOR D. D. PULLEN, Corps of Engineers, U. S. A., has been ordered to Norfolk to succeed COL. J. C. OAKES as engineer for that district. Col. Oakes has been transferred to New York City.

OBITUARY

A. S. BALDWIN, vice-president, Illinois Central R.R., died of heart disease June 26 while en route from New York to his home in Chicago. He was 61 years old. He was a past-president of the Western Society of Engineers, the American Railway Association and at the time of his death was a candidate for director, District 8, of the American Society of Civil Engineers in the election now in progress.

WILLIAM CREIGHTON BALL, president of Rose Polytechnic Institute, died recently at his home in Terre Haute, Ind., after an illness of several months. Mr. Ball was 75 years old. He was also secretary of the Indiana State Normal School and a member of the board of the state penal farm. Prior to his becoming president of the engineering school he and his brother published the Terre Haute *Gazette*.

A. W. GIBBS, chief mechanical engineer, Pennsylvania Railroad System, died at his home in Wayne, Pa., on May 19. Mr. Gibbs was born in 1856 and was graduated from mechanical engineering Stevens Institute. His professional experience was mostly in the service of the Pennsylvania Railroad from which he rose as an apprentice in the Altoona Shops to become superintendent of motor power and later chief mechanical engineer. For a short period he was connected with other railroads but returned to the Pennsylvania. Mr. Gibbs was president of the American Society for Testing Materials in 1914-15.

BUSINESS NOTES

The AMERICAN ABRASIVE METALS CO., of New York, manufacturer of anti-slip treads for stairs and floors, announces its appointment by the Carborundum Co., of Niagara Falls, to act as U. S. sales representative for the marketing of Carborundum anti-slip tile.

JAMES I. VINCENT has been appointed eastern representative of the Chicago Bascule Bridge Co., with offices in New York City. Mr. Vincent graduated from the University of Michigan in 1896 and was with the Scherzer Rolling Lift Bridge Co. from 1903 to 1912, when he became eastern representataive of the Strauss Bascule Bridge Co.

STROUD & COMPANY, of Omaha, has just sold to R. M. McCrone of Bangkok, Siam, three elevating graders to be shipped immediately to that country. The graders will be used on a large government railroad and irrigation project.

THE STRAUSS BASCULE BRIDGE CO., Chicago, has closed its New York office and has opened a new eastern office at 603 Albee Building, Washington, D. C., in charge of J. C. Eversman.

A. W. FRENCH & CO. is the name of the newly incorporated Illinois firm organized by A. W. French, E. A. Allen, and F. R. French, formerly associated as French & Allen. Land has been acquired and buildings are under construction at 87th St. and the Rock Island tracks, Chicago, for the manufacture, storage and repair of contractors' equipment. The company has been appointed western manager for the Orr & Sembower Co., Reading, Pa., manufacturers of engines, boilers, concrete mixers, and hoisting engines. The French company will also manufacture and distribute the Ord concrete road surfacer described below.

EQUIPMENT AND MATERIALS

Concrete Road Surfacer

The Ord concrete road surfacer, a new machine developed by William Ord since his resignation from the Lakewood Engineering Co. several months ago, has two heavy strike-off girders



or screeds which level the concrete by using the tops of the road forms as guides, as shown in the accompanying picture. The girders are 8 in. wide on the surface of the concrete and each weighs about 700 lb. for an 18-ft. road machine. They are adjustable for any crown.

Working backward and forward across the road as the machine advances, the girders not only strike off the superfluous concrete but float the remainder. Skin friction between the bottoms of the girders and the surface of the concrete results in a kneading action which is claimed to be sufficient to remove all excess air and water and to produce concrete of maximum density. A. W. French & Co., of Chicago, are the manufacturers and general distributors of the machine.

Electric Truck With 5-Ton Lift

A storage-battery truck for factory and freight purposes which has an elevating platform of 5-tons capacity has been brought out by the Atlas Car & Mfg. Co., Cleveland, Ohio, and is shown in the accompanying view. Its load platform is 74½x30 in. and 11½ in. from the floor in its lowest position, with a lift of 4 in. It has a maximum speed of 8 m. p. h. unloaded and its turning radius is 5 ft. 9 in. for the inside and 12 ft. for the outside. The driving wheels have metal-base rubber tires 4 in. wide and 27¾ in. in diameter. The 10¾ in. steel trailing wheels have double row ball bearings. Steering is applied to all four wheels and the brakes must be held off by



positive pressure on the treadle or foot lever. Three speeds are provided, but the controller is so interlocked with the brake that only the first speed can be used in starting. A worm gear gives the necessary driving reduction. In the elevating mechanism a motor is coupled to a double-worm reduction gear which drives miter gears carrying crank shafts fitted with rollers bearing against steel plates under the platform. By a half revolution of the cranks the platform is raised 4 in. in 10 seconds with a 5-ton load.

Pipe, Valves and Fittings in War Surplus Auction Sale

The War Department has declared as surplus, and will offer for sale by public auction, at Camp Jackson, S. C., July 25, quantities of materials which, it is believed, will prove of interest to buyers in the market for construction and engineering supplies. Chief among the offerings are several lots of Redwood water pipe, in sizes from 4 to 12 in., and quantities of terra cotta and iron pipe, joints, valves and fittings. Inquiries regarding these offerings should be addressed to the Quartermaster Supply Officer, Candler Warehouse, Atlanta, Ga.

Out-of-the-Ordinary Trade Publications

A good account of the methods of using steel fabric reinforcement for concrete pavements is published by the NATIONAL STEEL FABRIC CO., Pittsburgh, Pa.

An architect's specification handbook has just been issued by the TRUSCON LABORATORIES of Duluth. It is designed to supply information required for specifying waterproofing, damp-proofing, oil-proofing, floor hardeners, and protective finishes. Specifications are given on each right-hand page with a description of the particular product mentioned on the back of that sheet. The handbook contains fifty-two specification sheets.

Full details regarding the construction and use of steel sash, not only in industrial building but in commercial, institutional, and residential structures are described in two illustrated catalogs issued by the DAVID LUPTON'S SONS CO., Philadelphia. The first discusses building design from the point of view of light and ventilation and consists of 191 pages profusely illustrated with drawings and photographs. The second booklet deals with casements of artistic form for fine residences, hotels, and monumental buildings. For both industrial and residential structures, the text gives many new details of industrial sash, doors, partitions, and operating devices.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Lumber Output During May Highest Since 1919

Actual Production and Shipments Compared With Normal and Seasonal Production

The relation of actual production and shipments to normal production, and to average production and shipments of lumber is shown by these two three-year charts of the National Lumber Manufacturers Association. The most active period is May to August of each year. Since the middle of January, 1922, actual production and shipments exceeded the average, as based upon experience of eight years (1912-1919 inclusive); and in April, 1922, shipments exceeded normal production.

The seasonal line—dotted—on the chart was obtained by averaging the monthly figures for eight years prior to 1920. Compared with this is the fluctuating continuous line of actual production or shipment.

Not until April, 1922, were the high records of 1919 and 1920 equaled in either lumber production or shipments. Before 1922 the highest point reached by production and shipments was about 10 per cent below normal production; the lowest point touched by shipments was 70 per cent below normal production in December, 1920. Latest figures from 394 mills, reporting for the week ending June 17, give shipments 5 per cent above normal with production 3 per cent below normal.

Reports of four associations of the National Lumber Manufacturers Association are included in the compilations from which these charts were graphed: Southern Pine Association, West Coast Lumbermen's Association, Western Pine Manufacturers' Association and North Carolina Pine Association. The principal species represented are Southern long-leaf yellow pine; Douglas fir; Western hemlock; Western yellow and white pine and North Carolina short-leaf yellow pine.

Labor Bureau Revised Index Number for May

The Bureau of Labor Statistics has just issued its revised index numbers of wholesale prices for May, as given in the table. The details of this revision as affecting building materials were given in this section of the June 8 issue. It is interesting to note that by this new grouping and weighting building materials as a whole are shown to be only five points or 3 per cent cheaper than a year ago.

REVISED INDEX NUMBERS OF WHOLESALE PRICES, BY GROUPS OF COMMODITIES
(1913 = 100)

	1921	1922	
	May	April	May
Farm products	118	129	132
Foods	139	137	138
Cloths and clothing	173	171	175
Fuel and lighting	200	194	216
Metals and metal products	138	113	119
Building materials	165	156	160
Chemicals and drugs	134	124	122
Housefurnishing goods	209	175	176
Miscellaneous	126	116	116
All commodities	145	143	148

Comparing prices in May with those of a year ago, as measured by changes in the index numbers, it is seen that the general level has increased 2 per cent. The greatest increase is shown for farm products, in which prices have risen nearly 12 per cent. Fuel and lighting materials have increased 8 per cent and clothing over 1 per cent since May of last year. In all other groups prices have declined, the decrease ranging from less than 1 per cent for foodstuffs to 15¾ per cent for housefurnishing goods.

Production Heavy in May

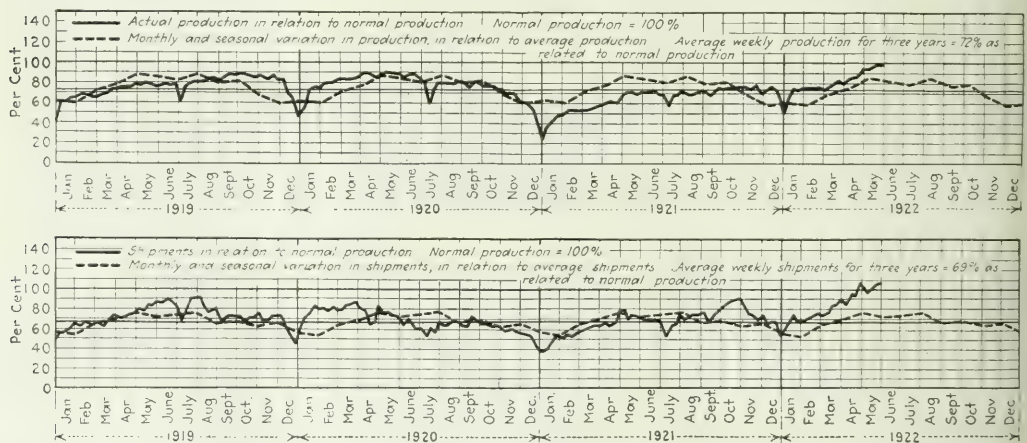
Pig iron production in May totaled 2,306,679 tons or 234,565 more than in April. Though under the 1913 monthly average, this is the largest output since January, 1921.

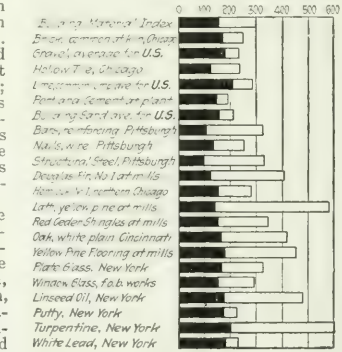
Steel ingots produced in May amounted to 3,099,155 tons, an increase of 300,000 over April. Unfilled orders of the U. S. Steel Corporation at the end of May totaled 5,254,228 tons, 157,000 more than the month before.

Laborers in 106 establishments of the iron and steel industry numbered 136,593 in May against 115,709 one year ago, with the combined payroll $514,026 greater. Per capita earnings were 4.6 per cent higher than in April.

Fabricated steel sales amounted to 146,900 tons in May, against 165,900 in April.

Bituminous coal produced in May totaled 20,506,000 tons, with practically no anthracite production.





Gasoline produced in April, the latest figures available, amounted to 472,920,000 gal.

Passenger automobiles and trucks produced in May totaled 252,000. This is considered a record output and prospects point to a continued heavy demand.

Southern pine production during May was but one per cent below normal, while shipments and orders exceeded normal by wide margins. Stocks decreased 6.4 per cent and are 12.1 per cent below normal.

Seven Years' Bidding Prices On New York Roads

Prices Bid on Every Item of Road Construction Averaged for Each Year During 1915-1921

BY W. G. CRANDALL
Assistant Engineer, New York State Highway Commission

Average bidding prices for seven years, of common items entering into road construction in New York State, are summarized in the accompanying table and charts. These averages have been computed from bids received on 3,175 miles of road. They are truly representative not only of the trend of road prices in New York, but they indicate the remarkable upward swing in prices during the war-price period of 1915-1921, for probably most of the roadbuilding portions of the country.

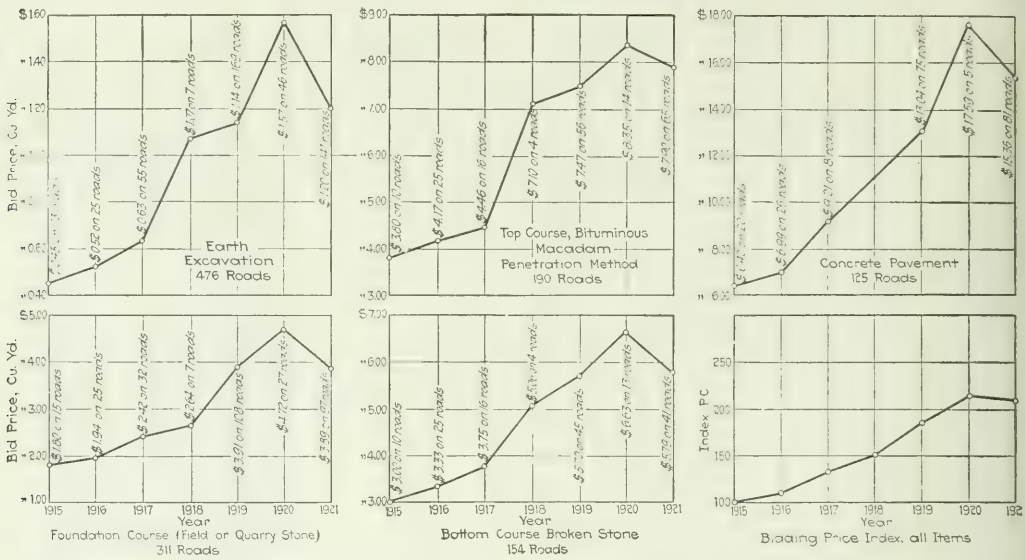
In preparing the table each highway was taken separately and the bids of all contractors for each item were averaged. These averages were tabulated and general averages for the year were computed. By averaging all bids instead of the successful low bids only, it was thought that a more true indication was secured of contracting opinion of fair prices. All obviously unbalanced bids were thrown out of the computation.

In the charts are shown the trend of bidding prices on a few of the leading items of road work. The final chart is a bidding price index curve with 1915 prices as 100 per cent.

(*Charts on p.* 1102)

BIDDING PRICES AVERAGED FOR ALL ITEMS OF ROAD CONSTRUCTION IN NEW YORK FOR SEVEN YEARS, 1915-1921

Item	1915		1916		1917		1918		1919		1920		1921	
	Average Price	No. of Roads	Average Price	No. of Roads	Average Price	No. of Roads	Average Price	No. of Roads	Average Price	No. of Roads	Average Price	No. of Roads	Average Price	No. of Roads
Clearing & Grubbing, mi	$50 00	30	$98.44	25	$99.96	47	$56.84	7	$67 80	162	$52 83	44	$104 13	150
Earth excavation, cu yd	.45	33	.52	25	.63	55	.07	7	1 14	169	1 57	46	1.20	141
Rock excavation, cu.yd	1.20	28	1.35	25	1.44	44	2.04	7	2 34	146	2.79	42	2.65	134
Overhaul, sta.yd	0.015	10	.012	25	.015	22	.02	2	.023	65	.0257	25	.019	71
6 in. vitrified pipe, lin ft	.20	11	.21	7	.55	3	. .	. .	.37	4	.60	1	.39	7
8 in. vitr fied pipe, lin ft	.35	5	.38	10	.50	4	. .	. .	.67	6	.75	2	.74	2
10 in. vitr fied pipe, lin ft	.40	5	.41	7	.53	3	. .	. .	.75	7	.92	4	1.05	4
12 in. vitrified pipe, lin ft	.50	10	.54	24	.71	19	.70	3	1.05	52	1 22	18	1.31	49
15 in. vitrified pipe, lin.ft.	.60	5	.73	19	.84	4	. .	. .	1 23	19	1.59	9	1.60	14
16 in. vitrified pipe, lin.ft.	.80	1	.62	1	1.35	1	. .	. .	1 32	2	. .	. .	. .	. .
18 in. vitrified pipe, lin.ft.	.90	10	.94	25	1.13	6	. .	. .	1 66	31	2 15	12	2 11	30
20 in. vitrified pipe, lin.ft.	1.00	3	.90	1	1.75	1	. .	. .	2 20	5	. .	. .	2 24	2
24 in. vitrified pipe, lin.ft.	1.60	10	1 66	17	1.98	4	. .	. .	2.93	13	2 63	2	3.08	7
6 in. vitrified pipe underdrain, lin.ft.	.20	11	.21	25	.27	28	.35	4	.40	77	.46	3	.42	3
6 in. porous tile underdrain, lin ft	.20	25	.17	25	.24	19	.23	3	.31	69	.36	37	.30	125
Concrete leaching basins, each	37.00	6	48 11	7	50.00	4	. .	. .	69 28	7	70 63	2	66 78	7
Vitrified leaching basins, each	16.00	4	13.50	4	. .	. .	. .	. .	27 00	5	. .	. .	27.91	10
Catch basins, each	36 00	10	38.86	22	53 12	4	30.00	1	66.10	15	56 56	8	68 80	22
Changing elevation manholes and catch basins, each	4 70	10	5.95	20	5 50	9	10 00	1	9 87	12	8 13	8	9 66	16
Cast iron pipe, ton	33 00	22	38 95	25	49 27	41	52.00	5	76.70	111	80 84	31	81.81	38
Relaying old pipe, lin.ft.	.17	5	.184	16	155	24	15	3	.22	86	.23	31	.29	91
Stone filling, cu yd	1.05	4	1.38	20	1.55	5	2.00	2	2.69	13	3.34	5	2.52	8
Piles, wood, lin.ft.	.52	3	.36	2	.40	1	. .	. .	. .	. .	. .	. .	1.16	2
Timber and lumber, M A B M	27 00	10	36 78	25	41.58	25	42.50	6	53.75	109	73 14	30	70.36	108
Riprap, cu yd	1 50	9	1 73	25	1.97	16	2.25	1	3 01	56	3 44	17	3 33	38
First class concrete, cu yd	12 90	1	7 98	2	. .	. .	. .	. .	13 76	11	20 59	22	16 67	8
Second class concrete, cu.yd.	7 70	32	8 08	25	9 06	53	10.37	7	12 90	146	18 62	41	16 41	12
Third class concrete, cu.yd.	6.30	32	6 91	25	7 95	53	9 66	7	11 82	156	17 77	22	14 70	5
Stone masonry, cu.yd.	3.70	8	3 88	2	4 50	2	5.00	1	7 67	8	9 65	1	6.72	2
Stone curb, lin ft	.75	10	90	7	1 00	2	. .	. .	1 25	1	1 58	3	1.76	1
Resetting old curb, lin ft	.30	2	.31	13	. .	. .	. .	. .	.49	5	.42	4	.69	3
Concrete curb, type A, lin ft	.40	10	.46	11	.575	4	.65	2	81	4	.94	4	.84	10
Concrete curb, type B, lin ft	.55	2	.62	11	.75	3	. .	. .	1 26	8	. .	. .	1.05	4
Concrete edging, lin ft	.15	10	.20	3	.25	1	. .	. .	55	1	. .	. .	. .	. .
Cobble gutter, cement joints, sq.yd.	.70	7	76	25	.805	15	1.22	3	1 29	63	1 40	17	1 05	99
Cobble gutter, sand joints, sq.yd.	.50	27	56	25	.617	39	86	6	95	121	1 26	21	95	9
Concrete gutter, sq.yd.	.80	7	1 18	21	1 22	6	. .	. .	2 02	18	2.17	6	2 20	4
Concrete gutter, cu.yd.	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	10 91	32
Brick gutter, sq.yd.	1.00	1	1 00	1	. .	. .	. .	. .	1 65	1	. .	. .	. .	. .
Metal reinforcement, lbs.	.07	30	.072	25	.086	52	125	7	106	153	119	39	.101	147
Metal reinforcement, pavement, lb.	. .	. .	.05	1	. .	. .	. .	. .	07	11	075	5	076	2
Metal reinforcement, pavement, sq.ft	. .	. .	.015	7	. .	. .	. .	. .	025	41	.023	7	025	79
Miscellaneous metal work, lb.	.07	26	072	25	086	47	104	8	105	129	.115	45	097	154
Wood guide railing, lin ft	.24	10	.27	25	336	49	.35	7	48	156	64	36	.63	18
Concrete wood guide railing, lin ft	. .	. .	. .	. .	1 00	2	. .	. .	1 26	4	69	5	76	119
Pipe railing, lin.ft.	1 18	2	1 29	10	1 74	6	. .	. .	1 95	10	2 27	3	2 71	5
Guide signs, each	2 10	10	2 33	20	2 72	53	3 14	7	3 28	140	3 78	46	4 16	153
Highway number signs, each	2 00	10	2 36	21	1 60	51	1 86	7	1 97	79	2 25	4	1 93	49
Danger signs, each	2 50	6	2 78	15	3 56	28	3 67	3	5 72	52	5 25	10	5 96	62
Concrete sign posts, each	10 40	10	13 00	19	13 39	51	16 00	7	16 14	85	17 17	11	18 21	13
Screened gravel, cu yd	1 80	9	1 64	24	2 00	13	3 10	1	2 79	47	2 75	6	3 20	8
Broken stone, loose measure, cu yd	1 80	7	2 02	13	2 04	28	2 65	6	3 57	109	4 23	28	3 81	77
Broken stone, bank measure, cu yd	2 00	9	2 36	12	2 43	18	1 88	2	3 78	47	. .	. .	3 70	8
Foundation course, screened gravel, cu yd	1 50	1	1 95	6	2 42	2	. .	. .	3.53	10	3.45	2	5.49	3
Foundation, macadam or quarry stone, cu yd	1 80	1	1 94	25	2 42	32	2 64	7	3 91	108	4 73	27	3.89	97
Bottom course, screened gravel, cu yd	2 25	1	2 58	3	3 46	1	. .	. .	5 50	1	3 48	1	. .	. .
Bottom course, bit. mac. penetration, cu yd	3 00	1	3 33	25	4 75	16	5 06	4	5 70	45	6 63	13	5.79	41
Concrete foundation for pavement, cu yd	5 00	5	5 45	25	6 68	8	5 20	1	9 98	7	15 00	1	12.05	5
Top course, screened gravel, cu yd	3 90	12	4 40	25	4 98	18	6 53	5	8 51	39	9 64	2	7.72	2
Cleaning old macadam, sq yd	.025	6	004	1	. .	. .	. .	. .	.023	3	. .	. .	. .	. .
Scarifying & reshaping old macadam, sq yd	04	1	037	1	. .	. .	. .	. .	042	5	085	3	. .	. .
Surface treatment with screened gravel, gal	11	3	011	25	141	8	12	1	169	26	162	3	. .	. .
Top course, bit. mac. penetration, cu.yd.	3 80	10	4 17	25	4 46	16	7 10	4	2 47	56	8 35	14	7 90	65
Bituminous carpet, sq yd	1 50	1	. .	. .	1 69	3	. .	. .	2 05	1	. .	. .	. .	. .
Concrete pavement, cu yd	6 42	2	6 99	26	9 21	18	15.25	1	13 04	75	17 59	5	. .	. .
Sealing bituminous gal	1	1	19	1	18	1	. .	. .	202	5	256	2	. .	. .
Asphalt blocks, sq yd	1 40	1	1 90	4	1 63	2	. .	. .	. .	. .	. .	. .	2.43	2
Brick pavement, 1 layer, sq yd	1 40	20	1 55	18	1 76	5	2.20	1	2 78	3	. .	. .	2 94	5
Stone block pavement, sq yd	2 60	1	2 75	4	3 50	1	. .	. .	6 00	2	7 35	1	. .	. .
Resetting curbstones, lin ft	. .	. .	04	3	. .	. .	. .	. .	108	5	. .	. .	. .	. .
Bit. mat. "A" penetration method, gal.	13	10	112	25	131	12	.21	3	132	49	245	12	.15	65
Bit. material for tack coat, gal	.12	3	111	8	126	4	.22	1	157	5	.15	2	. .	. .
Commercial grade asphalt, gal	. .	. .	115	25	131	5	. .	. .	. .	. .	10	4	16	1
Commercial grade coal tar, gal	12	. .	12 60	25	19 39	10	18.00	1	26 31	17	30 00	1	. .	. .
Macadam, grade coal tar, gal	1 30	1	1 41	25	1 96	10	1 50	1	2 54	20	3 00	1	. .	. .
Reinf. conc. pipe, 12 in. diam. lin ft	. .	. .	. .	. .	. .	. .	. .	. .	2 48	1	2 26	1	2 19	23
Reinf. concrete pipe, 15 in. diam. lin ft	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	2 45	3	2 66	33
Reinforced conc. pipe, 18 in. diam. lin ft	. .	. .	. .	. .	. .	. .	. .	. .	3 48	1	3 58	2	3 00	67
Reinf. concrete pipe, 24 in. diam. lin ft	. .	. .	. .	. .	. .	. .	. .	. .	4 20	1	4 60	5	4 54	57
Reinf. concrete pipe, 30 in. diam. lin ft	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	5 50	2	5 71	21
Reinf. concrete pipe, 48 in. diam. lin ft	. .	. .	. .	. .	. .	. .	. .	. .	12 60	1	. .	. .	. .	. .
Portland cement, bbl.	. .	. .	. .	. .	. .	. .	. .	. .	3 10	2	3 54	23	3 40	152
Cement conc. pavement 1-2-4 (*), cu yd	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	19 22	11	9 56	20
Cement conc. pave. 1-1½-3 (*), cu yd	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	11 96	3	8 29	42
Cement conc. pave. 1-1½-3 (*), cu yd	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	10 53	3	8 42	19



Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted. Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section. The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of June 1; the next, on July 6.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minne-apolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$2.68	+$3.65	$4.00	$2.48	$2.86	$3.60	$3.10	$3.60	$3.75
Structural rivets, 100 lb	3.60	+4.35	5.50	3.10	3.90	4.45	4.25	3.75	6.50
Reinforcing bars, ¾ in. up, 100 lb	2.58	3.50	3.50	2.38	2.76	3.67½	2.55	3.60	2.90
Steel pipe, black, 2½ to 6 in. lap, discount	61%	61.15%	45%	59½%	61.9–5%	44%	49.1%	53%	30.00
Cast-iron pipe, 6 in. and over, ton	48.80@49.80	48.50	51.50	44.10	50.50	57.00	51.00	53.00	50.00
Concreting Material:									
Cement without bags, bbl	2.40@2.50	2.34	2.25	2.07	2.34	2.90	—2.63	—2.90	2.48
Gravel, ¾ in., cu.yd	1.75	1.85	2.25	1.80	1.50	1.75	2.25	1.10	1.50
Sand, cu.yd	1.00	1.15	2.25	1.80	1.00	0.75	1.50	1.10	1.25
Crushed stone, ¾ in., cu.yd	1.75	1.90	2.73	1.60	2.25	3.50	2.25	3.00	2.00
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	49.00	39.00	38.00	45.00	40.00	49.00	25.00	+22.50	82.00
Lime, finishing, hydrated, ton	15.80@16.80	22.50	25.00	18.00	29.00	24.00	22.00	24.00	21.00
Lime common, lump, per bbl	2.75@3.18	1.75	2.50	1.40	1.40	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	+24.60	+11.00	11.15	11.00	16@17	12.00	15.00	14.00	16.00
Hollow building tile, 4x12x12, per block	Not used	.075	.115	.0707	.082	.08	....	.12	.09
Hollow partition tile 4x12x12, per block	.1112	.0707	.115	.0657	....	.08	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal	+.88	+.94	1.07	.96	+.99	1.08	1.04	.86	1.09
Common Labor:									
Common labor, union, hour	.75	.35	.....	.80	.....	.50@.55	.56¼	.50@.60	.....
Common labor, non-union, hour	.44@.60	.20	.25	.72½	.35@.50	.35@.50	.47½@.50	.....	.20@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl, net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at pit.

Montreal quotes on long-leaf yellow pine, short-leaf, $67.50. Sand, stone, gravel and lump lime per ton. Lime and tile are delivered; cement, sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 98 12 cents). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $30; 6-in., $110.

CONSTRUCTION NEWS

PROPOSALS

For proposals Advertised see the pages immediately following the "Construction News" Section.

WATERWORKS

Bids Close			See Eng. News-Record
July	3	St. Paul, Minn.	June 29
July	3	Waubay, S. D.	June 15
July	3	Euclid, O.	June 22
July	3	Charleston, S. C.	June 22
July	5	Reading, Pa.	June 22
July	6	Memphis, Tenn. Adv. June 22 and 29.	June 22
July	6	Memphis, Tenn.	June 15
July	6	Grand Rapids, Mich.	June 29
July	10	Harrold, S. D.	June 22
July	11	New York, N. Y. Adv. June 22 and 29.	June 22
July	11	Benton, Wis.	June 22
July	11	Buffalo, N. Y. Adv. June 22 and 29.	June 22
July	12	Vero, Fla. Adv. June 29.	June 29
July	18	Gillett, Ark. Adv. June 29.	June 29
July	18	Wilmington, N. C. Adv. June 29.	June 29
July	18	Fayetteville, Tenn.	June 29
July	19	Saugerties, N. Y. Adv. June 29.	June 29

SEWERS

July	3	Charleston, S. C.	June 22
July	3	Euclid, O.	June 22
July	5	Sharon, Pa.	June 29
July	6	Winter Haven, Fla.	June 8
July	7	Menominee, Mich.	June 22
July	7	Graceville, Minn.	June 22
July	7	Geneva, O. Adv. June 22 and 29.	June 29
July	8	Elma, Ont.	June 29
July	10	Eustis, Fla.	June 15
July	10	Lebanon, Tenn. Adv. June 29.	June 29
July	13	Thiells, N. Y.	June 22
July	17	Barnum, Minn.	June 29
July	18	Lake Forest, Ill.	June 15
July	18	Newark, N. J. Adv. June 29.	June 29
July	19	Camden, N. J.	June 22
July	24	Hackensack, N. J. Adv. June 29.	June 29

WASTE DISPOSAL

July	18	New Kensington, Pa.	June 29
July	25	Buffalo, N. Y. Adv. June 22 and 29.	June 22

BRIDGES

July	1	Georgia	June 29
July	5	Sturgis, S. D.	May 18
July	5	West Palm Beach, Fla. Adv. June 22 and 29.	June 22
July	5	Long Island City, N. Y.	June 29
July	5	Ft. Morgan, Col.	June 29
July	6	Riverview, Md. Adv. June 15 to 29.	June 15
July	6	Salinas, Cal.	June 8
July	6	Iowa Falls, Ia.	June 8
July	6	Washington, Ia.	June 8
July	7	Hewitville (Potsdam P. O.), N. Y.	June 15
July	8	Salem, N. J. Adv. June 22 and 29.	June 22
July	11	Williamsport, Pa.	June 15
July	11	Central Point (Dayton P. O.), Wash. Adv. June 15 to 29.	June 15
July	14	Tennessee	June 29
July	19	Alabama	June 8
July	29	Alabama	June 29
Aug.	1	South West	June 29
		Adv. June 29	
Oct.	31	Sydney, Australia	July 6

EXCAVATION AND DREDGING

July	5	Wessington, Minn.	June 29
July	7	Redwood Falls, Minn.	June 22
July	7	Chicago, Ill.	June 29
July	8	Cape May, N. J.	June 29
July	8	Richmond Beach, Wash.	June 29
July	8	Albert Lea, Minn.	June 29
July	10	Anacortes, Wash.	June 29
July	15	Rensselaer, N. Y. Adv. June 29	June 29

STREETS AND ROADS

July	2	Graham, N. C.	July 6
July	3	Lincoln, Ill.	June 29
July	3	Sullivan County, N. Y.	June 29
July	3	Woodbine, Ia.	June 29
July	3	Cleveland, O.	June 29
July	3	Colfax, Wash.	June 22
July	3	Lilly, Pa.	June 29
July	3	Lodi, Cal.	June 29
July	3	Yreka, Cal.	June 29
July	3	Atlanta, Ga.	June 29
July	3	Bradford, Pa.	June 29
July	3	Des Moines, Ia.	June 29
July	5	Ridgefield Park, N. J. Adv. June 15 to 29.	June 15
July	5	Maryland Adv. June 22 and 29.	June 22
July	5	Hutchinson, Kan.	June 22
July	5	Michigan	June 22
July	5	Long Island City, N. Y.	June 29
July	5	New York, N. Y.	June 29
July	5	Reading, Pa. Adv. June 29.	June 29
July	5	Louisiana	June 29
July	5	Akron, O.	June 29
July	5	Oroville, Cal.	June 29
July	6	New York, N. Y.	June 29
July	6	Fairmont, W. Va.	June 22
July	6	Winter Haven, Fla.	June 8
July	6	San Luis Obispo, Cal.	June 22
July	6	Yuba City, Cal.	June 22
July	6	Michigan	June 22
July	6	Washington, Pa.	June 22
July	6	Wisconsin	June 29
July	7	Troy, Kan.	June 15
July	7	Doniphan, Kan.	June 22
July	7	Tuckerton, N. J. Adv. June 15 to 29.	June 22
July	7	Barnegat, N. J. Adv. June 15 to 29.	June 22
July	7	Menominee, Mich.	June 22
July	7	Ontario	June 22
July	7	Michigan	June 22
July	7	Quebec	June 29
July	7	Colorado	June 29
July	7	Clinton, Ia.	June 29
July	8	Quebec	June 22
July	10	Eustis, Fla.	June 15
July	10	Los Angeles, Cal.	June 22
July	10	Duluth, Minn.	June 22
July	10	Faribault, Minn.	June 22
July	10	Elk River, Minn.	June 29
July	10	California	June 29
July	11	West Virginia Adv. June 22 and 29.	June 22
July	11	Michigan	June 22
July	11	Newton, N. J. Adv. June 22 and 29.	June 29
July	11	New York Adv. June 29.	June 29
July	11	Quebec	June 29
July	11	Covington, Va. Adv. June 29.	June 29
July	11	Louisiana	June 29
July	11	Michigan	June 29
July	12	Michigan	June 22
July	12	Gonzales, Tex	June 22
July	12	Mays Landing, N. J. Adv. June 29.	June 29
July	12	Camden, N. J. Adv. June 29.	June 29
July	12	Michigan	June 29
July	13	Somerville, N. J. Adv. June 29	June 29
July	14	Belvidere, N. J. Adv. June 22 and 29.	June 22
July	14	Somerville, N. J. Adv. June 22 and 29.	June 29
July	14	Ann Arbor, Mich. Adv. June 29.	June 29
July	14	Tennessee	June 29
July	14	New Jersey	June 29
		Adv. June 29.	
July	17	California	June 29
July	18	Salem, Ore.	July 6
July	18	Moundsville, W. Va.	June 29
July	19	Kansas	June 29
July	19	Ohio	June 29
July	21	Portland, Me. Adv. June 29.	June 29

INDUSTRIAL WORK

July	3	Cincinnati, O.	June 29
July	3	Pittsburgh, Pa.	June 22
July	3	Pittsburgh, Pa.	June 22
July	5	Pittsburgh, Pa.	June 29
		Adv. June 29.	

BUILDINGS

July	3	Cincinnati, O.	June 29
July	3	Pittsburgh, Pa.	June 15
July	3	Pittsburgh, Pa.	June 29
July	3	Pittsburgh, Pa.	June 22
July	3	Pittsburgh, Pa.	June 22
July	5	New York, N. Y.	June 22
July	5	Lansing, Mich.	June 22
July	5	New York, N. Y.	June 29
July	5	East Lansing, Mich.	June 29
July	6	Maquoketa, Ia.	June 15
July	6	Grafton, N. D.	June 15
July	6	International Falls, Minn.	June 22
July	6	New York, N. Y.	June 29
July	6	Buffalo, N. Y.	June 29
July	6	Phila., Pa.	June 29
July	7	Flagstaff, Ariz.	June 22
July	7	Grand Rapids, Minn.	June 22
July	10	Albany, N. Y.	June 8
July	10	Ft. Madison, Ia.	June 22
July	10	McKeesport, Pa.	June 22
July	10	Newark, N. J.	June 29
July	10	Janesville, Wis.	June 29
July	10	Schofield, Wis.	June 29
July	10	Plymouth, Mich.	June 29
July	11	Montclair, N. J.	June 22
July	11	Ashland, Wis.	June 29
July	12	Colorado Springs, Col.	June 22
July	13	Dayton, O.	June 29
July	15	Hookerton, N. C.	June 29
July	15	Houghton, Mich.	June 29
July	17	Urbana, Ill. Adv. June 15 to 29.	June 15
July	17	Rock Rapids, Ia.	June 22
July	17	Syracuse, N. Y.	June 29
July	17	Fargo, N. D.	June 29
July	30	Westwood, N. J.	June 22

FEDERAL GOVERNMENT WORK

July	3	Hangars, etc.—Pittsburgh, Pa.	June 15
July	3	Parcel Post Room, etc. —Crookston, Minn.	June 8
July	3	Foundations — Northampton, Mass. Adv. June 29.	June 29
July	5	Grilles—Augusta, Ga.	June 22
July	5	Equipment—San Francisco, Cal.	June 29
July	7	Dredging—Baltimore, Md.	June 8
July	10	Post Office, etc.—Apalachicola, Fla.	June 15
July	10	Boiler House, etc.—Rantoul, Ill. Adv. June 22 and 29.	June 22
July	11	Post Office—Gilmer, Tex.	June 15
July	12	Extension to Workroom, etc. —Albert Lea, Minn.	June 29
July	14	Alterations—Lowell, Mass.	June 29
July	17	Metal Work — Louisville, Ky. Adv. June 22 and 29.	June 22
July	17	Rubble Mound — Ashtabula Harbor, O. Adv. June 22 and 29.	June 22
July	17	Conduit—Wash., D. C. Adv. June 22 and 29.	June 22
July	17	Steel Ladder, etc. — New Orleans, La. Adv. June 22 and 29.	June 22
July	18	Piling—Louisville, Ky. Adv. June 22 and 29.	June 22
July	18	Fire Alarm System—Tuskegee, Ala.	June 29
July	19	Steel Hull — Pittsburgh, Pa. Adv. June 22 and 29.	June 22
July	19	Cincinnati, O.	June 29
		N. Y. Adv. June 29.	June 29
July	20	Mare Island Navy Yard, Vallejo, Cal.	June 8
		Adv. June 29.	
Aug.	2	Dredging—Wash., D. C.	June 15
Aug.	3	Pearl Harbor, H. T.	June 15

MISCELLANEOUS

June	3	Towing, Miami, Fla.	June 8
July	1	Ft. Leavenworth, Kan.	June 8
July	1	Ft. Leavenworth, Kan.	June 8
July	5	Ft. Leavenworth, Kan.	June 8
July	5	Ft. Leavenworth, Kan.	June 8
July	5	Ft. Leavenworth, Kan.	June 8
July	5	Ft. Leavenworth, Kan.	June 8
July	5	Ft. Leavenworth, Kan.	June 8
July	5	Ft. Leavenworth, Kan.	June 29
July	7	Ft. Leavenworth, Kan.	June 29
July	7	Ft. Leavenworth, Kan.	June 29
July	7

Bids Close		See Eng. News-Record
July 17	Heating, Ventilating, etc. — Urbana, Ill. .....June 22 Adv. June 22 and 29.	
July 18	Pier Sheds, etc.—Portland, Me. .....June 22 Adv. June 22 and 29.	
July 19	Turbine and Accessories — New Orleans, La. .....May 18 Adv. May 18 to June 29.	
July 19	Engine-Generator Unit—Belhaven, N. C. .....June 29	
Aug. 15	Hydro-electric Development—Dothan, Ala. .....July 29 Adv. June 22 and 29.	

Where name of official is not given inquiries should be addressed to City Clerk, County Clerk or corresponding official.

Waterworks

PROPOSED WORK

Mass., West Rutland—See "Buildings."

Conn., Manchester—Manchester Water Co. having sketches made new rein.-con. dam with 22 ft. spillway, concrete retaining walls. To exceed $25,000. J. F. Bowen, Manchester, engr.

Conn., Berlin—Having plans prepared 3½ mi. extension to water supply system in Hudson St., Farmington Ave., Middletown Rd. and Worthington Bridge sections. Oldershaw & Crowley, 259 Main St., New Britain, engrs.

N. Y., East Syracuse—Plans new reservoir at Wright Brook, 1 mi. west of Jamesville, 1,000,000 gal. capacity, concrete spillway and wall, 4,500 yd. concrete and 30,000 cu.yd. earth excav. $100,000. S. L. Adcook, 109 West Ellis St., engr.

N. Y., Scottsville—See "Sewers."

Ia., Waucoma—Making plans waterworks. $20,000. W. E. Buell & Co., 205 Davidson Bldg., Sioux City, engrs.

Ia., Waterloo—Making plans 2 rein.-con. reservoirs, rein.-con. slab covers, manholes, valves, aerators with screen house, etc. Mead & Seastone, State Journal Bldg., Madison, Wis., engrs.

Minn., North St. Paul—Plans waterworks extension and electrification of pumping plant. $60,000. Toltz, King & Day, 1410 Pioneer Bldg., St. Paul, engrs.

Minn., Storden—Plans waterworks, $15,000. W. E. Buell & Co., 205 Davidson Bldg., Sioux City, Ia., engrs.

Minn., West Concord—Plans waterworks extensions, electrification of pumping plant, constructing pump house. $35,000. Toltz, King & Day, 1410 Pioneer Bldg., St. Paul, engrs.

Neb., Lincoln—Plans 3,180 ft. 6 in. and 2,760 ft. 4 in. pipe in Dist. 32, 48th St. from South to Glade Sts., Glade St. from 48th to 51st Sts., 51st St. from Glade to Normal Sts., Normal St. from 51st to 53rd Sts., 53rd St. from Normal to Myrtle Sts., Myrtle St. from 53rd to 56th Sts., 56th St. from Myrtle to South Sts. G. W. Bates, city engr.

Tex., Winters—Voted $30,000 bonds for waterworks improvements incl. raising of present dam 4 ft. and extending mains. Address Mayor.

Wash., Walla Walla — Rejected bids opened June 6, constructing Div. 2 waterworks system, incl. 4 mi. 20 in. pipeline into Wenaha National Forest, gravity dam, 100 ft. wide, 16 ft. high, etc. Will readvertise at once. $140,000. E. B. Hussey, Alaska Bldg., Seattle, engr.

Cal., Manteca—Election soon to vote on $40,000 bonds to purchase and improve privately owned waterworks system.

Cal., Vernon—Had preliminary plans prepared high pressure water system, 63,000 ft. 8-16 in. c.i. pipe, 1,500 gal. per min. motor driven turbine pump, cement lined reservoir, 3,000,000 gal. capacity, 3 centrifugal pumps, etc. $450,000. H. McCurdy, 335 Pacific Electric Bldg., Los Angeles, engr.

BIDS DESIRED

N. Y., Saugerties—July 19, by Bd. Water Comrs., Market St., excavating of about 30,000 cu.yd. material, also excavating and laying about 1,800 ft. 18 in. temporary mains, etc. J. F. Loughran, Kingston, civil engr.; adv. this issue.

N. C., Wilmington—July 18, at office R. C. Cantwell, comr. pub. wks., addition to present water purification plant and extending water intake line; adv. this issue.

Fla., Vero—July 12, constructing waterworks system. G. M. Willing, clk; adv. this issue.

O., Columbus—See "Streets and Roads."

Mich., Grand Rapids—July 6, by G. J. Wagner, dir. pub. serv., addition to filtration plant, incl. intake pipe, clear water conduit, vitr. tile drain. C. A. Paige, city engr.

Minn., St. Paul—July 3, by H. W. Austin, city purch. agt., furnishing 12 filter operating tables for Water Dept. O. Claussen, city engr.

Ark., Gillett—July 18, by J. B. Quinn, secy. Farelly Lake Levee Dist., Marion Hotel, Little Rock, concrete flood gate and appurtenances, at Big Bayou Meto, here. Ayres & Miller, McCall Bldg., Memphis, Tenn., engr.; adv. this issue.

Tenn., Fayetteville—July 18, rein.-con. circular covered reservoir, 1,000,000 gal. capacity, 650 cu.yd. concrete. W. G. Kirkpatrick, 2103 Erdman Ave., Baltimore, Md., engr.

BIDS RECEIVED

N. Y., St. George—N. J. Hayes, comr. Water Supply, Gas & Electricity, Municipal Bldg., New York, opened bids June 19, mains in (1) Cary, Carter, Columbus Sts., etc., (2) Barton, Bay View, Bedell, Bogardus, Centre, Eagan, Fabian Sts., etc., from N. DeStefano, 257 Glenn Ave., Tompkinsville, (1) $15,061, (2) $48,892; Paladino Contg. Co., 437 East 120th St., New York, (1) $26,848; Dominick Constr. Co., (1) $15,511, (2) $53,470; Beaver Eng. & Contg. Co., 51 Chambers St., New York, (2) $55,606. Noted June 15.

Minn., Winona—G. W. Hoffman, city clk., opened bids extending watermain, 14,774 lin.ft. 6-10 in. Class D c.i. pipe, 10,812 lb. standard Class D c.i. castings, twenty-eight 6-10 in. gate valves, etc., from T. E. Wolley, LaCrosse, Wis., $31,587; W. Danforth, 810 Guardian Life Bldg., St. Paul, $33,900; E. T. Webster, 437 Beacon Ave., St. Paul, $35,255.

CONTRACTS AWARDED

Conn., Simsbury—Village Water Co., concrete dam and gate house at new reservoir, to A. W. Byrne & Son, 79 Linnmore St., Hartford. Engrs. est. $25,000.

N. J., Pompton Lakes—Boro Council, Municipal Bldg., furnishing and installing pipe line, to W. G. Fritz Co., 258 Valley St., West Orange, $22,712. Noted May 25.

N. J., Trenton—Installing 1 Ames Unaflow engine, 1 rotary pump, electric generator, condenser, etc., in pumping plant, to H. E. Stahl, Goodwill Pl., $57,989. Noted June 1.

Pa., Phila.—Furnishing and installing ash and coal handing equipment, to Specialty Eng. Co., Trenton and Allegheny Aves., $65,208; sand, to M. J. McCrudden, Real Estate Trust Bldg., $9,864; patent sleeves and stop valves, to Acme Machine Co., 316 North 7th St., $13,880; c.i. inlets, to F. T. Buckins, 4050 Kensington Ave., $14,593. Noted June 15.

N. C., Elkin—Installing water and sewerage plants, filtering plant and reservoir basin, to Myers Constr. Co., Meridian, Miss. Noted May 4.

N. C., Goldsboro—State Hospital for Negroes, water pumping equipment, power plant piping and apparatus and heating and ventilating equipment, to B. McKenzie, Greensboro, $134,000.

O., Columbus—R. W. Smith, clk. Franklin Co., 1,260 ft. 12 in. cement and 1,470 ft. 6 in. mains, to Pitt Constr. Co., Fulton Bldg., Pittsburgh, Pa., $12,144. Noted June 22.

Ia., Waukon—For rein.-con. reservoir 500,000 gal. capacity, 2,400 cu.yd. earth excav. and embankment, 48,000 lb. reinforcing, 500 cu.yd. concrete, to Harrison Transportation Co., 407 15th St., Des Moines, $12,460.

S. D., Sioux Falls—Bd. Comrs. filtration station, iron removal plant, 8,000,000 gal. daily capacity, filter building, filters, sedimentation basin, well, pumping machinery, etc., to A. Fanebust, 800 South 2nd St., $80,551. Noted May 11.

Okla., Bristow—Extending waterworks to Gibson & Mitchell, Pauls Valley, $46,018. Noted May 25.

Okla., Oklahoma City—For 6,000 ton 4-30 in. c.i. pipe, specials, valves hydrants, and valve boxes, to U. S. Cast Iron Pipe Co., Amer. Trust Bldg., Birmingham, Ala., $202,460. Noted April 27.

Wash., Sequim—Constructing 20,000 cu. ft. concrete reservoir and 9,700 lin.ft. 8 in. wood stave pipe, etc., to L. L. Lent, Bremerton. $13,916. Engrs. est. $15,000.

Que., Montreal—Water Works Dept., 25,000,000 gal. rein.-con. reservoir, 500 ft. square, 18 ft. deep, to E. G. M. Cape & Co., 10 Cathcart St. $575,000. Noted June 22.

Sewers

PROPOSED WORK

Mass., South Boston (Boston P. O.)—City of Boston plans rein.-con. overflow sewer in Farragut Rd. extension. $43,300. J. J. Carty, City Hall, engr.

N. Y., Scottsville—Bd. Village Trustees rejected bids opened June 14, sewerage system, disposal works and water works system. Will readvertise. Noted May 29.

N. J., Trenton—Making preliminary plans sewage disposal plant. $1,000,000. G. A. Johnson Co., 150 Nassau St., New York, engrs.

Va., Radford—Having plans prepared and will soon vote on $95,000 bonds for sewerage system. W. E. Gilbert, mayor.

Ky., Henderson—Having preliminary plans prepared for sewerage system. J. A. Cunningham, comrs. Pub. Wks.

O., Akron—Plans intercepting sewer. $300,000 bonds sold. J. E. Root, Delaware Bldg., engr.

O., Akron—M. P. Tucker, dir. Pub. Serv. soon takes bids 24-66 in. brick sewer in Sweitzer Creek Dist., $100,000; remodeling present brick and concrete sewage disposal plant, $100,000. J. E. Root, Delaware Bldg., engr.

O., Akron—See "Streets and Roads."

O., Columbus—Franklin Co. plans 8,000 ft. 15-24 in. vitr. sewer in 2nd alley east of Parson Ave. $27,750. E. G. Bradbury, 174 East Long St., Engr. Noted June 15.

Ia., Waucoma—Making plans sewerage system. $25,000. W. E. Buell & Co., 205 Davidson Bldg., Sioux City, engrs.

Neb., Lincoln—Plan laying sewers in 20 blocks, Dist. 238, South St. from Normal to 52nd Sts., 48th, 49 and 50th Sts. from South to Glade Sts., 50th, 51st and 52nd Sts. from South to Summer Sts. G. W. Bates, city engr.

Cal., Calipatria—Having plans prepared constructing 21,600 lin.ft. 6-12 in. vitr. pipe sewers in Assessment Dists. 2 and 3. $32,000. H.-Tsheppe, city engr.

Cal., Los Angeles—J. A. Griffin, city engr., completed preliminary estimate for temporary plant for handling sewage now going into ocean. Plans include extension of sewers to treatment plant $100,000. 4 in. wooden pipe line $200,000, treatment plant $153,000, equipment, connecting pipe lines, etc., $47,000.

Cal., Morgan Hill—Plan sewerage system. J. G. McMillan, engr., Auzerais Bldg., San Jose, preparing estimate of cost.

BIDS DESIRED

N. J., Hackensack—July 24, by Hackensack Impvt. Comn., constructing and equipping disposal works, flotation basins, force mains, pumping station, etc. L. Lozier, Bank Bldg., Main and Mercer Sts., engr.; adv. this issue.

N. J., Newark—July 18, by Passaic Valley Sewerage Comrs., 128 Market St., constructing city dock local sewer connection. J. R. Van Duyne, ch. engr.

Pa., Bradford—See "Streets & Roads."

Pa., Sharon—July 5, sewers in 11 streets, incl. 10,108 ft. 8 in. and 2,205 ft. 12 in. pipe. E. Burnside, city engr.

Tenn., Lebanon—July 10, at office of City Clerk, sewerage system and disposal plant also extending water system with reservoir tank. A. B. Clenny, city engr.; adv. this issue.

O., Geneva—July 7, by W. E. Morgan, village clk., sewage treatment plant. Burgess & Niple, 223 East Broad St., Columbus, engrs.; adv. this issue. Noted Jan. 19.

Wis., Shawano—July 7, by Dillett & Fischer, attorneys for Farm Drainage Bd., 136,188 cu.yd. ditching, length 7.7 mi., average depth 7 ft., width of bottom 6 and 4 ft. Private plans.

Minn., Barnum—July 17, by A. D. Dathe, clk., sewerage system, 5,000 lin.ft. 8-12 in. vitr. tile sewers, 15 manholes, 3 lampholes, 2 outfalls. $25,000. Druar & Milinowski, 500 Globe Bldg., St. Paul, engrs.

Ont., Elma—July 8, by G. Lochead, Atwood, constructing Boyle Drain, tile up to 18 in. $81,000. J. Roger, Mitchell, engr.

BIDS RECEIVED

N. Y., Long Island City—M. E. Connolly, pres. Queens Boro, Queens Subway Bldg., opened bids June 19, sewers in Brown Pl., etc., from Seaside Contg. Co., 193 Beach 108th St., Rockaway Park, Type A, $28,915, Type B $28,915; Kennedy & Smith, 93 Amity St., Flushing, Type A, $36,230; P. J. Murray, Type A, $46,006, Type B, $31,306; A. Mannano, Type B, $30,295. Noted June 15.

Cal., Stockton—Constructing 12,730 ft. 4 in. and 15,900 ft. 6 in. pipe, etc., in Fair Oaks Dist., from Schultz Constr. Co., 46 Kearny St., San Francisco, $28,691; Heafey, Moore & McNair, 2030 High St., Oakland.

Sewers (Continued)

$27,851; Frederickson & Shannon, Cory Bldg., Fresno, $28,568. Noted June 15.

CONTRACTS AWARDED

N. Y., Brighton—Comrs. Sewer Dist. 1, 847 Powers Bldg., Rochester, sewers in certain streets in Sewer Dist. 1, here, to A. Petrossi, Rochester, $33,998. Noted June 8.

N. Y., Jamestown—See "Streets and Roads."

N. Y., Syracuse—Intercepting Sewer Bd., sewage treatment plant, to J. Young, Bastable Bldg., $68,284. Noted June 8.

Pa., Phila.—Branch sewers in Allen Grove, 59th and Wakeling Sts., to F. T. Buckins, 4050 Kensington Ave., $23,896; Arlington and Berks Sts., to R. Higgins, 4642 Lancaster Ave., $18,943; Cornwall, Pratt and Stafford Sts., to A. J. Ellis, 5724 North Marshall St., $7,926; Dickinson St. and Kingsessing Ave., to D. DeLise, 4842 Leightgow St., $4,455; Fox St. and Wissahickon Ave., to E. Pascuzzi, Lincoln Bldg., $26,909; Hegerman, Keystone and Luzerne Sts., to A. DeSandro & Sans, 3906 North 50th St., $17,120; Price and Filbert Sts., to M. Mattia, 263 Simpson St., $4,612; Norwood St., to F. Berrelli, 6413 Callowhill St., $624; Westview St., and Rittenhouse St. from Chew to Ardleigh Sts., to D. MacMahon, Germantown, (Phila. P. O.), $9,134; Rittenhouse St. from Ardleigh to Andrews Sts., to A. Devito, 1721 Hicks St., $6,458; Boyer St., and Rittenhouse St. from Chew to MacMahon Sts., to E. T. Bennis, 641 East Chelten Ave., $37,797; Wood St. to R. Lombardi, Lincoln Bldg., $10,325; Johnson St., to J. Lombardi, Lincoln Bldg., $56,614; Anderson St., to C. Riccardi, 1220 South Juniper St., $4,970; Washington Lane, also Columbia Ave., Bonsall and Elling Sts., to A. A. Pastori, 5904 Woodland Ave., $25,048 and $25,942 respectively. Noted June 15.

Fla., Jacksonville—Sewers in 23rd, Talleyrand, 12th, Copeland and Spearing Sts., to B. Thompson, Box 1044, Tampa, $27,192. Noted June 15.

N. C., Elkin—See "Waterworks."

N. C., Lexington—Constructing sewer lines to Myers Constr. Co., Charlotte; pipe, to Pomona Terra Cotta Wks., Greensboro; total $71,100. Noted May 18.

Mich., Detroit—Sewers as follows to Western Constr. Co., 1208 Ford Bldg.: Lateral 3504 $8,196, Lateral 3548 $17,981, Lateral 3632 $3,540, Lateral 3650 $40,364; Hammen & Co., Mankato, Minn., Lateral 3597 $6,276; Judd Co., 2287 12th St., Lateral 3638 $24,778, Lateral 3657 $20,225, Lateral 3659 $17,348; P. Cappello & S. Fattore, Detroit, Lateral 3652 $1,725, Lateral 3658 $2,175; Martin & Kransman Co., 400 Penobscot Bldg., Lateral 3655 $6,347; M. Mucci, 1557 St. Joseph St., Lateral 3654 $5,950. Noted June 15.

Mich., Detroit—To Connelly Bros., Detroit, Trombley Ave. Arm of Jos. Campau Sewer, $90,116; Jeynes & Affeld, 1208 Ford Bldg., Harper Ave. Arm Sewer, 1 of Vetland Ave. Sewer, $129,936; R. D. Baker, 1631 Elmhurst Ave., Carrie Ave. Arm of North Six Mile Rd. Sewer, $36,984; A. Rosal, 3447 St. Aubin Ave., Moran Ave. Arm of McDougall Ave. Sewer, $39,990. Noted June 22.

Wis., Plymouth—Laying sewers to W. F. Ribbens Co., Mayville, $30,680; septic tank and sludge bed, to Ward & Weighton, Auduhon, Ia., $1,436. Engr., C. P. Bowie.

Ia., Exira—Sewerage System, to T. F. Reilly, 1414 7th St., De Moines, $ disposal plant to W. B. Carter, United Bank Bldg., Sioux City, $9,220.

Ia., Sioux City—[illegible] to W. B. Carter, United Bank Bldg., $5,419. Noted May 18.

Minn., Westbrook—For 15,350 lin.ft., 8-12 in. sewer pipe, [illegible] bed, etc., to O. N. Gjellefald Constr. Co., [illegible]

Neb., Lincoln—[illegible] general contract to A. Bruce & Son, [illegible] Valley & Missouri [illegible] Pipe & Foundry Co., [illegible] Pipe & Foundry Co., [illegible] Bldg., [illegible]

Okla., Bristow—[illegible] Bldg., Corpus Christi, Tex. Noted May 25.

Ont., St. Catharines—W. P. Mason engr., [illegible] to P. Mason & Son, [illegible] London, $13,800. May 11.

London, $1,600; Lorenzo & Sacco, Niagara Falls, $1,600.

Ont., Toronto—For 30,000 ft. concrete and vitr. drain pipe, 8 in. up, in connection with Western Harbor Development, to W. R. Worthington, 555 Markham St., $120,000.

Waste Disposal

PROPOSED WORK

Pa., Bradford—Plans to vote on $25,000 bonds for waste disposal plant. E. C. Charlton, city clk.

BIDS DESIRED

Pa., New Kensington—July 18, by W. N. Jenkens, boro. secy., 30 ton waste disposal plant.

Bridges

PROPOSED WORK

N. Y., Lackawanna—Plans rein.-con. bridge, Abbott Rd. $30,000. B. M. McDonnell, City Hall, comr. Pub. Wks.

Pa., East Liberty (Pittsburgh P. O.)—Voted $105,000 bonds to repair 4 viaducts crossing Pennsylvania R.R.

W. Va., Clarksburg—Comrs. Harrison Co. receive bids about July 15, constructing bridges over Harbert Run, Robinson Run, Honepot Run, Branch of Little Rock Camp Run, Branch of Patterson Fork, Patterson Fork, Hall Run, Branch of Tenmile Creek, Rush Run, Buffalo Creek, Stutlers Fork and Farmers Fork. $150,000.

Cal., Hetch Hetchy—Modesto and Turlock Irrigation Dist. having plans prepared 10 span plate girder bridge, concrete piers, 640 ft. long, across Six-Bit Gulch on line of Hetch Hetchy R.R. $70,000. M. M. O'Shaughnessy, City Hall, San Francisco, engr.

Cal., Stockton—Plans bridge over Mormon Channel. $35,000. W. B. Hogan, city engr.

BIDS DESIRED

N. Y., Hewitville (Potsdam P. O.)—July 7, by Town Clerk, Potsdam, 340 ft. rein.-con. and steel bridge, 16 ft. over Raquette River, $40,000. Concrete Steel Eng. Co., 15 Park Row, New York, engrs. Noted June 15.

N. Y., Long Island City—July 5, by G. H. Whalen, comr. Plant & Structures, Municipal Bldg., New York, constructing masonry piers for bridge over Hook Creek Canal at Rockaway Blvd., here.

Georgia—July 1, by State Hy. Dept., Peachtree Bldg., Atlanta, 3 concrete bridges Hartwell-Royston Rd., 47,626 lb. reinforcing, 448 cu.yd. concrete, 304 sq.yd. paving, etc. W. R. Neel, Peachtree Bldg., Atlanta, engr.

Alabama—July 19, by W. S. Keller, state highway engr., Montgomery, constructing 3 rein.-con. bridges over Cubahatchie Creek, Calechee Creek and Little Calechee Creek, Macon Co., 1,598.5 cu.yd. concrete, 232,679 lb. reinforcing, 1,791 sq.yd. 4 in. concrete surfacing, two 80 ft. steel spans, complete in place, 3,572 lin.ft. concrete piles, 1,120 lin.ft. untreated timber piles, 2,050 sq.yd. 6 in. concrete slope paving reinforced, etc. $80,000.

Alabama—July 20, by W. S. Keller, state highway engr., Montgomery constructing 590 ft. bridge 18 ft. roadway, over Tombigbee River at Moscow Ferry, Marengo and Sumter Counties, to be known as [illegible] 1 movable span with 150 ft. clearance, concrete substructure and approach. Alternate [illegible]

Illinois [illegible] Bldgs., Div. Highways, Springfield, [illegible] steel superstructure, Route 3, Sect. 38-C, and 1 steel Route 3, Combination J. Mc-

22-B, 1 steel superstructure Route 37, Sect. 22-C, and 18 concrete approach spans and 1 steel span Route 37, Combination O, Clinton Co.; 1 steel substructure Route 39, Sect. 1-B, 1 steel superstructure, 1 steel, Route 39, Combination P, Carroll Co. F. T. Sheets, state highway engr.

Ia., Iowa Falls—July 6 by Auditor Hardin Co., (Eldora), one 140 x 20 ft. open spandrel rein.-con. arch bridge, over Iowa River on River St., here. J. R. Mahed, co. engr.

Ia., Washington—July 6 by Auditor Washington Co., 1 slab bridge and 41 culverts on Federal Aid Project 167. W. P. Rawn, co. engr.

Colorado—See "Streets and Roads."

Col., Ft. Morgan—July 5, by Comrs. Morgan Co., 0.436 mi. concrete bridge and approaches across South Platte River, on State Highway 106, State Project 682, north of here, twenty 50 ft. concrete girder spans, $89,935. L. D. Blauvelt, State Office Bldg., Denver, engr.

Wash., Seattle—Aug. 4, by Bd. Pub. Wks., superstructure, etc., for steel bascule bridge and 2 side spans over West Waterway on West Spokane St. C. B. Bagley, secy.; adv. this issue.

BIDS RECEIVED

Conn., Kent—State Hy. Dept., Hartford, steel superstructure for bridge, two 106 ft. spans, over Housatonic River, near Kent School, here, from Standard Eng. and Constr. Co., Hartford, $26,990; Berlin Constr. Co., Depot Rd., Berlin, $29,600; Amer. Bridge Co., 30 Church St., New York, $31,000. Noted June 15.

N. Y., Schenectady—C. L. Cadle, supt. Pub. Wks., Albany, opened bids June 21, constructing arch rings and deck and tops of certain piers of bridge over Mohawk River, between here and Scotia, from Amer. Constr. Co., Marion Bldg., Cleveland, O., $739,931; Amer. Pipe & Constr. Co., 121 North Broad St., Phila., $763,671; Bush, Roberts & Schaffer Co., 1 Madison Ave., New York, $912,904. Noted May 25.

Nebraska—State Hy. Dept., Lincoln, received bids constructing (1) 2 bridges on Harvard-Eldorado Rd., Project 182, Clay Co., (2) 3 bridges, Bennette-Adams Rd., Project 175 B, Lancaster Co., (3) bridge on Curtis-Maywood Rd., Project 176, Frontier Co., (4) bridge on Minden-Newark Rd., Project 196, Kearney Co., (5) 3 bridges on Central City-Eldorado Rd., Project 156 B, Hamilton Co., (6) 6 bridges on Central City-Eldorado Rd., Project 156 A, Hamilton Co., (7) bridge on Burwell-Deverre Rd., Project 34 A, Garfield Co., (8) bridge on Hebron-Fairbury Rd., Project 118 B, Jefferson Co., (9) culverts on Haigler-Sanborn Rd., Project 191, Dundy Co., (10) bridge on Oakland-South Sioux City Rd., Project 49 E, Dakota Co., (11) 4 bridges on Shelby-Platte River Rd., Project 86, Polk and Butler Counties, (12) 2 bridges on Smiley Canyon Rd., Project 102 A, Sioux Co., (13) bridge on O'Neill-Butte Rd., Project 14 B, Holt and Boyd Counties, (a) with steel jetties, (b) with brush protection, (14) 3 bridges on Elwood-Stockville Rd., Project 184, Gosper Co., from Allied Contractors, Inc., 403 Bee Bldg., Omaha, (1) $5,414, (4) $6,115, [illegible] (1) $4,769, (5) $5,757, (6) $26,622; Southern Kansas Bridge Co., Wichita, Kan., (2) $17,656, (7) $15,705; Pioneer Constr. Co., Railway Exch. Bldg., Kansas City, Mo., (2) $14,283, (5) $6,310, (6) $21,068, (11) $17,681; M. Day Co., 310 Little Bldg., Lincoln, (2) $17,033; Standard Bridge Co., City Natl. Bank Bldg., Omaha, (3) $3,016, (8) $22,844; Western Bridge & Constr. Co., 748 [illegible] (14) $12,239; M. F. Morrison Constr. Co., Chadron, (7) $16,064, (13a) $33,658, (13b) $38,368; Central Bridge & Constr. Co., Wahoo, (9) $20,145; Beatty Constr. Co., Blair, [illegible] $15,833; Pickus Eng. Co., Sioux City, Ia., (12) $18,370, (13a) $47,709, Illinois Steel Bridge Co., 1308 Webster St., Omaha, (14) $12,559. Noted May 25.

CONTRACTS AWARDED

Conn., Kent—State Hy. Dept., Hartford, [illegible]

N. Y., Norwood—[illegible]

N. Y., Potsdam—[illegible] nel and West Channel Bridges, here, also [illegible]

W. Va., Weston—[illegible]

Bridges (Continued)

across West Fork River, to Concrete Steel Constr. Co., Clarksburg, $25,742. Noted May 25.

N. C., Elkin—Constructing 200 ft. rein.-con. bridge, 20 ft. roadway, two 6 ft. sidewalks, to R. M. Thurmond & Co., Lynchburg, Va. Noted April 27, under "Streets and Roads."

Fla., Tavares—See "Streets and Roads."

O., Bridgeport—West End Bridge, steel, to T. Bigelow, Bridgeport, $25,805. Noted June 8.

Ia., Nevada—Story Co. 333 ft. rein.-con. deck girder viaduct, 24 ft., over Chicago, Rock Island & Pacific R.R. tracks, on Lincoln Highway, 1 mi. east of here, to Cole Bros., Ames, $27,498. Noted May 25.

Ia., Newton—Jasper Co., one 331 ft. structural steel bridge, consisting of two 80 ft. plate girder spans and six I-beam approaches; one single span 80 ft. plate girder bridge, to Wickes Eng. & Constr. Co., Polk Bldg., Des Moines, $33,950. Noted June 22.

Minn., St. Louis—St. Louis Co. rejected bids opened June 22, 365 ft. concrete deck bridge, 20 ft., steel bents, I beam spans, over tracks of Duluth, Missabe & Northern and Northern Pacific R.R. $30,000. The above-mentioned railroads will do work with their own construction crews. W. H. Hoyt, Duluth, ch. engr. of former. H. E. Stevens, St. Paul, ch. engr. of latter.

Montana—See "Streets and Roads."

Montana—State Hy. Dept., Helena, grading 1.49 mi. and building Grantsdale Bridge, 280 ft. steel, on Federal Aid Project 174, Ravalli Co., to Illinois Steel Bridge Co., 551 Giffillan Bldg., St. Paul, Minn., 155,000 lb. structural steel in trusses $0.0719 per lb., 66,000 lb. in joints $0.0575, 9,961 cu.yd. common excav. $0.36, 1,600 cu.yd. gravel surfacing $2, 6.72 cu.yd. Class A concrete $25, 100 cu.yd. Class B $20.12 and 10.02 cu.yd. Class B $23, 285 cu.yd. Class D concrete $17.25, etc., total $39,828, engrs. est. $38,778. Noted May 25.

Col., Denver—For Bway. Viaduct, 2,294 lin.ft., Group A, to Amer. Bridge Co., Equitable Bldg., $159,124; Group B, to Kansas City Bridge Co., 510 Orear-Leslie Bldg., Kansas City, Mo., $37,345; Group C, to C. S. Lambie Co., Tramway Bldg., $57,-593; Group D, to D. Munro, 716 Adams St., Kansas City, Kan., $21,560. Noted May 25.

Cal., Marysville—Repairing approach to Feather River Bridge, to E. H. Martin, 1520 Franklin St., Oakland, $28,600.

Cal., Stockton—Western Pacific R.R., Mills Bldg., San Francisco, 210 ft. steel drawbridge over San Joaquin River, near here, steel work to McClintic-Marshall Co., Call Bldg., San Francisco. Balance of work will probably be done by day labor. $300,000.

Wash., Seattle—Bd. Pub. Wks., constructing foundation for double-leaf bascule and two 140 ft. fixed span approaches, to J. A. McEachern Co., Inc., Colman Bldg., $264,-497. Engrs. est., $335,000. This corrects report of June 15 issue.

Railways

PROPOSED WORK

Maine—Mattawamkeag & Eastern R.R., Mattawamkeag, plans 13.3 mi. railway extension from Mattawamkeag to Bancroft. $500,000. Private plans.

BIDS DESIRED

New York—See "Streets and Roads under Syracuse."

Excavation and Dredging

PROPOSED WORK

La., Lake Charles—Calcasieu Parish voted $2,700,000 bonds for deep water channel to the sea, incl. deepening and widening of Intracostal Canal between Calcasieu and Sabine Rivers, to depth of 30 ft. and bottom width of 125 ft., also cut off near Lake Charles, and dredging Prien and Moss Lakes.

Cal., El Centro—Imperial Irrigation Dist. voted $7,500,000 bonds, $5,000,000 of which will be used for buying up and consolidating various mutual water companies, and balance for constructing extensive drainage system. District now includes more than 600,000 acres.

Cal., Gridley—Sutter Butte Canal Co. having surveys made extending Encinal ditch and laterals to irrigate 10,000 acres, 7 mi. long, concrete lined. N. Ware, Gridley, engr.

Cal., Live Oak—Recl. Dist. 2056 had plans prepared 40 mi. ditches, 400,000 cu.yd. excav., 3,000 lin.ft. 12-36 in. concrete pipe for laterals, 148 cu. yd. concrete. E. W. Stanton, Jr., Live Oak, engr.

Cal., Marysville—Had plans prepared dredging and cleaning out Ellis Lake, and installing 8 in. pump, 10 ft. lift. $50,000. W. Meek, Marysville, engr.

Cal., Westley—Easley & Anderson, engrs., Antioch, preparing plans irrigation system, including 8 mi. ditches, wooden lateral ditches, pumping plants, two 12 in. horizontal centrifugal pumps, direct connected 250 hp. motors for each pump. Owner's name withheld.

BIDS DESIRED

N. Y., Brooklyn—July 25, by C. L. Cadle, supt. Pub. Wks., Albany, dredging portion of Henry St. slip at Gowanus Bay, here, Terminal Contr. 90; adv. this issue.

Minn., Albert Lea—July 8, by F. Tavis, aud. Freeborn Co., Judicial Ditch 5, Sect. L, 1,600 cu.yd. excav., 32,808 lin.ft. trenching, laying and backfilling, twenty-three 24 in. intakes, 1 outlet and flood control structure, 2 equalizing wells; Sect. T, 31,205 lin.ft. 6-28 in. drain tile. $25,000. J. H. Sevenson, Albert Lea, engr.

Minn., Austin—July 10, by O. J. Simmons, aud. Mower Co., Judicial Ditch 6, Sect. O, 60,796 cu.yd. excav., 30,000 cu.yd. leveling spoil bank, 24 flood water control structures, 2 weirs and spillways, 3 timber bridges; Sect. T, 39,583 lin.ft. 6-24 in. drain tile; Sect. L, 39,583 lin. ft. trenching, etc. J. H. Severson, Albert Lea, engr.

Minn., Redwood Falls—July 7, by Redwood Co., Ditch 52, 257,561 cu.yd. excav., $28,000, and Ditch 68, 147,804 cu.yd. excav., $19,377. B. J. Reynolds, Redwood Falls, engr. for above projects. Four sections Ditch 33, 111,850 cu.yd. excav., tile, etc., $100,935. G. P. Smith, Central Bank Bldg., St. Paul, engr. Noted April 27.

Minn., Redwood Falls—July 8, by Redwood Co., laying tile in Ditch 69. $47,305. B. J. Reynolds, Redwood Falls, engr.

BIDS RECEIVED

N. Y., Brooklyn—E. Riegelmann, boro pres. opened bids June 23, dredging (1) Wallabout Canal, (2) Gowanus Canal, from W. E. Potter, 49 Hudson St., Jersey City, N. J., (1) $13,378 (2) $9,490; J. and J. McSpirit, (1) $14,800 (2) $9,800; C. F. Bickle, (1) $17,800 (2) $13,700. Noted June 15.

CONTRACTS AWARDED

Ia., Webster City—Hamilton and Webster Counties, Carlberg Joint D.D. 229 and 299, 29,59 lin.ft. 6-36 in. tile, to Natl. Sewer Pipe Co., Webster City, $30,347; labor to Cooper & Hanson, Iowa Falls, $12,982.

Minn., New Ulm—Brown Co., Ditch 49, 101,215 lin.ft. 6-42 in. tile, 700 lin.ft. 24-42 in. sewer pipe, 1 rein.-con. bulkhead, etc., tile material to New Ulm Tile Co., New Ulm, $39,712, labor to J. W. Wilkin, Dundee, $33,000; Co. Ditch 54, 69,453 lin.ft. 6-30 in. tile, etc., tile material to North State Constr. Co., Mankato, $20,500, labor to A. E. S. Huso, Lake Mills, Ia., $8,995. Noted May 25.

Cal., Los Angeles—City Harbor Comn., City Hall, grading and excavating 118,000 cu.yd. at terminus of Outer Harbor Blvd., San Pedro Dist., to O. Hanson, 653 22nd St., San Pedro, $42,480. Noted June 22.

Cal., Los Angeles—Dredging about 670,000 cu.yd. Los Angeles harbor, San Pedro, to San Francisco Dredge Co., San Francisco, $70,360.

Streets and Roads

PROPOSED WORK

Mass., Newburyport—Plans paving various streets. $100,000. City Hy. Dept., City Hall, engrs.

Conn., New London—Plans 8 mi. concrete sidewalk in various streets. $50,000. Dept. Pub. Wks., City Hall, engrs.

N. Y., Clyde—Plans paving several streets, concrete. $70,000. Engineer not announced.

N. Y., Elmira—Plans paving North Main, East Miller and Baldwin Sts., repaving North Main and Sly Sts. $450,000. C. W. Jarchow, clk.

N. Y., Niagara Falls—Plans paving 1,110 ft. Whitney St. between 24th and 27th Sts., brick, bithulithic, concrete, sheet and block asphalt. $26,000. Estimate based on granite or wood block. W. B. Bennett, Convention Hall, city engr.

N. Y., Rochester—Plans and soon takes bids paving Werner Park, $17,000, Akron St. $22,000, Hazel St. $28,000, Sylvester St. $23,200, Violetta St. $12,000, Paige St. $13,400, Plymouth Ave. $46,000, Townsend St. $12,000, Rugraff St. $11,300, Penn St. $11,400, Bronson Ave. $18,600, Dewey Ave. $74,000, Chatham St. $45,000, Willow St. $7,500, Pavilion St. $8,150, Iceland Park $8,400, La Mont Pl. $6,550, roads in Mt. Hope Cemetery $154,000; resurfacing George St., $11,250, Averill St. $27,900, Upton Park $10,500, Erion St. $3,100, Lawton St. $2,200, Brunswick St. $7,150, Churchlea Pl. $5,150, Savannah St. $16,200, all foregoing asphalt; Arnold Park, wood block, $32,800; resurfacing and widening North Union St. $21,000; grading and laying sidewalks on Merchants Rd. $33,000; grading, laying sidewalks and sewers in Westfield St. $22,900, Arnett Blvd. $11,300, Inglewood Dr. $9,200, Penhurst St. $3,550; extending Clifton St. $60,000; surface treating Albermarle St. $2,000, Birr St. $2,900. C. A. Poole, city engr.

N. Y., Salamanca—Plans paving East State St., Wildwood and Nelson Aves., brick and concrete. To exceed $25,000.

N. J., Hillsdale—Hillsdale Twp. at Firemans Hall, Park Ave and Valley St., rejected bids opened June 6, grading, curbing and laying sidewalks, etc., on Valley and Cross Sts., Park, Hillsdale, Railroad, Summit and Central Aves. Noted May 25.

W. Va., Huntington—Soon takes bids improving La Tulle Ave., 24½ St. and 2nd St. W., 7,332 sq.yd. vitr. brick, 5,270 ft. curb and gutter. A. B. Maupin, city engr.

N. C., Maiden—Preparing plans paving various streets, concrete or some asphaltic type. $50,000. Mees & Mees, Charlotte, engrs.

N. C., Morganton—Burke Co plans relocating, grading, topsoiling and constructing bridges, and culverts on 9 mi. Lenoir-Morganton Highway from Morganton to Burke Co. line. $40,000. H. L. Milner, comr.

Fla., Arcadia—De Sota Co. to vote July 7 on $500,000 bonds paving 26 mi. road from Manatee Co. line to Highland Co. line; $500,000 bonds 20 mi. from Hardee Co. line to Charlotte Co. line; $500,000 bonds 18 mi. from State Aid Rd. 7 to County line near Kinsey; $500,000 bonds 6 mi. from Nocatee via Owens to Arcadia; $500,-000 bonds 13 mi. from Arcadia, Nocotee, Ft. Ogden to Charlotte Co. line.

Fla., Dade City—Pasco Co. to vote July 14, on $500,000 bonds paving 3 mi. road from here to Gulf. A. J. Burnside, clk.

Fla., West Palm Beach—Palm Beach Co. voted $40,000 bonds paving with 9 in. compacted rock, oil surface, road from Delray north, Aiken St. south, Rd. 1 along Military Trail, along Lake Worth Drainage Canal; $30,000 bonds 7½ mi. Atlantic Ave. west to Range line canal. R. F. Goodman, West Palm Beach, engr. Noted March 23.

Ohio—Dept. Highways and Pub. Wks., Columbus, rejected bids opened June 9, grading, bridging and paving roads in following counties:

Crawford Co., Sect. "G" Bucyrus-Cresline Rd., 1.69 mi., rein.-con., bituminous macadam, asphalt or tar, brick or state to furnish brick.

Licking & Knox Counties, Sect. "K" Columbus-Millersburg Rd., 1.42 mi., rein.-con.

Jarain Co., Sect. "D" and "E" Cleveland-Elyria Rd., 6.23 mi., brick or bituminous macadam.

Tuscawaras Co., Sect. "Mineral City" Canton-Canal Dover Rd., 1.03 mi., Kentucky rock asphalt or brick. Noted June 15.

Ohio—Dept. Highways and Pub. Wks., Columbus, rejected bids opened June 16, grading, bridging and paving 10.297 mi. Sect. "C-1" Painsville-Warren Rd., Ashtabula Co., monolithic brick or rein.-con. Noted June 22.

O., Akron—Summit Co. takes bids in July or August grading and paving 2.64 mi. Sect. B-2 and C Vaugh-Twinsburg Rd., vitr. brick, concrete or bituminous concrete. J. Weaver, Court House, engr.

O., Belmont—Plans to issue $50,000 bonds to grading, curbing and paving 4,584 ft. Main, Bridge, Fair, 3rd and Center Sts., brick, Block or concrete. W. M. White, clk.

O., Columbus—W. H. Duffy, dir. Pub. Serv. cancelled contract grading, curbing, laying water mains and paving 1,190 ft. Bruck St. from Markison Ave. to Hasack St. Will readvertise. Noted June 22.

O., Findlay—Hancock Co. will sell $25,000 bonds to pave and improve North Main St.

Mich., Detroit—Having plans prepared paving with 3½ in. sheet asphalt on concrete, Linwood Ave. from Burlingame to Ford Highway, $104,930, Hibbard Ave., $3,910, Pelouze Ave., $21,340, Burton Ave., $14,720, Farnsworth Ave., $9,780, Theodore St., $28,060, Visger Ave., $16,730, also 3 alleys with one course concrete, totaling $11,030. J. W. Reid, city engr.

Mich., Detroit—Plans grading, shaping and paving with 3½ in. sheet asphalt on 8 in. concrete, 14th Ave. from Euclid to Clairmont Sts., $29,700, Iverness Ave. from Fenkell to Pilgrim Sts., $21,000, Elsemere

Streets and Roads (Continued)

Ave. from Fort to Chamberlain Sts., $16,980, Wilson Ave. from Blaine to Hazelwood Sts., $9,360, Davison Ave. from Jos. Campau to Conant Sts., $31,770, also 7 alleys with one course concrete, totaling $23,955. J. W. Reid, city engr.

Minn., St. Paul—Plans paving Raymond and Western Aves. from University to Como Aves., each 1 mi. long. $80,000. A. Claussen, city engr.

Neb., Lincoln—Lancaster Co. plans paving 1½ mi. O St. A. H. Edgren, co. engr.

N. D., Mandan—Plans paving 6 blocks East Main St. $25,000. W. J. Seitz, city clk.

Mont., Helena—Soon receives bids grading and paving Stuart St., Park and Barton Aves., 23,000 sq.yd. concreete, bitulithic, penetration macadam, sheet asphalt or brick. $70,000. T. Carmichael, P. O. Box 398, city engr.

Tex., Brownsville—Cameron Co. voted $350,000 bond and plans additional highway improvements incl. completion of concrete highway between here and Hidalgo Co. line. W. O. Washington, co. engr.

Tex., Sanderson—Terrell Co. will sell $250,000 bonds July 1, highway improvements, incl. State Highway 12. State and Federal Aid will be requested. G. J. Henshaw, co. judge.

Cal., Calipatria—Plans paving 1½ mi. Main St. H. Tsheppe, city engr.

Cal., Fresno—Soon takes bids grading and paving Peralta Way between Lucerne Lane and Van Ness Blvd., 70,645 sq.ft. grading, 61,060 sq.ft. 3½ in. asphalt with 1½ in. warrenite top, 6,145 sq.ft. gutter, 1,760 lin.ft. curb, 2,307 sq.ft. walks, etc. W. Stranahan, city engr.

Cal., San Diego—Had plans prepared paving A, Ash, Beech, Cedar and 7th Sts., 2,251 lin.ft. cement curbing, 7,266 sq. ft. cement sidewalks, 3,658 sq.yd. 5 in. concrete, 7,225 sq.yd. 1½ in. asphaltic concrete on concrete. F. A. Rhodes, city engr. Noted April 6.

Cal., Yuba City—Takes bids about July 5, improving 1,620 B St. between Plumas and Robinson Sts., 57,700 sq.ft. concrete paving, 3,240 lin.ft. concrete curb. E. Von Geldern, city engr.

Que., Hull—Voted $204,500 bonds for new pavements and sidewalks. T. Lanctot, city engr.

Que., Verdun—Takes bids about July 15, paving 1 mi. Verdun and Murlarkey Aves., bituminous macadam. $175,000. C. E. Gyshens, city engr.

BIDS DESIRED

Me., Portland—July 21, by E. M. Hunt, bridge comr., Dept. Pub. Wks., City Hall, rebuilding floor of fixed spans of Vaughans Bridge, wood block paving; adv. this issue.

New York—July 11, by H. S. Sisson, comr. State Hy. Dept., Albany, improving highways in Cattaraugus, Chenango, Delaware, Madison, St. Lawrence, Washington, Wyoming and Yates Counties; reconstructing highway in Chenango Co. J. C. Finch, engr.; adv. this issue.

N. Y., Brooklyn—July 5, by E. Riegelmann, boro pres., Boro Hall, repaving Willoughby St., Bway., from Kent to Bedford Aves., 80th St. between 17th and 18th Aves.; grading East 14th St. from Sheepshead Bay Rd. to Voorhies Ave., lot at St. Johns Pl. and Plaza St., portion of lot on Underhill Ave. near Lincoln Pl., grading sidewalk spaces, curbing and flagging Ave S from West 8th to West 9th Sts.; resurfacing Van Sicklen Ave.

N. Y., Long Island City—July 5, by M. J. Connolly, pres., Queens Boro, Queensway Bldg., grading Armond Pl. from Walker to Charlotte Pl., Vincent St. from 5th St., Griffith Ave.; grading and constructing gutters in Eliot Ave. from Ernst Rd. to Mary St., etc.; grading sidewalk spaces and curbing Jamaica Ave.; laying sidewalk and curbing forms in front of 3 lots on west st from point 115 ft. north of Jamaica Ave. [illegible] and [illegible] 5th Ave., repaving Cooper Ave., etc.; Liberty Ave within railroad area, sheet asphalt [illegible]

N. Y., New York—July 6, by [illegible] pres., Municipal Bldg., [illegible] paving Pl. Washington Pl. Macdougal St. from W. 131st to W. 135th St., 142nd St. from Pl. Washington to Macdougal Ave., widening and [illegible] Macdougal Ave. south to meet [illegible] Conv. Site, 30th st. [illegible] to 9th Ave., [illegible]

N. Y., Syracuse—July 25, by [illegible] City Pur. Agt., [illegible] [illegible] Tonawanda [illegible] [illegible] Tonawanda [illegible]

New Jersey—July 14, by State Hy. Dept., Trenton, [illegible] from Stelton Rd. to Metuchen, [illegible] Sect. 13 from Highland Park to Stelton Rd., both Middlesex Co., warrenite bitulithic. A. L. Grover, ch. clk.; adv. this issue.

N. J., Camden—July 12, by C. F. Wise, chn. Bd. Comm., constructing portion of Kings Highways, Delaware Twp., Camden Co. J. J. Albertson, Court House, co. engr.; adv. this issue.

N. J., Mays Landing—July 12, by Bd. Freeholders Atlantic Co., Guarantee Trust Bldg., Atlantic City, reconstructing Hamilton Twp. Sect. of Mays Landing-Downstown Rd. F. W. Willetts, clk.; adv. this issue.

N. J., Newton—July 11, paving High St., rein.-con. W. J. Hardin, town engr.; adv. this issue.

N. J., Newton—July 11, by Sussex Co. paving Fredon-Newton and Branchville Dingmans Rds., rein.-con. H. Snook, Co. engr.; adv. this issue.

N. J., Somerville—July 13, constructing State Highway Route 9, Sect. 0.7, Main St., reinforced cement concrete. W. J. Hardin, boro engr.; adv. this issue.

N. J., Somerville—July 14, by Somerset Co. constructing State Highway Route 16, Sect. 2 from Mine Mount Rd. to Bedminster Corner, 1 course reinforced cement concrete. H. C. Van Emburgh, Court House, co. engr.; adv. this issue.

Pa., Bradford—July 3, by E. C. Charlton, city clk., paving Hobson Pl., Pearl Ave., Mill and York Sts., also sanitary sewers in Willis and Holley Aves., to exceed $30,000. Noted June 1.

Pa., Lilly—July 3, for 1,812 ft. vitr. brick on Cleveland and Piper Sts. P. F. Campbell, Portage, boro. engr.

Pa., Reading—July 5, at office City Clerk, street paving, etc. E. B. Ulrich, city engr.; adv. this issue.

Va., Covington—July 11, at Council Chamber, Masonic Bldg., paving various streets. C. P. Barnett, consult. engr.; adv. this issue.

W. Va., Moundsville—July 18, by Comrs. Marshall Co., grading 2,846 ft. Ramp Hollow Rd.; grading and paving with hillside brick, and concrete curbing 3,300 ft. Jones Hill Rd. R. C. Yoho, Box 517, Cameron, engr.

South Carolina—July 18, by State Hy. Dept., Columbia, constructing 5 mi. Greenwood-Abbeville Highway, Greenwood Co. $50,000.

Ga., Atlanta—July 3, by J. N. Landis, City Hall, paving with asphalt on belgian block, 3,885 sq.yd. Angier Ave. from Boulevard to Arnold St.; concrete and belgian block, 5,249 sq.yd. Hurt St. from DeKalb to Euclid Ave.; concrete paving 13,828 sq. yd. Central Ave. from Fair St. to Georgia Ave., 3782 sq.yd. Central Ave. from Georgia Ave. to Dodd St., 4,217 sq.yd. Glenwood Ave. from Grant to Kelly Sts., 2,440 sq.yd. Garfield Pl. from Highland to East Aves., 2,296 sq.yd. Battlefield Ave. from Arkwright St. to 1st Ave., 16,410 sq.yd. Fitzgerald Ave. from Edgewood Ave. to Decatur St., 1,853 sq.yd. Lawton St. from Greenwood to Sells Aves., 2,650 sq.yd. Welborn St. from West End to Greenfferry Aves., 3,195 sq.yd. Hopkins St. from Gordon St. to Lucile Ave., 1,985 sq.yd. Gordon Terrace from Gordon St. to Mozaley Dr., 6,395 sq.yd. Holderness St. from Lucile to Greensferry Aves., 2,970 sq.yd. Barnett St. from Ponce De Leon to North Aves., 1,790 sq.yd. Iverson St. from Mayson to Mell Aves., 1,610 sq.yd. Walthall St. from Flat Shoals to Kirkwood Aves., 6,310 sq.yd. McPherson Ave. from Flat Shoals to Patterson Aves., 4,444 sq.yd. North Ave. from Peachtree to West Peachtree Sts., 5,899 sq. yd. Boulevard De Kalb from Whiteford Ave. to South Decatur car line, 1,608 sq.yd. Patterson St. from Metropolitan to McPherson Aves. H. L. Collier, City Hall, engr.

Fla., Palatka—July 22, by Comrs. Putnam [illegible] concreting 10 mi. road from here to Melrose. A. Bruner, Palatka, engr.

Alabama—July 19, by W. S. Keller, state [illegible] Montgomery, [illegible] and gravel surfacing 20.48 mi. road from Montgomery [illegible] Montgomery [illegible] 34.82 acres clearing, 128,077 cu.yd. excav. [illegible] to cu.yd. local gravel surfacing within 1 mi. [illegible] 1 mi. haul, 157,000 one-half mi. units overcrete, 35,864 lb. reinforcing, 5,000 sq.yd. mixing sand, gravel and clay, 1,000 cu.yd. [illegible] 34,632 lb. re-

adam, penetration method, using local limestone, alternate bids for surfacing on 25,000 cu.yd. local gravel, 6,000 cu.yd. clean gravel, imported via Athens, 15,000 cu.yd. clean gravel, via Elk River, 275,000 one half mi. units overhaul on gravel; grading, surfacing and re-shaping 3.48 mi. Heflin Anniston Rd., Cleburne Co., 1,462 cu.yd. common and 1,187 cu.yd. solid rock excav., 6,343 cu.yd. imported chert, etc.

Louisiana—July 5, by State Hy. Dept., Baton Rouge, gravel surfacing 11.21 mi. Sorrento-St. Amant Walker, Brittany and Asa Highways, Ascension Parish, incl. 4.079 cu.yd. washed gravel, 8,156 cu.yd. sand-clay gravel; 4.98 mi. Opelousas-Marksville Highway, Sect. B, 8.88 mi. Opelousas-Lafayette Highway, Sect. A, St. Landry Parish, incl. 8,690 cu.yd. washed gravel, 17,363 cu.yd. sand clay gravel. J. M. Fourmy, state highway engr.

Louisiana—July 11, by State Dept., Redmond Bldg., Baton Rouge, gravel surfacing 3.3 mi. East Bank Highway, 5.36 mi. West Bank Highway, 5.7 mi. Vacherie Highway, incl. 17,350 cu.yd. washed gravel. J. M. Fourmy, state engr.

O., Akron—July 5, by M. P. Tucker, dir. Pub. Serv., grading, paving and laying sidewalks on Cole Ave., 3,930 lin.ft. stone curb, 28,720 sq.ft. cement sidewalk, 8,000 cu.yd. earth excav., 915 lin.ft. granite circle curb, 8,445 sq.yd. vitr. brick or asphalt on concrete, $62,000; Weber and Charlotte Sts., 1,280 lin.ft. stone curb, 8,510 sq.ft. cement sidewalk, 1,550 cu.yd. earth excav., 2,210 sq.yd. vitr. brick on concrete, $16,000; Bluff and Prospect Sts., 2,500 lin.ft. stone curb, 17,000 sq.ft. cement sidewalk, 4,000 cu.yd. earth excav., 5,400 sq.yd. vitr. brick, 1,000 sq.yd. granite block or medina block, 5,400 sq.yd. concrete base, $25,000; Spicer St., 3,500 lin.ft. stone curb, 20,000 sq.ft. cement sidewalk, 5,700 cu.yd. earth excav., 210 sq. yd. vitr. brick, 5,340 sq.yd. asphalt, 6,000 sq. yd. concrete base, $56,000; grading, paving, laying sidewalks and sewers in Tallmadge Ave., 10,750 lin.ft. stone curb, 66,400 sq.ft. cement sidewalk, 20,000 cu.yd. earth excav., 17,250 sq.yd. vitr. brick or asphalt on concrete, $200,000. E. A. Kemmler, Delaware Bldg., engr.

O., Columbus—July 13, by W. H Duffy, dir. Pub. Serv., grading, curbing, laying water mains and paving Adams Ave. from Blake St. to Arcadia Ave., 2060 ft. long, 24 ft. wide, asphalt $26,528, brick, $29,108; Alley north of 17th Ave. from second alley west of Summit St. to Summit St., 247 ft. long, 15 ft. wide, brick, $1,597, concrete, 1,294; Markison Ave. from Ann to 18th Sts., 785 ft. long, 24 ft. wide, asphalt, $12,755, brick, $13,867; Mt. Pleasant Ave. from 2nd to 3rd Aves., 410 ft. long, 20 ft. wide, asphalt $8,774, brick, $8,774; Olentangy Blvd. from Orchard Lane to Winthrop Rd., 1,497 ft. long, 26 ft. wide, asphalt $25,470, waterbound macadam, $21,417; Mooberry St. from Gilbert St. to Wilson Ave., 1,805 ft. long, 26 ft. wide, asphalt, $25,240, waterbound macadam, $21,713. R. H. Simpson, city engr.

Michigan—July 11, by State Hy. Dept., Lansing, grading and surfacing 4 mi. State Trunk Line Rd. 12-42, Sect. A, 5,200 cu.yd. excav., 42,200 sq.yd. bituminous macadam; 5 mi. State Trunk Line Rd. 69-3, Sect. A, 5,867 sq.yd. bituminous macadam, 41,062 sq.yd. gravel; 2.275 mi. State Trunk Line Rd. 12-37, Sect. A, 2,615 cu.yd. excav., 24,027 sq.yd. gravel, all Iron Co. L. H. Belknap, ch. engr. Noted June 22.

Michigan—July 11, by State Hy. Dept., Lansing, grading and surfacing 6.42 mi. Assessment Dist. Rd. 23, Monroe and Lenawee Counties, 15,570 cu.yd. excav., 45,176 sq.yd. waterbound macadam. L. H. Belknap, ch. engr.

Michigan—July 19, by State Hy. Dept., Lansing, [illegible] State Trunk Line Rd. 25-15, Sects. B and C, Chippewa Co., 124,012 cu.yd. excav., also grading and [illegible] cu.yd. excav., 38,987 sq.yd. waterbound macadam. L. E. Belknap, ch. engr.

Mich., Ann Arbor—[illegible] nolds, city clk., concrete curbs and gutters [illegible] Lateral Dist. 112, and storm sewer in [illegible]

Illinois—[illegible]

Streets and Roads (Continued)

mi. Route 12, Combination C, Franklin-Williamson Co.; 10.46 mi. Route 44, Sect. 18, Will Co.; 0.88 mi. Federal Aid Project 9, Sect. V, Bond-Fayette Co.; 6.49 mi. Route 26, Sect. 16, 5.21 mi. Route 26, Sect. 17, 5.28 mi. Route 26, Sect. 18, 16.98 mi. Route 26, Combination D, and 16.98 mi. Route 26, Combination E, incl. bridge, McLean Co.; 3.14 mi. Route 27, Sect. 31, Woodford Co.; 5.28 mi. Route 27, Sect. 36, Tazewell Co.; 8.42 mi. Route 27, Combination F, Woodford-Tazewell Co.; 5.71 mi. Route 34, Sect. 26 and 5.71 mi. Route 34, Combination G, incl. bridge, Clinton Co.; 3.91 mi. Route 35, Sect. 17, Marion Co.; 3.68 mi. Route 35, Sect. 18 and 7.59 mi. Route 35, Combination H, Marion-Clinton Co.; 4.81 mi. Route 40, Sect. 29, Hancock Co.; 5.03 mi. Route 41, Sect. 16, Winnebago Co.; 6.85 mi. Route 42, Sect. 161, Cook Co.; 0.3 mi. Route 8, Sect. V-4, Macoupin Co. All foregoing 18 ft. Alternate bids on portland cement concrete, 4 in. monolithic brick, 3 in. bituminous filled brick, bituminous concrete with and without binder course. Grading 3.73 mi. Route 3, Sect. 56-A, Greene Co., 137,120 cu.yd.; 0.2 mi. Federal Aid Project 2, Sect. 31, Will Co., 6,400 cu.yd.; 2.92 mi. Route 34, Sect. 27-A, 66,590 cu.yd., 0.4 mi. Route 37, Sect. 22-A, 42,420 cu.yd., both Clinton Co.; 3.85 mi. Route 39, Sect. 1-A, 34,900 cu. yd., 1.99 mi. Route 39, Sect. 2-A, 17,375 cu. yd., and 5.84 mi. Route 39, Combination I, 52,275 cu.yd., Carrol Co. F. T. Sheets, state highway engr.

Wisconsin—July 6, by State Hy. Comn., at div. office 6, 213 South Barstow St., Eau Claire, grading 6 mi. Cornell-Medford Rd., Federal Aid Project 1011, Chippewa Co., incl., 40,273 cu.yd. earth excav., 1,119 cu.yd. borrow, 740 cu.yd. channel change, etc. A. R. Hirst, highway engr.

Ia., Clinton—July 7 grading, curbing and paving 27 blocks in Sects., F-J-K-N-O-P-Q, 34,800 sq.yd. pavement, 31,330 lin.ft. combined curb and gutter, 1,000 cu.yd. excav., 34,800 sq.yd. concrete base, 34,800 sq.yd separate block base, etc., 1 mi. Paving Dist. 2, 9th St., Lyons St., from Main St. to north city limits, 13,000 sq.yd. pavement, 2,200 lin.ft. curb and gutter, etc., $175,000 and $51,000 respectively. Alternate bids on bitulithic, Willite, sheet asphalt, asphaltic concrete and rein.-con. B. R. Anderson, 410 Weston Bldg., city engr. Noted March 9 and 23.

Ia., Des Moines—July 3 by Auditor Polk Co., grading 1 mi. road south of Valley Junction, 34,848 cu.yd. excav., also paving and incidental work on 7,691 mi. primary road northwest of Polk City, Federal Aid Project 180, 12,183 cu.yd. excav., 90,246 sq. yd. pavement, etc.

Minn., Elk River—July 10, by C. S. Wheaton, Jr., aud. Sherburne Co., grading and graveling 3 mi. Job 2205, State Rd., 4, 28,000 cu.yd. excav., 39,600 cu.yd. gravel surfacing, portable culverts. $25,000. H. E. Chard, Elk River, engr.

Colorado—July 7, by State Hy. Dept., Denver, gravel surfacing 5.414 mi. Moffat Highway, Hayden-Mt. Harris Rd., incl., 22,-700 cu.yd. common earth and 900 cu.yd. rock excav., 19,800 cu.yd. borrow fill, 562 cu.yd. concrete, 15,860 lb. reinforcing, $57,-898; 10.5 mi. Norwood-Naturita Rd., State Project 7-C, 11,500 cu.yd. common and 6,200 cu.yd. rock excav., 76,600 cu.yd. borrow fill, 478 cu.yd. concrete, 32,300 lb. reinforcing, $62,918; 30 concrete bridges and approaches over Little Dry Creek, State Project 674, $7,931. L. D. Blauvelt, State Office Bldg., Denver, engr.

California—July 10, by State Hy. Comn., Sacramento, grading and paving 16.6 mi. road between Auburn and Colfax, Placer Co., bituminous macadam. A. B. Fletcher, state hy. engr.

California—July 17, by State Hy. Comn., Sacramento, grading 11.3 mi. between Chester Grade and N. E. quarter of Sect. 3, T 28 N., R 9 E., M. D. B. & M., Plumas and Lassen Counties. A. B. Fletcher, state highway engr.

Cal., Lodi—July 3, by City Trustees, improving portion Sacramento St., 49,682 sq.ft. 1½ warrenite on 2½ asphaltic concrete, 55,125 sq.ft. grading, 3,110 lin.ft. concrete curb, 3,887 sq.ft. concrete gutter. L. F. Barzellotti, Lodi, engr.

Cal., Oroville—July 5, by Supervs. Butte Co., excavating, placing in storage, hauling and spreading 14,000 cu.yd. gravel. H. H. Hume, co. surv.

Cal., Yreka—July 3, by Supervs. Siskiyou Co., constructing 3½ mi. McCloud-Bartle Rd. H. J. Sarter, co. surv.

Quebec—July 7, by I. L. Boulanger, deputy minister Dept. Pub. Rds., Parliament Bldgs. Quebec, graveling 3 mi. Levis-Rimouski Highway, through Bord de L'Eau, St. Michael de Bellechasse Parish. M. Neckar, Dept. Rds., engr.

Quebec—July 11, by I. L. Boulanger, deputy minister Dept. Pub. Rds., Parliament Bldg., Quebec, 53,332 ft. Montreal-Ottawa Highway, macadam, in St. Jerusalem, St. Hermas, St. Scholastique, St. Augustin and St. Eustache Parishes, also 11,687 ft. Joliette-L'Assomption Highway, gravel, in L'Assomption Parish. M. Neckar, Dept. Rds., engr.

BIDS RECEIVED

Massachussetts—State Hy. Dept., Boston, opened bids June 13, paving 19,430 ft. State Highway in Haverhill and Merrimac, rein.-con., from Rowe Constr. Co., Malden, $189,082, Hassam Paving Co., 17 Federal St., Worcester, $194,901, Powers Bros., North Montello St., Brockton $196,396; 20,000 ft. State Highway in Cummington and Goshen, bituminous macadam, also bridges, from T. J. Quinn, Providence, R. I., $221,951, Lane Constr. Co., 37 Colony St., Meriden, Conn., $227,582, D. F. O'Connell & Sons, Holyoke, $228,920; 7,815 ft. State Highway in Windsor and Cummington, bituminous macadam, also bridges, from Hanscom Constr. Co., 70 Kilby St., Boston, $119,803, T. J. Quinn, Providence, R. I., $134,065, Middlesex Constr. Co., Medford, $138,954

N. Y., New York—W. J. Flynn, acting pres. Bronx Boro, opened bids June 22, grading (1) Mt. Edon Ave., (2) Elliott Pl., repaving (3) Jerome Ave., sewers in (4) Middletown Rd., from I. F. Cavaluzzo, 1528 Walton Ave., (1) $32,838, (2) $11,211; Fordham Contg. Co., 1932 926 Ave., (4) $13,-249; M. Delbaiso, 660 East 221st St., (1) $34,096; P. Castell, (2) $12,663; J. V. Timoney Constr. Co., 220 East 201st St., (2) $12,882; Leonard Paving Co., 233 Bway., (3) $150,877; P. J. Kearns Contg. Co., 2306 Creston Ave., (3) $151,031; Astoria Contg. Co., 169 Hunter Ave., Long Island City, (3) $154,961; C. E. Farrell Contg. Co., 1981 Pilgrim Ave., (4) $12,575; C. W. McDonald, West 10th St., Brooklyn, (4) $12,858. Noted June 15.

N. Y., Niagara Falls—Paving following alleys (1) Contr 234, (2) Contr. 235, (3) Contr. 241, (4) Contr. 242, (5) Contr. 247, (6) Contr. 248, (7) Contr. 249, (8) Contr. 255, (9) Contr. 256, (10) Contr. 257, (11) Contr. 258, (a) concrete, (b) 3 in. vertical fibre brick, from Read-Coddington Eng. Corp., 238 Portage Rd. (1a) $4,403 (1b) $6,179 (2a) $4,631 (2b) $6,627 (3a) $4,993 (3b) $7,315 (4a) $10,464 (4b) $15,308 (5a) $6,140 (5b) $8,891 (6a) $12,404 (6b) $18,-145 (7a) $5,404 (7b) $7,576 (8a) $8,837 (8b) $12,665 (9a) $6,258 (9b) $9,043 (10a) $3,449 (10b) $4,855 (11a) $7,220 (11b) $9,934; J. F. McKinney Corp., Gluck Bldg., (1a) $4,724 (2a) $4,990 (3a) $5,356 (4a) $11,308 (5a) $6,596 (6a) $13,159 (7a) $5,825 ($a) $9,479 (9a) $6,725 (10a) $3,673 (11a) $7,779. Engrs. est. (1) $6,330 (2) $6,100 (3) $8,325 (4) $16,200 (5) $9,350 (6) $19,-525 (7) $7,775 (8) $11,380 (9) $9,350 (10) $4,100 (11) $8,775.

Pa., Phila.—Opened bids June 19, paving (1) Louden, Tower, Opal, Water and Woodlawn Sts., (2) Abington and Godfrey Aves., Bonsall and Hope Sts., (3) Banes St., (4) Delaware Ave., (5) 22nd St., (6) grading, paving and curbing, and building concrete wall at Bensalem Ave. Bridge, from Barber Asphalt Paving Co., Land Title Bldg., (1) $29,828, (2) $27,203; Master Paving Co., Colonial Trust Bldg., (1) $32,658, (2) $31,-652, (5) $45,676; United Paving Co., Colonial Trust Bldg., (3) $14,863; A. J. Henderson, 72nd and Ognotz Aves., (3) $12,423; Curtis Bros., Real Estate Trust Bldg., (3) $13,866; Citroni & Mezzola, 703 South Broad St., (4) $163,904, (5) $41,574; J. Devlin, Jr., Real Estate Trust Bldg., (4) $154,-673, (5) $42,964, (6) $11,348; T. Yettman, Jr., Lincoln Bldg., (4) $160,273; F. T. Buckins, Kensington and Deal Sts., (6) $12,673; J. J. McHugh, 1617 Race St., (6) $15,965. Noted June 15.

South Carolina—State Hy. Comn., Columbia, constructing 15.6 mi. Varnville-Yemassee Rd., from Harrison & Glover, Augusta, Ga., $51,277; constructing bridges on above road, from King Bros., Greenwood, creosoted timber, $4,803, Simons-Mayrant Co., Peoples Bldg., Charleston, concrete $10,455. Noted June 1.

Ohio—Dept. Highways and Pub. Wks., Columbus, opened bids June 23, grading, bridging and paving roads with (a) brick, (b) state to furnish brick, (c) asphaltic macadam oil (d) asphaltic macadam, lake, (e) tar macadam, (f) plain concrete, (g) Kentucky rock asphalt, (h) rein.-con. (i) sheet asphalt, (j) asphaltic macadam, oil, sandstone base, (k) tar macadam, sandstone base, (l) asphaltic macadam, lake, sandstone base, in following counties: Ashland Co., Sect. "F" Mansfield-Wooster Rd., 3.468 mi., from F. J. Munn & Sons, Marion, (a) $147,351 (b) $106,000. Columbiana Co., Sect. "F-1" Youngstown-Lisbon Rd., 2.224 mi., T. W. Miller Contg. Co., 3 South Side Savings Bank Bldg., Youngstown, (a) $92,243, (e) $73,930; Morgan Bros., Leetonia, (a) $94,256 (c) $73,622 (d) $73,622; G. B. Patterson, Wellsville, (a) $97,377; R. H. Shafer Co., Chamber of Commerce Bldg., Columbus, (c) $69,825; Tengenthorst & McLaughlin, East Liverpool, (c) $73,903 (d) $73,903; Jones Constr. Co., Salem, (e) $78,092; W. G. Owen, Mineral Ridge, (e) $72,142. Franklin Co., Sect. "B" Columbus-Millersburg Rd., 5.528 mi., from M. C. Miller, 314 East Northwood Ave., Columbus, (c) $173,447 (e) $142,019 (j) $142,019. Hamilton Co., Sect. "B" Cincinnati-Zanesville Rd., 5.221 mi., from Englewood Constr. Co., Englewood, (f) $244,-801; Scully Bros., Harrison Pikee, Miamitown, Cincinnati, (f) $246,956; J. Wroe, 54 Davies St., Dayton, (f) $251,407. Huron Co., Sect. "R" Sandusky-Columbus Rd., 1.717 mi., from Wise Bros. and Burman, Elmore, (a) $50,414 (b) $35,898 (g) $36,-279 (h) $39,361; A. N. Richards & Sons, Willard, (g) $38,928; Rice & Rice, Shelby, (g) $41,358 (h) $40,010; A. G. Witte & Sons, Elmore, (a) $51,641 (h) $39,990; A. J. Baltes, Norwalk, (a) $52,752. Huron Co., Sect. "E" Barberton-Greenwich Rd., 4.124 mi., from Acton Bros., Vaughnsville, (h) $98,805; Rice & Rice, Shelby, (h) $99,-025; A. J. Baltes, Norwalk, (h) $99,289. Huron Co., Sect. "Greenwich" Barberton-Greenwich Rd., 0.1619 mi., from Doris Constr. Co., Akron, (h) $3,928; Acton Bros., Vaughnsville, (h) $3,933; A. J. Baltes, Norwalk, (h) $3,941. Huron Co., Sect. "S" Norwalk-Mansfield Rd., 2.504 mi., from Rice & Rice, Shelby, (h) $58,155; Acton Bros., Vaughnsville, (h) $58,155. Jefferson Co., Sect. "Brilliant South" Ohio River Rd., 0.902 mi., from H. M. Bates, Steubenville, (a) $39,961; E. J. Kane, 461 West Indianaola Ave., Youngstown, (a) $39,-936 (b) $31,262. Jefferson Co., Sect. "Brilliant South" Ohio River Rd., 0.902 mi. (federal aid does not participate) from E. J. Kane, 461 West Indianaola Ave., Youngstown, (a) $16,105 (b) $11,788; H. M. Bates, Steubenville, (a) $16,243. Jefferson Co., Sect. "P" Ohio River Rd., 1.776 mi., from H. M. Bates, Steubenville, (a) $54,987; E. J. Kane, 461 West Indianola Ave., Youngstown (a) $87,744 (b) $74,914. Morgan Co., Sect. "I" McConnelsville-New Lexington Rd., 2.061 mi., from S. W. Wrightsel Co., Logan, (c) $62,991 (e) $63,733; Wilson Constr. Co., Newark, (c) $63,725; W. M. Gray, Columbus, (c) $64,-252 (e) $64,242. Morrow Co., Sect. "J" Marion-Galion Rd., 2.233 mi., from Marifield & Uncapher, Marion, (c) $67,540, (e) $68,724 (j) $54,919 (k) $56,103; H. F. Ault & Son, Cardington, (c) $71,296 (d) $71,296 (k) $56,838; Benschoter & Lauder, Toledo, (c) $72,258 (e) $72,258 (j) $61,765 (k) $61,756 (l) $58,462; Malloy & Seckel, Marion, (d) $69,889; C. W. Conley, Columbus, (e) $70,363. Pickaway Co., Sect. "G" Cincinnati-Zanesville Rd., 4.785 mi., from Brewer & Brewer Sons, Chillicothe, (a) $173,286 (b) $124,763 (d) $141,513 (h) $153,545 (i) $168,505; Neff & Roder, Circleville, (c) $128,566 (e) $128,566; C. L. Straw, Paulding, (c) $128,807 (e) $128,807; W. H. Ringwald Co., Chillicothe, (c) $131,-955 (e) $131,955; P. H. Agerter, Lima, (i) $168,955; Reichelderfer Constr. Co., Circleville, (h) $155,055. Putnam Co., Sect. "X" Lima-Ottawa Rd., 2.715 mi., from G. B. Wolther, Lima, (g) $59,419; R. Stone Constr. Co., Lima, (g) $59,971. Acton Bros., Vaughnsville, (g) $60,575 (h) $68,-225; Lewis & Copeland, Lima, (h) $72,820; J. E. Karsch & Sons, Celina, (h) $72,915. Putnam Co., Sect. "O" Lima-Ottawa Rd., 6.58 mi., from Acton Bros., Vaughnsville, (g) $12,362 (h) $14,516; F. F. Walton, Upper Sandusky, (g) $12,664; G. B. Wolther, Lima, (h) $15,718; Lewis & Copeland, Lima, (h) $15,180. Putnam Co., Sect. "Columbus-Grove" Lima-Ottawa Rd., 1.21 mi., from Acton Bros., Vaughnsville, (g) $28,342 (h) $31,801; R. Stone Constr. Co., Lima, (g) $28,662; F. F. Walton, Upper Sandusky, (g) $28,272; Lewis & Copeland, Lima, (h) $33,113. Madison Co., Sect. "G" Plain City-Dublin Rd., constructing concrete girder bridge, from Bennett & Drum, Celina $5,141; G. K. Moses, Troy, $5,894. Noted June 15.

O., Akron—S. Porter, clk. Summit Co., opened bids June 21, grading and paving 3.91 mi. Kent-Darrowville Rd. 119, (a) bituminous concrete, (b) asphaltic concrete, from Carey & Nelson, Akron, (a) $100,514; Sterling Constr. Co., Akron, (a) $107,950; Kahl Bros. Constr. Co., 13004 Woodland St., Cleveland, (b) $102,784. Noted June 15.

O., Akron—M. P. Tucker, dir. Pub. Serv., opened bids June 21, grading, paving and laying sidewalks on (1) 715 ft. Fultz St., (2) 1,800 ft. Bellows St., (3) 1,122 ft. Eastern alley, (4) 707 ft. Fernwood Dr., with (a) Trinidad asphalt, (b) Texaco asphalt, (c) Mexican asphalt, from McAlonan Bros., 506 Woodland Ave., (1) $12,825 and $13,-

Streets and Roads (Continued)

008, (2) $46,398, (3) $4,977, $5,065 and $4,551; Hollinger & Davidson, 313 South Bway., (1) $13,149 and $13,331, (3) $5,409, $5,497 and $4,610; E and W. McShaffrey Co., Rhodes Ave., (1) $13,759 and $13,760, (2) $46,734; Columbus Asphalt Paving Co., 304 Buckeye Bldg., (2) $46,437 and $45,755, (4a) $7,247, (4b) $6,924, (4c) $6,601; T. E. McShaffrey Constr. Co., 171 South Forge St., (4a) $7,137, (4b) $6,428, (4c) $6,428. Noted June 15.

O., Columbus—Franklin Co. opened bids June 20, grading and paving (1) 4.16 mi. Babbitt Rd., Plain and Jefferson Twps., (2) 5.43 mi. Walker Rd., Norwich and Brown Twps., from T. D. Van Camp, 84-85 Nims St., (1) $92,070; M. C. Miller, 301 Clinton Bldg., (1) $93,892, (2) $99,756; B. F. Bolin Co., 1149 Neil Ave., (1) $94,446, (2) $97,666; E. D. Lawrence, Hilliards, (2) $93,447. Noted June 8.

Mich., Detroit—Grading, shaping and paving alleys with one course concrete as follows: (1) 1484, (2) 1485, (3) 1486, (4) 1487, (5) 1488, (6) 1489, (7) 1490, (8) 1491, (9) 1492, (10) 1493, (11) 1494, (12) 1495, (13) 1496, (14) 1497, (15) 1498, (16) 1499, (17) 1500, (18) 1501, (19) 1502, (20) 1503, (21) 1504, from G. Nunn, 6409 3rd Ave., (1) $3,703, (3) $4,013, (15) $2,420, (18) $1,926, (20) $1,208; R. J. Powelson & Co., 6445 Iroquois Ave., (1) $3,432, (2) $4,058, (4) $3,174, (5) $3,719, (6) $3,103, (7) $5,386, (8) $2,840, (9) $5,206, (10) $2,003, (11) $1,835, (12) $1,891, (13) $5,450, (14) $3,184, (15) $2,443, (16) $3,438, (17) $4,395, (19) $1,692, (20) $1,049, (21) $2,795; Otis Cement Constr. Co., 806 Hammond Bldg., (1) $3,538, (2) $4,109, (3) $4,029, (4) $3,237, (5) $3,655, (6) $3,208, (7) $5,335, (8) $2,790, (9) $5,142, (10) $1,980, (11) $1,805, (12) $1,859, (13) $5,392, (14) $3,129, (15) $2,428, (16) $3,378, (17) $4,345, (18) $1,931, (19) $1,663, (20) $1,084, (21) $2,812; J. Porath, 34 McGraw Bldg., (2) $4,126, (3) $3,994, (6) $3,099, (18) $1,811; T. E. Currie, 20 McGraw Bldg., (7) $5,071, (9) $4,890, (13) $5,126, (17) $4,275; Mincel & Zanni, Detroit, (10) $1,998, (11) $1,850, (12) $1,908; Dept. Pub. Wks., Detroit, (21) $2,112.

Mich., Detroit—Grading, shaping and paving (1) Glynn Court, (2) St. Albertus Pl., (3) McGregor Pl., (4) Arizona Ave., (5) Burlingame Ave., (6) Cortland Ave., (7) Cicotte Ave., (8) Duncan Ave., (9) Fairview Ave., (10) Horatio Ave., (11) Lakewood Ave., (12) Parkwood Ave., (13) Seebaldt Ave., (14) Worchester Pl., (15) Tuxedo Ave., (16) Mandalay St., (17) Otsego Ave., (18) Wanda Ave., (19) Herbert St., (20) Davison Ave., from Willite Road Constr. Co., 600 Griswold St., (1) $38,126, (4) $13,362, (5) $37,589, (6) $14,531, (12) $35,480, (13) $7,125, (14) $22,834, (15) $38,427, (16) $19,919, (17) $12,800; Detroit Asphalt Paving Co., 20 McGraw Bldg., (1) $37,369, (2) $7,313, (3) $5,803, (4) $13,255, (5) $36,031, (6) $13,942, (7) $17,229, (8) $6,994, (9) $21,869, (10) $18,920, (11) $22,372, (12) $32,525, (13) $6,685, (14) $21,656, (15) $35,514, (16) $18,369, (17) $11,978, (18) $33,225, (19) $23,019, (20) $34,722; Cleveland Trinidad Paving Co., 913 Hammond Bldg., (1) $36,140, (2) $7,583, (3) $6,161, (5) $34,924, (6) $13,549, (7) $52,317, (8) $7,439, (9) $24,196, (10) $21,748, (11) $25,462, (12) $36,365, (13) $7,596, (15) $35,375, (16) $20,350, (17) $12,899, (18) $34,515, (19) $24,713, (20) $36,408; G. R. Cooke, 1006 Penobscot Bldg., (1) $13,662, (14) $21,465, (18) $32,367, (20) $34,170. Noted June 8.

Wisconsin State Hy. Dept., Madison, opened bids June 20, surfacing [illegible] Auburn-Chester Rd., Project 186, Barron Co., 9.217 mi. gravel gravel from S. J. [illegible] & Sons, Globe Bldg., Duluth, Minn., $21,075; Fitch & Bekka, Minneapolis, Minn., $23,288; Kannia Lumber Co., Mellen, $26,213. Noted June 1.

Wis., Monroe—Paving Adams [illegible] Payne, Racine and Mechanic Sts., 18,515 sq.yd. (4) 6-in. gravel, (4a) 6-in. asphalt, concrete combined curb and gutter, Geo. Gibbs & Son, [illegible] Thos. Mullen, $4.50 (4), $2.25 (4a); J. E. [illegible] & Son, 701 St. Croixland [illegible] Western Industry Co., Racine, (4) $3.54. Noted June 1.

Wis., Racine—Opened bids June 21 [illegible] Grading, Asphalt Macadam Base and Asphalt Surface Course, 7,000 sq.yd. Lisle Ave., (4) 4,000 sq.yd. Albert St., resurfacing [illegible] 15,000 sq.yd. [illegible] 3,000 sq.yd. [illegible] Douglas Ave., (4) [illegible] Geo. Gibbs & Son, 165 Water St., [illegible] $4.14 per sq.yd. (4a) $4.20, (6a) $3.24; W. Inspect Co., 84 20th St., (4) $3.44, (4a) $3.74, (6a) $3.91, (6b) $2.81, (6c) $3.44, (6d) $1.84. Noted June 15.

Minn., St. Paul—Ramsey Co. opened bids June 19, surfacing 2.52 mi. Edgerton St. from Crosley Rd. to Centerville Rd. station, (1) crushed rock and tarvia, (2) 1 course rein.-con., (3) asphaltic concrete on concrete, (4) brick on concrete with integral curb, from W. Devine, New Brighton, (1) with limestone base, $45,622, traprock, $52,615, gravel $45,622, (2) gravel aggregate, $69,533, traprock, $73,977; Fielding & Shepley, 216 University Ave., (2) granite aggregate, $83,871, (3) $78,051, (4) gravel base, $110,227; Feyen Constr. Co., 277 Burgess St., (4) limestone base, $110,682. Noted June 1.

Nebraska—State Hy. Dept., Lincoln, improving 48 projects; bidders as follows:

(1) Peterson, Shirley & Gunther, W. O. W. Bldg., Omaha, (2) Beatty Constr. Co., Blair, (3) Pickus Eng. Co., Sioux City, Ia., (4) Keefe Constr. Co., Sioux City, Ia., (5) R. J. Hysham, Route 3, South Omaha, (6) Central Bridge & Constr. Co., Wahoo, (7) C. Metz Constr. Co., Springfield, (8) Monarch Eng. Co., Falls City, (9) M. F. Morrison, Chadron, (10) Phelan & Shirley, W. O. W. Bldg., Omaha, (11) J. J. Thomson, 5619 James St., Omaha, (12) Huston & Gillam, Kearney, (20) C. T. Wheiton, North Platte, (21) S. M. Aldridge, Auburn, (22) Pioneer Constr. Co., Railway Exch. Bldg., Kansas City, Mo., (23) National Constr. Co., 511 Federal Bldg., Omaha, (24) Lameraux Bros., 416 Arthur Bldg., Omaha, (25) Schlueter Bros., Fremont, (26) Lincoln Co., Board, North Platte, (27) M. Day Co., 310 Little Bldg., Lincoln, (28) E. Euler, Troy, Kan., (29) County Board of York Co., York, (30) Western Bridge Co., 748 Bee Bldg., Omaha, (31) Norfolk Bridge Co., Norfolk, (32) B. B. Gano, Elwood, (33) C. L. Rogers, Franklin, (34) F. L. Smith, Winner, S. D., (35) Cheyenne Co. Board, Sidney, (36) J. W. McGeer, 1722 M St., Lincoln, (37) F. C. Krotter, Palisade, (38) Amer. Paving Co., 411 Finance Bldg., Omaha, (39) Bid Four Constr. Co., Loup City.

Project 191, Haigler-Sanborn Rd., Dundy Co., (1) $15,030; excav. 43,000 cu.yd., $0.29.

Project 49 A, Oakland-South Sioux City Rd., Dakota Co., (2) $7,953, (3) $8,584, (4) $9,398; concrete pavement, 1,930 sq.yd., (2) $3.70, (3) $3.79, (4) $4.33.

Project 49 E, Oakland-South Sioux City Rd., Dakota Co., (1) $12,940, (5) $3,690; excav., 10,250 cu.yd., (1) $0.21, (5) $0.36; gravel surfacing 22,409 sq.yd., (1) $0.36.

Project 107 C, Greenwood-Chalco Rd., Sarpy Co., (6) $4,567, (7) $5,015, (8) $6,018; concrete pavement 1,543 sq.yd., (6) $2.96, (7) $3.25, (8) $3.90.

Project 102 B, Smiley Canyon, Sioux Co., (1) $9,083, (9) $9,298, (10) $10,230; excav. 24,288 cu.yd., (1) $0.29, (9) $0.2975, (10) $0.31.

Project 91 B, road from Douglas Co. line to Ft. Calhoun, Washington Co., (1) $7,654, (10) $8,001; excav. 24,206 cu.yd., (1) $0.31, (10) $0.32.

Project 55 B, Dorchester-Fairmount Rd., Saline Co., (10) $9,933, (11) $10,027, (12) $10,186; excav. 29,240 cu.yd., (10) $0.235, (11) $0.24, (1) $0.245.

Project 49 D, Oakland-South Sioux City Rd., Burt Co., (10) $13,247, (14) $13,370, (1) $13,665; excav., 51,740 cu.yd., (10) $0.235, (14) $0.237, (1) $0.24.

Project 29, Osceola-David City Rd., Butler Co., (1) $22,928, (12) $23,336, (13) $27,139; gravel surfacing 46,791 sq.yd., (1) [illegible] $0.35.

Project 98 C, Crete-Wilber-Dorchester Rd., Saline Co., (11) $6,500, (10) $6,680, (1) $7,287; excav. 21,000 cu.yd., (11) $0.24, (10) $0.235, (1) $0.26.

Project 185 A, Geneva-Milligan Rd., Fillmore and Saline Counties, (11) $15,580, (10) [illegible] [illegible] Rd., Garden Co., (1) $8,589, (15) $9,185, (16) $10,322; topsoil surfacing 6,889 cu.yd., (1) [illegible] $0.35.

Project 180, Columbus east, Platte Co., [illegible] cu.yd., $0.25, [illegible] $0.45, [illegible] Auburn Rd., [illegible] cu.yd., (1) $0.265, [illegible] $0.49.

Project 79 A, Bayard-Broadwater Rd., [illegible] $0.49.

Project 76 A, Alliance-Chadron Rd., Dawes Co., (22) $1,065, (9) $1,302; concrete pavement 23.67 cu.yd., (22) $4.50, (9) $5.50.

Project 164 B, Hebron-Nelson Rd., Nuckolls Co., (10) $13,555, (11) $13,673, (1) $14,406; excav. 50,570 cu.yd., (10) $0.235, (11) $0.24, (1) $0.25.

Project 108, Hay Springs-Merriman Rd., Sheridan Co., (1) $48,444, (23) $49,127, (24) $49,976; excav., 164,397 cu.yd., (1) $0.28, (23) $0.285, (24) $0.29.

Project 70 A, Stanton-Wisner-Wayne Rd., Stanton Co., (1) $23,294, (11) $23,623, (10) $24,411; excav. 97,734 cu.yd., (1) $0.235, (11) $0.24, (10) $0.245.

Project 70 B, Stanton-Wisner-Wayne Rd., Wayne Co., (1) $29,585, (14) $30,136, (11) $31,842; excav., 124,900 cu.yd., (1) $0.22, (14) $0.224, (11) $0.24.

Project 88 C, Oakland-Crowell Rd., Cuming Co., (5) $5,960 (not complete), (10) $6,830 (not complete), (1) $7,980; excav. 18,000 cu.yd., (5) $0.32, (10) $0.36, (1) $0.31.

Project 172, West Point-Wisner Rd., Cuming Co., (1) 101,836, (13) $102,558 (no excav. or grader), (25) $162,285; excav., 15,300 cu.yd., (1) $0.29, (25) $0.30; gravel surfacing 156,651 sq.yd., (1) $0.59, (13) $0.65, (25) $0.975.

Project 170, North Platte east, Lincoln Co., (19) $81,008, (13) $119,583, (26) $121,628; excav., 18,500 cu.yd., (19) $0.25, (13) $0.29, (26) $0.30; 4 in. gravel 280,711 sq.yd., (19) $0.21, (13) $0.30, (26) $0.305; 3 in. gravel 21,627 sq.yd., (19) $0.21, (13) $0.23, (26) $0.24; 2 in. gravel 6,333 sq.yd., (19) $0.17, (13) $0.20, (26) $0.20.

Project 168 A, Stuart-Bassett Rd., Holt Co., (20) $11,355, (1) $14,034, (27) $21,393; excav. 45,210 cu.yd., (20) $0.25, (1) $0.245, (27) $0.27; gravel surfacing 8,790 cu.yd., (1) $0.30, (27) $1.

Project 146 B, Ogallala-Belmar Rd., Keith Co., (1) $24,286, (16) $24,579, (28) $51,128; excav. 46,894 cu.yd., (1) $0.31, (16) $0.32, (28) $0.35; topsoil surfacing 12,846 cu.yd., (1) $0.30, (16) $0.30, (28) $1.10.

Project 143 B, Fairmount-Osceola Rd., York Co., (1) $51,715, (29) $57,124, (13) $57,730; gravel surfacing 108,184 sq.yd., (1) $0.45, (29) $0.50, (13) $0.50.

Project 139 B, Norfolk-Ewing Rd., Madison Co., (30) $13,875, (31) $14,927, (3) $18,525; excav. 2,088 cu.yd., (30) $0.30, (31) $0.30, (3) $0.50.

Project 181, Ravenna Sweetwater Rd., Buffalo Co., (24) $13,763, (20) $13,845, (1) $15,195; excav., 52,500 cu.yd., (24) $0.245, (20) $0.25, (1) $0.26.

Project 137 A, Springview-Bassett Rd., Rock Co., (10) $6,625, (1) $9,496; excav. 19,900 cu.yd., (10) $0.32, (1) $0.29.

Project 184, Elwood-Stockville Rd., Gosper Co., (1) $27,657, (24) $29,811, (32) $29,968; excav. 92,543 cu.yd., (1) $0.27, (24) $0.275, (32) $0.31.

Project 186, Kimball-Bushnell Rd., Kimball Co., (20) $18,877, (1) $21,702, (33) $23,832; excav. 70,000 cu.yd., (20) $0.26, (1) $0.25, (33) $0.28.

Project 139 E, Norfolk-Ewing Rd., Holt Co., (10) $11,842, (1) $13,694; excav. 34,090 cu.yd., (10) $0.34, (1) $0.26.

Project 188 A, Arnold-Merna Rd., Custer Co., (20) $34,394, (10) $35,268, (1) $35,887; excav. 123,713 cu.yd., (20) $0.26, (10) $0.265, (1) $0.27.

Project 130 B, Sidney-Dalton Rd., Cheyenne Co., (1) $27,761, (35) $29,472, (34) $58,228; excav. 118,200 cu.yd., (1) $0.18, (35) $0.18, (34) $0.39.

Project 168 B, Stuart-Bassett Rd., Rock Co., (10) $33,336, (1) $55,506, (27) $86,817; excav. 126,388 cu.yd., (10) $0.25, (1) $0.245, (27) $0.27.

Project 139 F, Norfolk-Ewing Rd., Antelope Co., (10) $13,830, (1) $19,114; excav. 32,000 cu.yd., (10) $0.315, (1) $0.29.

Project 189, Florence Heights, Douglas Co., (1) $7,875, (23) $8,116, (10) $8,390; excav. 25,557 cu.yd., (1) $0.24, (23) $0.249, (10) $0.26.

[illegible] 115 E, [illegible] Rd., Lancaster Co., (1) $41,642, (10) $42,431, (36) $44,703; excav. 136,390 cu.yd., (1) $0.225, (10) [illegible]

Project 176, Curtis-Maywood Rd., Frontier Co., (10) $21,144, (37) $22,605, (1) $[illegible] [illegible] cu.yd., (10) $0.15, (37) $0.25, (1) $0.26.

Project 187, Elk City Rd., Douglas Co., (1) $[illegible] [illegible] 141,500 cu.yd., [illegible] Douglas Co., (1) $[illegible] excav. 125,800 cu.yd., (1) $0.24, (20) $0.25, (23) $0.247.

Project 20, in Lincoln, Douglas Co., excav. [illegible] $0.245, [illegible] $0.25, [illegible] $0.25, [illegible] $0.25

Streets and Roads (Continued)

$168,156, (23) $175,063; sheet asphalt pavement 54,475 sq.yd., (23) $3, total $165,477; bituminous concrete pavement 54,475 sq.yd., (23) $2.98, total $164,382; concrete pavement 54,475 sq.yd. (13) $2.57, (23) $2.92, (38) $2.57, total (13) $141,869, (23) $161,-095, (38) $141,839.

Project 195 A, Litchfield-Hazard Rd., Sherman Co., (10) $14,200, (1) $15,939, (24) $15,985; excav. 48,000 cu.yd., (10) $0.28, (1) $0.29, (24) $0.275.

Project 182, Harvard-Eldorado Rd., Clay Co., (10) $28,297, (1) $31,612; excav. 85,-360 cu.yd., (10) $0.32, (1) $0.36.

Project 196, Minden-Newark Rd., Kearney Co., (13) $21,225, (1) $22,457, (19) $23,011; excav. 25,000 cu.yd., (1) $0.245, (19) $0.25; gravel surfacing 29,422 sq.yd., (13) $0.47, (1) $0.36, (19) $0.38.

Project 37, Rockville-Loup City Rd., Sherman Co., (39) $11,038, (1) $16,048; excav. 8,900 cu.yd., (39) $0.17, (1) $0.29.

Project 164 A, Hebron-Nelson Rd., Thayer Co., (10) $12,958, (17) $13,158, (1) $13,-278; excav. 40,000 cu.yd., (10) $0.315, (17) $0.32, (1) $0.32. Noted May 25.

Neb., Lincoln—Improving 35th St. from O to X Sts., and X and W Sts. from 33rd to 35th Sts., from Abel Constr. Co., Terminal Bldg., asphaltic concrete $2.31, concrete $2.15, curb $0.50, etc., total $38,806; Cochrane Constr. Co., 1st Natl. Bank Bldg., asphaltic concrete $2.36, concrete $2.15, curb, $0.50, etc., total $39,443.

Tex., Decatur—Wise Co. grading and surfacing 20.7 mi. State Highway 2 from here to Montague Co. line, incl. 1,840 cu.yd. concrete, 140,989 lb. reinforcing and 49,700 lb. structural steel, 14,420 cu.yd. clay, from Mitchell Constr. Co., and Everheart Bros., Cleburne and Mathis, Tex., $58,882; Harris & Powell, Marlin, $67,631; F. P. McElwrath, Corsicana, $71,146. Noted June 8.

Tex., Paris—Lamar Co. surfacing (1) 4 mi. State Highway 19, Federal Aid Project 296, incl., 37,397.78 sq.yd. concrete, 280 cu.yd. concrete base, 47,827 cu.yd. wire mesh reinforcing, paving (2) 6 mi. State Highway 5, incl., 56,320 sq.yd. concrete, from F. P. McElwrath, Corsicana, (1) $89,-246, (2) $137,984; J. C. Field Co., Denison, (1) $93,877, (2) $143,616 ;McCollum Constr. Co., 1507 F & M Bldg., Ft. Worth, (1) $102,304, (2) $155,443. Noted June 8.

CONTRACTS AWARDED

N. H., Newport—State Hy. Dept., Concord, paving 1.46 mi. State Highway, bituminous macadam on stone, to R. E. Bull, 148 Boutelle St., Fitchburg, Mass., $51,704.

Massachusetts—State Hy. Dept., Boston, paving 18,950 ft. State Highway, in Windsor and Dalton, bituminous macadam, to Lane Constr. Co., 37 Colony St., Meriden, Conn., $161,958; 13,700 ft. in Lee, rein.-con., to C. E. Horne, Milford, $143,139; 5,580 ft. in Middleton, bituminous macadam, to J. E. Watkins, 1 Fern Ave., Amesbury, $29,397.

Conn., New Haven—Paving Bassett, Perkins and Arch Sts., about 11,500 sq.yd. asphalt, to D. V. Frione & Co., 105 Ward St., $28,266.

N. Y., Brooklyn—Dept. Parks, Municipal Bldg., New York, improving South Lake Dr., Prospect Park, here, to Cleveland Trinidad Paving Co., Flushing, $54,879. Noted June 22.

N. Y., Brooklyn—E. Riegelmann, boro pres., Boro Hall, paving Bristol and East 8th Sts., to Borough Asphalt Co., 1301 Metropolitan Ave., $7,398 and $6,791 respectively; grading, curbing, etc., Schenectady Ave., to F. Donavan Sons Trucking & Contg. Co., 614 Union St., $6,606; Union St., to T. B. Scott, $3,180; 80th St., to G. M. Mandatto, 129 29th St., $3,626; curbing, etc., Coney Island Ave., to Soviero & Britton, 10111 114th St., Richmond Hill, $81,-437; resurfacing Canarsie Lane, to C. Gallagher, 745 Dean St., $16,985; Gravesend Neck Rd., to Murphy Bros., 262 Bay 43rd St., $16,446; Ave. U, to J. J. Guinan Contg. Co., 2314 Gravesend Ave., $64,146. Noted June 15 and 22.

N. Y., Brooklyn—E. Riegelmann, boro pres., Boro Hall, paving Dupont St., to Welsh Bros. Contg. Co., 32 Queens St., Long Island City, $11,210; East 14th St., and resurfacing Sheepshead Bay Rd., Neptune, Ocean and Voorhies Aves., to C. Gallagher, 745 Dean St., $12,465, $11,905, $35,462, $51,-298 and $16,555 respectively; paving Kenmore Pl. from Ave. L to Ave. M and paving and curbing Kenmore Pl. from Ave. I to Ave. L, to Borough Asphalt Paving Co., 1301 Metropolitan Ave., $7,735 and $28,179 respectively; paving New York Ave. and Ave. R, to Cleveland Trinidad Paving Co., Flushing, $4,888 and $10,789 respectively; 59th and 61st Sts. from 17th to 18th Aves., 46th, 70th and 81st Sts., to Uvalde Asphalt Paving Co., 1 Bway., New York, $15,923, $9,137, $7,619 and $14,132 respectively; grading, curbing and laying sidewalks on Kenmore Pl. from Ave. L to Ave. M, to G. Mandatto, 139 29th St., $3,073. Noted June 8.

N. Y., Buffalo—To Rock Asphalt & Constr. Co., Morgan Bldg., repaving Main St. from Hertel Ave. to old city line, $111,-489, paving Parkridge Ave., $26,794, Collaton St., $6,014, Fuller St., $16,826, all specification B standard asphalt on concrete; to H. F. Burgard Co., 1968 Fillmore Ave., Elicott St., $35,300, specification B standard asphalt and block stone on Portland cement, Thatcher Ave., $20,900, Midway Ave. $13,-600 and Northland Ave., $20,350, all specification B standard asphalt on concrete; to Erie Contg. Co., Morgan Bldg., Athol St., $9,572, Salem St., $9,533, both specification B brick on concrete; to B. F. Spire, 24 Colonial Circle, Jackson St., $5,850, specification B brick on concrete. Noted May 18.

N. Y., Jamestown—Bd. Estimate & Review will pave Arnold, Thayer, Lafayette and Crossman Sts., vitr. brick on concrete, by day labor under supervision of L. Bergman, city engr. and superintendent Pub. Wks. $25,000.

N. Y., Jamestown—Bd. Estimate & Review will concrete curb and gutter 750 ft. King St., $1,500, 585 ft. Fairview Ave., $585, 1,370 ft. Ivy St., $1,233; pave 2 short streets, with Hillside brick on 5 in. concrete, $9,000; 2,334 ft. 12-18 in. storm sewers in Lind alley, Cedar and Fluvanna Aves., King, English and Tower Sts., $6,650; 263 ft. 8 in. sanitary sewer in Jefferson St., $700; 450 ft. extension of concrete culvert in 11th St., $5,000. Work will be done by day labor under supervision of L. Bergman, city engr.

N. Y., New York—J. Miller, pres. Manhattan Boro, Municipal Bldg., repaving Amsterdam Ave., from West 139th and West 147th Sts., to Asphalt Constr. Co., 208 Bway., $27,812, $13,349 and $9,219 respectively; 114th St., to Interboro Asphalt Co., Creston Ave., $9,882. Noted June 15.

N. Y., Niagara Falls—Paving 11th St. and Highland Ave. (a) outside of tracks, (b) inside of tracks and 2 ft. outside, asphalt, to Read-Coddington Eng. Co., 238 Portage Rd., (a) $83,797; J. F. McKinney Corp., Gluck Bldg., (b) $11,000.

N. Y., Rochester—Bd. Contract & Supply, to J. Frederich, Inc., Rochester, paving East Main St., $75,104, Barons St., $10,553, Henry St., $11,356, all asphalt; to T. Holahan, 164 Lewis St., Barrington St., $7,980, asphalt; to Whitmore, Rauber & Vicinus, 279 South Ave., Cleveland St., $8,009, asphalt; to W. J. Bender Cement Walks, Inc., Rochester, cement walks on Santee St., $394.

N. Y., Scotia—Village Bd. Trustees, concrete curbing and paving 1st St., to W. H. Brown, 434 State St., Schenectady, $17,699. Noted May 18.

N. J., Belvidere—Warren Co., constructing State Highway Route 9, Sect. 9 from Phillipsburg to Still Valley, to Crilly & Cannon Constr. Co., 4 Union Sq., Phillipsburg, $110,345, 89.18% of engrs. est. Noted June 8.

N. J., Mt. Holly—Burlington Co. improving Bridgeboro-Riverside Rd., concrete, to Union Paving Co., 30th and Market Sts., Phila., $77,759. Noted June 8.

N. J., Morristown—Morris Co. reconstructing 21,114 sq.yd. Speedwell Ave. from here to Morris Plains, concrete, to J. S. Geigers Sons, 83 Hartford St., Newark, $144,585. Noted June 1.

N. J., Trenton—Mercer Co. constructing State Highway Route 1, Sect. 6, Greenwood Ave., to Rees-Taylor Co., Mechanics Bldg., $95,347. Noted June 1.

Pa., Phila.—To Barber Asphalt Paving Co., Land Title Bldg., paving Lawrence and Anderson Sts., $26,435, Price, Lauden, Delphine and B Sts., $26,276, Chew and 16th Sts., $24,959, Garnet St., $13,875; Eastern Paving Co., Colonial Trust Bldg., Highland Ave., Clearfield, 49th and Helen Sts., $15,-974. Noted June 8.

W. Va., Berkeley Springs—Comrs. Morgan Co. constructing Paw Paw-Great Cacapon Rd., Cacapon Dist., to W. J. and J. T. Gephart, Linden, Williamsport, Pa., $68,015. Noted May 11.

North Carolina—State Hy. Comn., Raleigh, grading and paving 6.65 mi. Project 620 B, Gaston Co., 2 in. bitulithic on 5 in. concrete, to W. F. McCanless, Charlotte, $179,241.

N. C., Elkin—For 35,000 to 40,000 yd. concrete to Campbell Constr. Co., Columbus, Ga., $2.525 per yd. Noted April 27.

S. C., Charleston—State Hy. Dept., Charleston, constructing 5.3 mi. bard surfaced road, Charleston Co., to J. M. Gregory & Co., Newton, N. C., $158,283. Noted May 11.

Ga., Atlanta — To Jamison-Hallowell, Chandler Bldg., paving 750 sq.yd. Irene St., 6 in. vibrated slag $2.30, Dixie Ave. from Waddell St. to Druid Circle, vibrated stone $2.34; to Nichols Contg. Co., Trust Co. Georgia Bldg., 1,565 sq.yd. Virginia Circle, concrete, $2.12, 930 sq.yd. De Leon St., concrete, $2.12, 2,700 sq.yd. Clemont Dr., concrete, $2.12, 1,380 sq.yd. Greencove St., concrete $2.12; to T. D. Meador, Jr., Glenn St. from Washington to Pryor Sts., 6 in. vibrated $2.34, Clifton Ave. from McLendon to Ponce De Leon Aves., 6 in. vibrated $2.22, 3,250 sq.yd. Euclid Ave., 6 in. vibrated $2.27. Noted June 15.

Ga., Thomaston—Upson Co. paving 9 mi. Sect. C, from here to Tabler Bridge to Nichols Constr. Co., Trust Co., Georgia Bldg., Atlanta, $55,212; 19 mi. various roads, to Brooks Callaway Co., Forsyth Bldg., Atlanta, $23,935; bridge, to Stanley Ringer, La Fayette, Ala., $23,364.

Ga., Thomasville — Paving various streets and sidewalks, 12,510 sq.yd. asphalt, 3,732 lin.ft. curbing, 3,732 lin.ft. gutter, 1,810 sq.yd. sidewalk., to Adams, Evans Co., Atlanta Bank Bldg., Jacksonville, Fla., $39,442.

Fla., Tavares—Lakee Co. clearing, grading and sand-clay surfacing 10½ mi. road from Clermont to Polk Co. line, also constructing 155 ft. creosoted timber bridge over Palatlakaha River, to Bryson Live Stock Co., Box 929, Jacksonville, $40,799 and $3,750 respectively.

Ohio—Dept. Highways and Pub. Wks., Columbus, grading, bridging and paving roads in following counties: Allen Co., Sect. "I" Lima-Wapakoneta Rd., 3.929 mi., to E. J. Heill, 410 South Jameson St., Lima, brick, $135,745; Brown Co., Sect. "Hammersville" Cincinnati-West Union Rd., 0.637 mi., to J. E. Barbro, Withimsville, tar macadam, $13,285; Brown Co., Sect. "P-1" Cincinnati-West Union Rd., 3.072 mi., waterbound macadam, to E. J. Barbro, Withimsville, $62,688; Mahoning Co., Sect. "W" Akron-Youngstown Rd., 0.457 mi., brick, to R. C. Miller, Youngstown, $13,861. Noted June 15.

Ohio— Dept. Highways and Pub. Wks., Columbus, grading, bridging and paving roads in following counties: Allen Co., Sect. "L-3" Lima-Sandusky Rd., 3.119 mi., to L. L. Clymer, Bluffton, brick, $104,493; Ashtabula Co., Sect. "I" and "H" Youngstown-Conneaut Rd., 6.992 mi., tar macadam, to E. J. Inman, Ashtabula, $154,852; Darke Co., Sect. "E" Dayton-Greenville Rd., 4.491 mi., rein.-con., to E. and G. Alexander, North Star, $121,388; Hancock Co., Sects. "A-2", "E-1" and "B-2" Ottawa-Findlay Rd., 3.07 mi., rein.-con. to Pottibone & Graves, Lakeside, $78,200; Trumbull Co., Sect. "A-3" Canfield-Niles Rd., 0.26 mi., brick, to J. De Jute, Niles, $11,418; Union Co., Sect. "F" and "Marysville," Marysville-Bellefontaine Rd., 0.597 mi., Kentucky rock asphalt, to M. B. Koffroth, Richwood, $12,-720; Fayette Co., Sect. "K" Hillsboro-Washington C. H. Rd., constructing bridge, t. Middle States Constr. Co., 524 East Hudsor St., Columbus, $9,780. Noted June 22.

O., Akron—Summit Co. grading and paving Kenmore-Mogadore Rd., Cuyahoga Falls-Middlebury Rd. and Portage Lakes Dr., to T. E. McShaffrey Constr. Co., 171 South Forge St., $34,658, $39,668 and $65,-875 respectively; Tallmadge Ave. extension, to J. Gilbert, Akron, $72,365. Noted June 22.

O., Canton—Paving 1 mi. Harrison Ave. from Navarre Rd. S. W. to corporation line, to Natl. Asphalt Paving Co., Canton, $131,-285, Young Ave. N. E. from tracks of Wheeling & Lake Erie R.R. to Mahoning Rd., N. E. and 17th St. N. E. from Market Ave. N. to Cherry Ave., N. E., to Burd Constr. Co., 1043 Spring Ave., N. E., $53,704 and $4,574 respectively, all asphalt; 18th St. N. W. from Market Ave. N. to Yale Ave. N. W., etc., and Savannah Ave. N. E. from 7th to 9th Sts. N. E., to Garaux Bros., Court Ave. and Reynold Pl., S. W., $40,005 and $13,180 respectively, 15th St. S. E. and N. E. from Allen to Cleveland Aves., to Wise Bros., $136,691, all brick.

O., Cleveland—Paving St. Olga and St. Tichon Aves., to Burnett & Hathaway, Society for Savings Bldg., $24,473; Hazeldell Ave., to Freshwater Constr. Co., Natl. Bldg., $13,624. Noted June 15.

Michigan—State Hy. Dept., Lansing, grading and surfacing 5.97 mi. State Trunk Line Rd. 27-9, Sect. A, Sanilac Co., to Atlanta Constr. Co., General Bldg., Detroit, 15,415 cu.yd. excav. $0.45, 166.6 cu.yd. 1:2:4 concrete $17, 234.3 cu.yd. 1:3:6 concrete $16, 56,037 sq.yd. gravel $0.87, total $63,957; 7,043 mi. State Trunk Line Rd. 60-1, Sects. A, C and D, Cass Co., to Highway Improvement Co., South Bend, Ind., 39,853 cu.yd. excav. $0.60, 96.9 cu.yd. 1:2:4 concrete $15, 21.1 cu.yd. 1:3:6 concrete $14, 72,263 sq.yd. waterbound macadam $1.48, $136,202. Noted May 4.

Michigan—State Hy. Dept., Lansing, grading and surfacing 6.135 mi. Federal Aid Project 57, Sects. B and C, to Willite Road Constr. Co., Union Trust Bldg., Detroit, 35,093 cu.yd. excav. $0.55, 225.7 cu. yd. 1:2:4, 198.7 cu.yd. 1:2:5 and 280.5

Streets and Roads (Continued)

cu.yd. 1:3:6 concrete $14, 65,795 sq.yd. rein. bituminous pavement $2.05, total $170,066. Noted June 8.

Mich., Detroit—To R. J. Powelson Co., 6445 Iroquois Ave., paving Alley 1475, $3,867, Alley 1477, $2,980, Alley 1478, $5,182, Alley 1480, $2,375; J. Porath, 34 McGraw Bldg., Alley 1473, $3,169, Alley 1474, $2,085, Alley 1475, $938; Mincel & Zanni, Detroit, Alley 1476, $1,516; T. E. Currie, 20 McGraw Bldg., Alley 1479, $5,539, Alley 1481, $4,325, Alley 1482, $3,291, Alley 1483, $3,218. Noted June 22.

Mich., Ironwood—For 23,000 sq.yd. tar macadam pavement on various streets, also concrete curb and gutter, to Nieuwenkamp & Thompson, Ironwood, $75,200.

Ill., Benid—Paving 13,000 sq.yd. various streets, to L. Clotfelter, Hillsboro, $59,811. Noted May 25.

Ill., Lincoln—Bd. Local Impvts., brick paving various streets, to H. K. Rhoads, Lincoln, $60,000, and Hoffman & Small, $10,000. Noted June 1.

Wisconsin—State Hy. Comn., Madison, Arkdale—Wisconsin Rapids Rd., Project 250, Adams Co., to E. A. Bloss, La Crosse, 16,644 cu.yd. earth excav. $0.27, 4,824 cu.yd. surfacing $0.75, etc., total $9,379; New Lisbon-Mauston Rd., Project 280, Juneau Co., to Young & Austin, Sparta, 18,081 cu.yd. earth excav. $0.30, 5,850 cu.yd. gravel surfacing $3.25; 1,000 cu.yd. sand surfacing $.75, etc., total $33,742; Coloma-Wautoma Rd., Project 283, Waushara Co., to Drew, Johnston & Blystone, Endeavor, 22,561 cu.yd. earth excav. $.29, 10,531 cu.yd. gravel $1.25 first mile or less and $0.25 each additional ½ mi., etc., total $23,376. Noted June 15.

Wisconsin—State Hy. Comn., Madison, surfacing Spooner-Rice Lake Rd., Project 90, Washburn Co., 7,786 cu.yd. gravel surfacing, to S. J. Groves & Sons, Globe Bldg., Duluth, Minn., $22,893. Noted June 1.

Wis., Milwaukee—Grade separation 1st Ave. and Dakota St., to R. H. Gumz, 831 13th Ave., Milwaukee, $122,479.

Ia., Algona—Paving various streets to Empire Constr. Co., 308 7th St., Des Moines, 22,350 sq.yd. granite concrete $2.75 per sq. yd., 2,400 sq.yd. limestone concrete $2.51. Noted May 4.

Ia., Keokuk—Concrete paving 10,000 sq.yd. various streets, to Cameron, Joyce & Co., Keokuk, $2.20 per sq.yd.; 2,360 sq.yd. alleys, to Keokuk Quarry & Constr. Co., Keokuk, $2.27. Noted June 1.

Ia., Waterloo—Black Hawk Co. grading and paving 17.17 mi. Hawkeye Highway, Federal Aid Project 82, from her east to Buchanan Co. line and from Cedar Falls west to Grundy Co. line, 49,146 cu.yd. excav., 181,475.8 sq.yd. pavement, to Northern States Contg. Co., St. Paul, Minn., $497,145. Noted May 25.

Minn., Glenwood—Pope Co., Job 2201, 57,225 cu.yd. earth and 400 cu.yd. loose rock excav., 78,131 cu.yd. overhaul, culverts, to H. A. Hallum, Glenwood, $14,558; Job 2202, 34,238 cu.yd. earth and 100 cu.yd. loose rock excav., 13,741 cu.yd. overhaul, culverts, to G. H. Clear Co., Glenwood, $8,739; Job 2203, 7,422 cu.yd. excav., 2,222 cu.yd. overhaul, to L. E. Crown, Glenwood, $3,215. Noted May 4.

South Dakota—State Hy. Dept., Pierre, gravel surfacing 17 mi. Federal Aid Project 40, McCook Co., incl. 25,460 cu.yd. gravel, to Lindebungel & Barthlow, Spencer, $29,897. Noted June 1.

Montana—State Hy. Dept., Helena, grading, gravel surfacing and building bridges on 14 mi. Federal Aid Project 183, from Three Forks east, Gallatin Co., road work to H. Deaner, Deaner, Wyo., $255,548; bridges to Illinois Steel Bridge Co., 55 Oliver Bldg., St. Paul, Minn., $29,326. Noted May 4.

Montana—State Hy. Dept., Helena, grading 2.65 mi. and surfacing 4.77 mi. Yellowstone Trail, Federal Aid Project 44 and 82-D, Gallatin Co., to Pioneer Constr. Co., Bozeman, 11,060 cu.yd. excav., 7,000 cu.yd. gravel, 9,585 cu.yd. gravel B, 28,750 cu.yd. Class A concrete $22 and 29.17 cu.yd. Class B $30, etc., total $37,508; engrg., roll., etc., $31,225; 7.36 mi. Rocky Yarrel Federal Aid Project 145-A, Lincoln Co., to Gates & Sellers, Big Wolf Flats, 17,517 cu.yd. common excav. $0.65, 11,175 cu.yd. intermediate excav. $0.65, 11,175 cu.yd. $1.15 solid excav., subgrading $15, 7,000 gravel surfacing $0.75, 11,175 cu.yd. $2.38 concrete culverts, 114 lin.ft. 24-in. Pipe Creek Rd. Federal Aid Project 145-A, Lincoln Co., to Rich & Markuson, Granite Co., to Rich & Markuson, Granite, 67,918 cu.yd. excav. $0.37, 10,000 cu.yd. borrow $0.40 and 1,151 cu.yd. excav. $1.15, 5,141 cu.yd. gravel surfacing $1.90, 1,268 cu.yd. Class B concrete $30, 1,268 cu.yd. Class C concrete $32, 1,268 cu.yd. concrete $42, 1,268 cu.yd. concrete $42, 268 culverts, estimate $42,425, etc.

Tex., Mckinney—Collin Co. grading and surfacing 5.7 mi. State A. B. C. Highway, State Highway 5-A to Tibbets Chapel, to Edrington Bank Bldg., Ft. Worth, $385,130. All materials furnished by county.

Tex., McKinney—Collin Co. surfacing 11.06 mi. Wylie Rd. Dist. 15, to D. H. Purvis & Son, Ft. Worth, $32,926. Noted May 25.

Tex., Marshall—Harrison Co. grading gravel surfacing, etc., (1) 14.2 mi. State Highway 8 from here to Panola Co. line, (2) 10.79 mi. State Highway 8 from here to Marine Co. line, from Cocke & Turner, Marshall, (1) $86,765, (2) $54,012; Mc-Clung Constr. Co., Cleburne, (1) $84,915, (2) $60,832; C. W. Burgess, 501 Dallas County State Bank Bldg., Dallas, (1) $97,-238, (2) $56,400. Noted June 15.

Col., Denver—Grading and bridging 3.3 mi. Parmalee Gulch Rd., 20 ft., to C. Wells & Co., 1642 Pearl St., $18,526; paving 12 blocks Alley Paving Dist. 83, and 12 blocks Alley Paving Dist. 82, 16-20 ft., concrete, to W. F. Pigg & Son, Engineers Bldg., $23,851 and $22,839 respectively.

Nevada—State Hy. Comn., Carson City, grading, gravel surfacing and building culverts on 5 mi. Sect. D-1, Route 2, Lincoln Highway, 1.5 mi. west of Franchmans to 3.5 mi. east of same, 10 ft. wide, Churchill Co., to J. N. Tedford, Fallon, $29,977. Noted June 8.

Arizona—State Hy. Dept., Phoenix, grading, surfacing and building structures on 32.231 mi. Holbrook-Winslow Highway, Federal Aid Project 40, Schedule (1) from Sta. 905 plus 79-1325 plus 00, to Hunt, Stratton & Larson, Snowflake, 4,682 cu.yd. excav. $0.27, $19,155 cu.yd. excav. $0.15 and 820 cu.yd. excav. $0.75; 10,534 cu.yd. surfacing $0.43, 316,571 sta.yd. surfacing overhaul $.009, 232 cu.yd. Class A concrete $16, 85 cu.yd. Class B $14 and 72 cu.yd. Class C $13, 12,929 lb. reinforcing $0.04, etc., total $24,295; Schedule 2, Sta. 1325-1745, to Tanner Bros., St. Joseph, 2,511 cu.yd. excav. $0.27, 34,760 cu.yd. excav. $0.14, 577 cu.yd. excav. $0.60, and 576 cu.yd. excav. $0.15, 15 cu.yd. Class A concrete, $17, 132 cu.yd. Class B $15 and 64 cu.yd. Class C, $15, 10,627 cu.yd. surfacing $0.45, 574,921 sta.yd. surfacing overhaul $0.01 etc., total $22,663; Schedule 3, Sta. 1745-2165, to Cashion, Caldwell Constr. Co., 33 East Adams St., 3,268 cu.yd. excav. $0.28, 35,444 cu.yd. borrow $0.18, 704 cu.yd. excav. $0.50 and 269 cu.yd. excav. $0.235, 10,449 cu.yd. surfacing $0.45, 265,715 sta.yd. surfacing overhaul $0.01, 89 cu.yd. Class A concrete $15, 89 cu.yd. Class B $14 and 206 cu.yd. Class C $14, 831 cu.yd. gravel base $1.25, etc., total $25,423; Schedule 4, Sta. 2165-2628 plus 47, to S. E. Rogers, Snowflake, 3,276 cu.yd. excav. $0.28, 33,362 cu.yd. borrow $0.16, 762 cu.yd. excav. $0.75 and 416 cu.yd. excav. $0.15, 11,070 cu.yd. surfacing $0.43, 791,423 sta.yd. surfacing overhaul $0.009, 730 cu.yd. gravel base $1.50, 6 cu.yd. Class A concrete $22, 120 cu.yd. Class B $15 and 182 cu.yd. Class C $13, etc., total $27,914.

Wash., Aberdeen—Concrete paving G and H Sts., to Haukeli, Hegg & Co., Aberdeen, $28,427. Engrs. est. $27,000.

Cal., Glendale—Grading, oiling, cement curbs and walks, Maple and Oak Sts. et al., to P. L. Ferry, 614 East Peach St., $36,250.

Cal., National City—Grading and concrete paving various streets, to Fairchild-Gilmore-Wilton Co., Los Angeles Ry. Bldg. Los Angeles, $27,500. Noted June 22.

Cal., San Diego—Bd. Supervs. San Diego Co., concrete paving Mission Rd. from Camp Kearney easterly, to H. H. Peterson, 3044 Goldsmith St., $96,084. County will furnish cement and crushed rock. Noted June 15.

Cal., Stockton—Improving North Center, North Eldorado, Arcade and Noble Sts., etc., to C. Moreing, Commercial & Savings Bldg., 12,048 cu.yd. cut, $0.60 per cu.yd.; 4,634 cu.yd. fill, $0.40; 20,476 ft. curb and gutter, $0.9 [illegible] ft. 4 in. walks, $0.20, 272,249 ft. 2 in. asphalt macadam on 4 in. gravel, $0.135; total $85,382.

Ont., Cobourg—Paving [illegible] sq.yd. King St., bithulithic on 6 in. concrete, to Warren Bituminous Paving Co., 54 University Ave., Toronto, $118,000. Noted June 1.

Ont., Mimico—Paving 12,000 sq.yd. concrete, to E. G. Heffernan, Stop 17, Lake Shore Rd., $[illegible].

Ont., Niagara Falls—H. H. Beam, engineer, is not receiving and opening bids until [illegible] for pavement on Victoria Ave., from Ferry St. to Main St., Hooker Terrace and Falls Ave., $35,000 [illegible] May 25.

Ont., St. Catharines—W. P. Shaw, city engineer, [illegible] to Newman Bros., Ltd., Toronto, $45,[illegible].

Ont., Toronto—Paving Tyne, ridge pike on [illegible] St., from G. Thompson & Sons, St.; 3 streets, to Ruscica Bros., 256 Ontario St.; 2 streets, to W. E. Taylor, 22 Falcon St. Total $40,000.

Ont., Walkerton—Paving Station Rd., asphaltic concrete, to Warren Bituminous Paving Co., 54 University Ave., Toronto, Engrs. est. $65,000. Noted June 1.

Ont., Wingham—Concrete pavements on Josephine St. and Diagonal Rd., to W. C. Brennan Contg. Co., Melrose Ave., Hamilton. Engrs. est. $40,000. Noted June 1.

Industrial Works

PROPOSED WORK

Me., Pejepscot—Pejepscot Paper Co., Brunswick, plans extension to plant, here. $1,000,000. Architect not selected.

Vt., Rutland—Rutland Sash & Door Co. plans 2 story, brick and timber mill. $50,-000. Private plans.

R. I., Providence—W. P. Hamblin, Inc., c/o J. W. Foster, archt., 46 Narragansett St., having plans prepared 1 story, 65 x 200 ft. brick and concrete garage and service shop. $40,000.

Conn., Manchester—Orford Soap Co., Hillard St., soon takes bids 2 and 3 story, 73 x 150 ft. brick and concrete addition to plant, Hillard St. $60,000. Private plans.

N. Y., Batavia—C. Mancuso & Son, 322 Ellicott St., plans 2 story, 81 x 100 ft., brick and terra cotta garage and sales-room, East Main St. $40,000. Architect not announced.

N. J., Gloucester City—A. W. Grant, Harrison Bldg., Phila., soon takes bids 1 and 2 story, 100 x 500 ft. factory, here. $500,000. A. W. Akinoff, Harrison Bldg., Phila., engr.

Pa., Butler—Riock McJunkin Dairy Co., Forbes St., Pittsburgh, having plans prepared by A. Daniels, archt., c/o owner, remodeling 2 and 3 story ice cream plant and dairy, South McKean and Wayne Sts. $50,000.

Pa., Cambridge Springs—Blystone Mfg. Co., Cambridge Springs, plans 2 story, 40 x 96 ft. and 1 story, 90 x 400 ft. concrete and tile factory, to replace one recently destroyed by fire. Private plans.

Va., Newmarket—E. T. Brown, president and organizer private company, plans power plant, 125 hp., for development on Pits Springs Run River. Engineer not announced.

Va., Radford—Having plans prepared and will soon vote on $115,000 bonds for power and light plant. W. E. Gilbert, mayor.

La., New Orleans—Eng. Dept. of Bd. Port Comrs., 1 Canal St., preparing plans for sacking plant on site adjoining grain elevator. $162,000.

O., Cleveland—Blodgett-Beckley Co., 615 Huron Rd., having plans prepared by Hadlow & Hick, archts., Finance Bldg., 2 story, brick, steel and concrete. Central Ave., near East 14th St. $50,000.

O., Cleveland—Crucible Steel Castings Co., Canal Rd., having plans prepared by G. S. Rider & Co., archts. and engrs., Century Bldg., 1 story, brick and steel foundry, Almira and West 98th St. $100,000.

O., Cleveland—Kronheim Furniture Mfg. Co., 2043 East 55th St., having plans prepared by Steffens & Steffens, archts., 1029 Williamson Bldg., 4 story, 56 x 130 ft., brick and steel factory and warehouse. $75,000.

O., Cleveland—M. Sokol, 10019 Parkgate Ave., had plans prepared 1 story, 42 x 120 ft., brick and steel garage, 2526 Cedar Ave. $40,000. Private plans.

O., Painesville—See "Buildings."

Wis., West Bend—West Bend Aluminum Co. having plans prepared by Federal Eng. Co., engrs., 444 Milwaukee St., Milwaukee, 1 story, 20 x 80 ft., brick and steel boiler house, [illegible] $12,000.

Tex., Refugio—[illegible] Co., Wm. Inc. Natl. Bank of Commerce Bldg., San Antonio, [illegible] bottle factory, here, capacity 50,000 bottles per day. $75,000. W. M. Stephenson, Pres. Private plans.

Okla., Ardmore—Ardmore Petroleum Co., 211 [illegible] Bldg., Tulsa, plans [illegible] 144 x 144 ft. machinery, rein.-con. $75,000. Private plans.

[illegible]—North Sydney [illegible] owner. Private plans.

Industrial Works (Continued)

Ont., Toronto—Toronto Wet Wash Laundry Co., 11 Dundas St. W., having plans prepared by Harkness, Loudon & Hertzberg, archts., Confederation Life Bldg., 2 story, 40 x 60 ft. rein.-con., brick and steel laundry, Dundas St. $65,000.

BIDS DESIRED

Conn., South Manchester—F. T. Blish Hardware Co., Main St., taking bids 2 story, 42 x 165 ft. brick and timber warehouse, rear Main St. $40,000. B. A. Sellew, 721 Main St., Hartford, archts. and engrs.

Fla., Erie—Union Storage Co., 819 Commerce Bldg., and J. F. Wadsworth, engr., Commerce Bldg., taking bids 3 story, 78 x 100 ft. storage plant, rein.-con.

Fla., Gainesville—July 3, by Bd. Pub. Wks., enlarging and improving light and water plant. G. H. Cairns, city mgr.

Fla., Homestead—July 28, by S. E. Livingston, mayor and Town Council, constructing electric light plant. R. E. Edwards, clk.; adv. this issue.

O., Cleveland—July 5, by W. S. Ferguson Co., archts., 1900 Euclid Ave., 3 story, 140 x 148 ft., brick, steel and concrete service station, plain foundation, East 25th St. near Payne Ave., for Studebaker Corp., 2020 Euclid Ave. $250,000. E. J. Murane, sales dir.

O., Cleveland—July 5, by W. S. Ferguson Co., archts., 1900 Euclid Ave., 3 story, 140 x 148 ft., brick, steel and concrete service station, plain foundation, East 25th St. near Payne Ave., for Studebaker Corp., 2020 Euclid Ave. $250,000. E. J. Murane, sales dir.

O., Cleveland—F. B. Strawn, 43 The Arcade, taking bids 1 story, 70 x 88 ft., brick and steel garage, 12510 Penobscot Ave. $40,000. E. E. Smith, Williamson Bldg., archt.

O., Cleveland—C. W. Fessenden, 411 Woodland Ave., taking bids 1 story, 50 x 141 ft., brick and steel garage and commercial building, East 116th St. and Buckeye Rd., to A. A. Lane Constr. Co., 1869 East 55th St. $50,000.

O., Cleveland—P. Matzinger & Co., archts., Caxton Bldg., taking bids 3 story, 52 x 70 ft., brick and steel garage and commercial building, plain foundation, Chester Ave. and East 20th St., for A. Kohn & Sons Investment Co., 2380 Canal Rd. $75,000. Noted Dec. 15.

O., Cleveland—E. Schimmelman, 412 Engineers Bldg., taking bids 1 story, 49 x 50 ft. and 54 x 84 ft. brick and steel garage and store building, plain foundation, East 152nd St. and St. Clair Ave. $50,000. Private plans.

Ind., Michigan City—Sullivan Mchy. Co., 122 South Michigan Ave. and A. S. Coffin, archt., 39 West Adams St., taking bids 2 story, 400 x 550 ft. and 2 story 60 x 400 ft. brick and steel factories. $1,000,000.

Mich., Detroit—A. Kahn, archt., 1000 Marquette Bldg., taking bids 2 story, 40 x 106 ft. rein.-con. and brick factory, plain foundation, Rose and 16th Sts., for Burr-Patterson Co., 4211 Woodward Ave. $40,000.

Mich., Plymouth—See "Buildings."

Ill., Chicago—W. F. Bleck & Co., 1846 North Lamon Ave., receiving bids 1 and 2 story, 180 x 200 ft., rein.-con., brick and steel factory, Lamon Ave. near Bloomingdale Ave. $200,000. H. H. Green, 304 South Wabash Ave., archt. Noted June 15.

Ill., Chicago—M. M. Fishbaum, archt., 118 North La Salle St., receiving bids 3 story, 133 x 166 ft., rein.-con., brick and steel factory, Irving Park Blvd., and Hermitage Ave., for Natures Rival Co., 306 South Franklin St. $180,000.

BIDS RECEIVED

Minn., Minneapolis—J. A. Ridgway, secy. Bd. Park Comrs., opened bids June 19, 3 story, 43 x 144 ft. brick and tile shops and warehouse, from Madsen Constr. Co., 848 Builders Exch. Bldg., $41,450; F. N. Hegg, 2942 Nicollet Ave., $43,389. J. C. Nelson & Son, 915 Bway. N. E., $45,200.

CONTRACTS AWARDED

Vt., Brattleboro — Presby-Leland Co. Barre, cutting sheds, machine shop, office and other storage sheds, all 1 story, to A. B. Lane, 38 Highland Ave., Barre. Archts. est., $100,000. Noted May 25.

Mass., Boston—Peterboro Realty Trust Co., 18 Tremont St., 2 story, 75 x 170 ft. brick and rein.-con. garage, Kilmarnock Rd., to Snider & Druker, 18 Tremont St. Archts. est. $70,000.

Mass., Lawrence—Amer. Woolen Co., 245 State St., Boston, 6 story, 100 x 500 ft. rein.-con. and brick addition at Washington Mills, here, to Turner Constr. Co., 178 Tremont St., Boston. Archts. est. $500,000. Noted March 9.

Mass., Lynn—Ravin & Gorden, Lynn, 1 story, 79 x 201 ft. brick and concrete factory, Pleasant St., to N. Hurwitz, 294 Washington St., Boston. Archts. est. $50,000.

Mass., South Boston (Boston P. O.)—H. Norman, 20 Lawrence Ave., Boston, will build 3 story, 50 x 167 ft. brick and timber factory, A St., by day labor, $75,000. Dow, Harlow & Kimball, 101 Tremont St., Boston, archts.

R. I., Pawtucket—Perry & Whipple, archts. and engrs., Rhode Island Hospital Trust Bldg., Providence, 6 story, 85 x 190 ft. brick and timber addition to plant, plain foundation, here, to C. S. Cunningham & Sons Constr. Co., 80 Boylston St., Boston, Mass., for Hope Webbing Co., 1005 Main St. Archts. est. $200,000. Noted June 15.

Conn., Danbury—Tweedy Silk Mills, Inc., East Franklin St., 1 story, 60 x 120 ft. brick and steel weave shed, 1 story, 40 x 60 ft. brick power house, 1 story dye house, and 2 story office, to L. F. Sweeney, 26 Montgomery St. Archts. est. $40,000 to $50,000.

Conn., Hartford—Buck & Sheldon, Inc., archts. and engrs., 60 Prospect St., 1 story, 100 x 104 ft. brick and timber plant, Franklin Ave. and Bolton St., to Hartlett-Brainerd Co., 252 Asylum St., for R. S. Peck & Co., 26 High St. Archts. est. $40,000. Noted June 22.

Conn., Thompsonville—Bigelow-Hartford Carpet Co., Tariff St., 111 x 227 ft. jacquard mill, 113 x 145 ft. worsted mill and 82 x 142 ft. dyehouse addition, all 1 story, brick and steel, plain foundations, to L. E. Locke & Sons Co., South Union St., Lawrence. $1,000,000.

N. Y., Buffalo—Knowlton Warehouse Co., 93 Perry St., 5 story, 100 x 150 ft. warehouse, Perry and Mississippi Sts., to Turner Constr. Co., 244 Madison Ave., New York. Noted June 22.

N. Y., New York—North Dock Realty Co., Inc., c/o J. J. Dunnigan, archt. and engr., 394 East 150th St., 1 story, 100 x 500 ft. garage, West 49th St., by day labor.

N. Y., New York—See "Buildings."

N. J., Mt. Holly — Folsom & Stanton, archts., 10 South La Salle St., Phila., 1 story, 40 x 100 ft., brick and steel garage, plain foundation, here, to McCloskey & Co., 1620 Thompson St., Phila., for W. D. Marren, Mt. Holly. Archts est. $50,000. Noted June 8.

Pa., Chambersburg—A. C. Wood, engr., Stock Exch. Bldg., Phila., 1 story, 80 x 90 ft. brick and steel power house, plain foundation, to Hofer & Shields, Chambersburg. Noted May 4.

Pa., Greenville—Greenville Steel Car Co., Fort Union St., will build 73 x 390 ft. steel and concrete factory and foundry, by day labor. $200,000. F. A. Conner, genl. mgr.

Pa., Phila.—See "Buildings."

Pa., Phila.—P. Hosebach, 2415 South St., 2 story, 64 x 76 ft. brick and steel factory, plain foundation, 12th and Brown Sts., to J. N. Gill, Otis Bldg.

Pa., Phila.—T. B. Martindale, Broad and Allegheny Aves., 2 story, 100 x 265 ft. brick and steel service and sales building, plain foundation, Broad and Allegheny Aves., to Bowden Constr. Co., 1935 Chestnut St. Archts. " $105,000.

Pa., Phila.—Phila. Electric Co., 100 Chestnut St., 1 story, 62 x 70 ft. brick and steel substation, plain foundation, 56th and Race Sts., to F. M. Harris Co., 1520 Parrish St.

Pa., Phila.—Phila. Electric Co., 1000 Chestnut St., 2 story, 66 x 114 ft. brick and steel substation plain foundation, 6th and Federal Sts., to Irwin & Leighton, 126 North 12th St., $60,000. Noted June 15.

Md., Hagerstown—Pennsylvania R.R., Broad St. Sta., Phila., Pa., roundhouse and terminal facilities, here, to W. W. Boxley, Roanoke, Va. Engrs. est. $250,000.

W. Va., Bluefield—B. L. Bailey, 4 story, 83 x 121 ft., rein.-con., brick and steel garage, to W. T. Bowen, Earle Ave. About $40,000. Cost plus percentage basis.

W. Va., Fairmont—Dattile Fruit Co., 3 and 7 story, 68 x 70 ft., warehouse, to Valley Eng. Co., Fairmont. Engrs. est. $40,000. Noted May 4.

W. Va., Huntington—Consolidated Light, Heat & Power Co., will build 2 story, 28 x 64 ft. rein.-con., brick and steel sub-station, 2nd Ave., by day labor. Private plans.

W. Va., Wheeling—Trimble & Leitz, 112 19th St., constructing 2 story rein.-con., brick and steel addition, at 112 19th St., to J. Butts, 191 16th St. Archts. est. $40,000.

N. C., Gastonia—Loray Mills, controlled by Jenckes Spinning Co., 335 Barton St., Pawtucket, R. I., spinning mill, here, to Aberthaw Constr. Co., Forsyth Bldg., Atlanta, Ga. $200,000.

N. C., Spindale—Spinners Processing Co., constructing 2 story, 137 x 234 ft., brick mill, to Potter & Shackelford, Inc., Greenville, S. C., $80,000.

O., Cleveland—Representative Constr. Co., Hanna Bldg., will build 1 story, 58 x 160 ft., brick and steel garage and workshop, 4008 East 89th St., by day labor. $50,000. Private plans.

O., Cleveland—G. H. Thorne, 2104 East 22nd St., 1 story, 36 x 86 ft., garage and sales room, brick and timber, plain foundation, to C. Vivian & Son, 2533 Scovill Ave. Archts. est. $40,000.

Ill., Chicago—Shea-Smith & Co. 322 Federal St., 4 story, 86 x 150 ft., printing plant, rein.-con., brick and steel, West Congress St. and Ashland Ave., to J. W. Snyder & Co., 122 South Michigan Ave. $250,000.

Wis., Kenosha—G. L. Rose, Pub. Serv. Bldg., 1 story, 66 x 126 ft., garage, steel and corrugated iron, plain foundation, Sheridan Rd., to Esslen Sheet Metal Wks., 1001 30th St., Milwaukee. Engrs. est. $40,000.

Wis., Manitowoc—A. M. Ritcher Sons Co., South 8th and Madison Sts., 1 and 2 story, 110 x 122 ft. vinegar factory, brick, rein.-con. and steel, plain foundation, to L. Pentzlie, Savings Bank Bldg., $40,000. Noted March 30.

Wis., Milwaukee—Sixth St. Garage Co., c/o M. Tullgren & Sons, archts., 425 East Water St., 5 story, 100 x 150 ft., brick and concrete, garage, plain foundation 6th St. and Grand Ave., to S. M. Siesel, 105 Wells St., Engrs. est. $200,000. Noted June 8.

Minn., Minneapolis—Fulton Bag and Cotton Mills, 642 Security Bldg., 4 story, rein.-con. and brick factory and office, East Hennepin Ave. and Taft St., to H. N. Leighton Co., 127 South 10th St., $230,000. Noted March 30.

Kan., Atchison—Pillsbury Flour Mills Co., Metropolitan Life Bldg., Minneapolis, Minn., additional unit to flour mill, 72 x 148 ft., rein.-con., incl. elevator, transformer house, offices, etc., to Fegles Constr. Co., 7th St. and 1st Ave. N., Minneapolis, Minn., $225,000.

Ariz., Morenci—Stargo Mines, Inc. will build cyanide mill, rein.-con., by day labor. $75,000. General Eng. Co., 159 Pierpont Ave., Salt Lake City, Utah, engrs.

Cal., Merced—Merced Irrigation Dist. will build 1 story, hollow tile and steel, garage and machine shop, by day labor. Former bids rejected. I. W. Hoover, Planada, archt. Noted June 1.

Cal., San Leandro — Supervs. Alameda Co., Oakland, constructing 1 story power and 1 story laundry, tile, on County Infirmary Site, here, to M. E. Hopper & Sons, 1117 Webster St., Oakland, $122,545. Noted May 4.

Ont., Stamford—Canadian Carborundum Co., Montrose, 2 story, 50 x 100 ft. concrete, brick and steel factory addition, to Robertson Constr. Co., Stamford.

Buildings

PROPOSED WORK

Mass., Dorchester (Boston P. O.) — Schools—City Schoolhouse Dept., 1009 City Hall, Boston, plans 20 room, Mather Dist., $450,000; 16 room, Blue Hill Ave., $320,000; both brick. Architect not selected.

Mass., New Bedford—Parish House and Auditorium—St. James Church, 223 County St., plans 3 story, brick and concrete parish house and auditorium, County and Wash Sts. $150,000. Architect not selected.

Conn., Hartford—School—School Bd. plans 2 story, brick and steel addition to Chauncy Harris Grammar School. $150,000. Whiton & McMahon, 36 Pearl St., archts.

N. Y., Brooklyn — Theatre and Store — Times Plaza Theatre, c/o D. Lucas, archt. and engr., 98-3rd Ave., soon takes bids 2 story, brick, steel and stone, plain foundation, Dean St. $250,000.

N. Y., New York—Hotel—United Hotels Co., 25 West 45th St., having preliminary plans prepared by G. B. Post & Sons, archts. and engrs., 101 Park Ave., 15 story, brick, steel and stone, plain foundation, 45th and 46th Sts., Madison and Vanderbilt Aves. $8,000,000.

N. Y., New York—School—St. Francis De Sales, c/o F. J. Murphy, archt. and engr., 405 Lexington Ave., soon takes bids 4 story, brick, steel and stone, plain foundation, 116 East 97th St. $150,000.

N. Y., New York — Synagogue — Hebrew Tabernacle Assn., c/o Sommerfield & Steckler, archts. and engrs., 31 Union Sq., soon takes bids 1 story, 75 x 90 ft., brick, steel and stone, plain foundation, 505 West 161st St. $150,000.

N. Y., New York—Y. M. C. A., 2 West 45th St., having plans prepared by J. F. Jackson, archt. and engr., 137 East 45th St., 20 story, 75 x 100 ft., brick, steel and stone, plain foundation, 333 West 56th St. $1,200,000.

N. J., Maplewood—High School—South Orange Bd. Educ., South Orange, plans brick, steel and stone, plain foundation, Academy St. and Parker Ave., here. $500,000.

Pa., Phila.—Church and Parsonage—Roman Catholic Church of Incarnation, c/o M. J. Brady, pastor, 5th and Lindley Aves., plans 2 story, 60 x 160 ft. church and 3

Buildings (Continued)

story, 40 x 50 ft. parsonage, brick and stone, 5th and Lindley Aves. $300,000. F. F. Durang, 1220 Locust St., archt.

Pa., Phila.—Office—Mastbaum Bros. and Fleitcher, 1424 South Penn Sq., soon takes bids 10 story office, Broad and Pine Sts. $1,000,000. Hoffman-Henon Co., Finance Bldg., archts. Noted Feb. 23.

Pa., Pittsburgh—Sales, etc.—Mueller Bros., 5101 Baum Blvd., plans 80 x 60 ft. sales and service building, Baum Blvd. and Woodworth St. Architect not selected.

Pa., Pittsburgh—Temple—Syria Improvement Assn., Syria Temple, having preliminary sketches made by R. G. Schmid, archt., 154 West Randolph St., Chicago, brick and steel addition, Bigelow Blvd., near 5th Ave. $150,000.

Pa., Unlontown—Store—Randolph Desk Co., c/o R. L. Randolph, 1859 Prospect St., Cleveland, O., having sketches made by H. W. Altman, archt., Fayette Title & Trust Bldg., 3 story, brick. $200,000.

W. Va., Charleston—Store and Lodge—Scottish Rite Masons (Colored), c/o J. C. Norman, archt., K. of P. Bldg., plans 4 or 5 story, 90 x 94 ft., brick, steel and terra cotta. Bradford and Washington Sts. $152,000.

O., Cleveland—Children's Hospital and Administration—City plans 2 and 3 story, brick, steel and concrete, Warrensville Farm. $162,000. R. D. Perkins, welfare dir. Architect not selected.

O., Cleveland—Commercial and Market—Miles Ave. Market House, c/o Coney-Degraw Co., 1900 Euclid Ave., having plans prepared by De Lorenzo Constr. Co., archts., Guardian Bldg., 1 story, 100 x 150 ft., brick and steel, Miles Ave. near East 113th St. $150,000.

O., Cleveland—Temple—Tifereth Israel Congregation, c/o H. Silver, rabbi, East 55th St. and Scovill Ave., had plans prepared by C. R. Greco, archt., Guardian Bldg., 2 story, brick, steel, concrete and stone, plain foundation, East 105th St. and Ansel Rd. $350,000.

O., Dayton—Store—Schwind Realty Co., Schwind Bldg., having plans prepared by Schenck & Williams, archts., Mutual Home Bldg., 4 story, 80 x 100 ft., rein.-con. and brick, North Main St. $200,000.

O., Painesville—Dormitory, etc.—Lake Erie College for Women having plans prepared by A. Garfield, archt., 913 Natl. City Bldg., Cleveland, 2 story, brick, steel and concrete dormitory and heating plant. $500,000.

O., Zanesville—Schools—Bd. Educ. having plans prepared by F. L. Packard, archt., New Hayden Bldg., Columbus, two 2 story, brick and concrete. $175,000 each.

Ind., Beardsley—School—Bd. Educ. plans 2 story, brick. $150,000. A. H. Elwood & Sons, Elkhart, archts.

Ill., Chicago—Apartment—E. E. Heil, archt., 123 West Madison St., soon receives bids 4 story, 200 x 200 ft., rein.-con., brick and steel, near South Shore Dr. and 75th St., for W. E. Gehring, c/o architect. $500,000.

Ill., Chicago—Apartment—Harris & Jillson, archts., 190 North State St., soon receive bids first unit 14 story apartment. $1,000,000.

Ill., Chicago—Apartment—Marshall & Fox, archts., 721 North Michigan Blvd., preparing plans and receive bids in a month, for 10 story, 130 x 140 ft., rein.-con., brick and steel, 20-28 East Cedar St., for Cedar Building Corp., c/o architects. $2,000,000.

Ill., Chicago—Apartment—J. K. Sp[illegible], c/o Essanay Film Mfg. Co., 1333 Argyle St., plans five 14 story apartments [illegible] Shore between Argyle and Alt[illegible]. $5,000,000.

Ill., Chicago—Apartment—A. V. T[illegible], archt., 1804 Ford, Kedzie Ave. preparing plans and soon receive bids for 3 story, 180 ft., rein.-con., brick and steel, on North Kedzie Ave. $250,000. Owner's name withheld.

Ill., Chicago—Hotel—N. M. [illegible], archts., 310 South Wabash Ave., preparing plans 6 story addition to Hayes Hotel, University Ave. and 64th St. $1,000,000.

Ill., Chicago—Store etc.—Whitney & Williams, archts., 122 South Michigan Ave., receiving bids and soon take bids on 3 stores, cafe and dance hall, rein.-con. and steel, Howard St. and Marshfield Ave. $2,000,000. Owner's name withheld.

Ill., Evanston—Apartment—C. [illegible], c/o H. J. Luellberg, archt., 134 West Randolph St., Chicago, having plans prepared 3 story, 160 x 171 ft., rein.-con. and steel at 732 Hinman Ave. $200,000.

Wis., Clinton—High School—Bd. [illegible] plans 2 and 3 story, 75 x 165 ft., rein.-con. and steel, plain foundation. $150,000. Architect not selected.

Wis., De Pere—Grade School—Bd. Educ. plans 3 story, 75 x 150 ft., brick, rein.-con. and steel. $150,000. Architect not selected.

Wis., Kenosha—Hotel—M. Tullgren & Sons, archts., 425 East Water St., Milwaukee, and L. Hunt, associated archt., 445 Milwaukee St., Milwaukee, take bids about July 8, for Hotel Maywood, 5 story, 66 x 126 ft., brick, steel and concrete, plain foundation, at 274 Main St., here, for S. Schwartz, 888 Sheridan Rd., Waukegan, Ill. $150,000.

Wis., Milwaukee—Apartment—Harris & Jillson, archts., 190 North State St., Chicago, soon takes bids 3 story, 125 x 135 ft., rein.-con., brick and steel. $225,000. Owner's name withheld.

Wis., Milwaukee—Bank—Amer. Exch. Bank, Plankinton Arcade, had plans prepared by Kirchoff & Rose, archts., 221 Grand Ave., 4 story, 70 x 102 ft., brick, steel and concrete, plain foundation, Grand Ave. and 2nd St. $500,000. Noted Jan. 12.

Utah, Salt Lake City—Office and Bank—Continental Natl. Bank, 21 East 2nd St., and Natl. Bank of the Republic, Main St., plan 20 story. G. W. Kelham, Sharon Bldg., San Francisco, archt.

Cal., Alhambra—Schools—Bd. Educ. having plans prepared by Allison & Allison, archts., 1405 Hibernian Bldg., Los Angeles, for grammar school, $125,000 bonds voted; by Hunt & Burns, archts., 701 Laughlin Bldg., Los Angeles, for high school, $350,000 bonds voted.

Cal., Fresno—Lodge—Knights of Pythias had plans prepared by Swartz & Ryland, archts., Rowell Bldg., 4 story, Van Ness Ave. $175,000. Noted June 22.

Cal., Los Angeles—Hospital—St. Vincents Hospital having plans prepared by J. C. Austin, archt., Baker-Detwiler Bldg., 8 story, 60 x 200 ft. hospital and 3 story, 50 x 100 ft. dormitory, rein.-con., brick and steel, concrete foundation, Sunset Blvd. $450,000.

Cal., Los Angeles—Schools—Voted $7,360,000 bonds for new high schools; $10,040,000 bonds for elementary schools. Address Bd. Educ.

Cal., San Bernardino—Hotel—C. B. Phillips, having plans prepared by H. E. Jones, archt., Katz Bldg., 5 story, steel and brick, E St. $208,000.

Que., St. Anne de Beaupré—Church and Monastery—Reverend Fathers Redemptionist, plan to rebuild church and monastery recently destroyed by fire, Main St. $3,500,000. Architect not selected.

BIDS DESIRED

N. Y., Buffalo—School—July 6, by Bd. Educ., 1401 Telephone Bldg., 2 story, 130 x 201 ft., rein.-con., brick and steel, Skillen St. $250,000. Associated Buffalo Architects, 232 Delaware Ave., archts.

N. Y., New York—Bank and Office—July 6, by L. A. Abramson, archt. and engr., 46 West 46th St., 5 story, 50 x 85 ft., brick, steel and stone, plain foundation, 1765 Madison Ave., for Bank of United States, 5th Ave. and 32nd St. $250,000. Noted June 8.

N. Y., New York—School—July 5, by Bd. Educ., 500 Park Ave., P. S. 130, 2nd portion, brick, steel and stone, plain foundation, Hester and Baxter Sts. $300,000. C. B. J. Snyder, Concord St., Brooklyn, archt. and engr. Noted April 2.

N. Y., New York—School—July 5, by Bd. Educ., 500 Park Ave., P. S. 57, brick, steel and stone, plain foundation, 114th St. near 3rd Ave. $250,000. C. B. J. Snyder, Concord St., Brooklyn, archt. and engr.

N. Y., Syracuse—Hotel—July 17, by G. B. Post & Sons, archts. and engrs., 101 Park Ave., New York, 11 story, brick, steel and stone, plain foundation, Harrison and Warren Sts., here, for Syracuse Hotel Corp., Burney Bldg. $2,500,000. Noted Nov. 24.

N. Y., Penn Yan—Hospital—W. N. Wise, chn. building com. of Sailors & Soldiers Memorial Hospital, taking bids 3 story, 39 x 105 ft., brick and concrete. To exceed $[illegible]. F. C. Pierce & Co., 2 Park St., Boston, archt. Noted March 30.

N. J., Newark—Bank—July 10 by Guilbert & Betelle, 41 Park Row, 4 Lombardi St., brick and stone, plain foundation, for North Ward Bank. $[illegible].

Pa., Phila.—Office and School—Carson & Carson, archts., 22 South 15th St., taking bids [illegible] for rein.-con. and brick, plain foundation, Iron and Walnut Sts., for Westinghouse Electric Co., Weldner Bldg.

Pa., Phila.—School—July 6, by Bd. Educ., 2 story, 74 x 144 ft., brick, steel and stone, plain foundation, Somerset and Almond Sts. $[illegible].

Pa., Pittsburgh—Bank—Logan Trust Co., Penn Exchange Bldg., build 2 story, 50 x 150 ft., at Ellsworth Ave., here. $250,000.

Work will be done by separate contract. P. R. L. Hogner, c/o Aluminum Co. of America, New Kensington, archt. Noted May 18.

Pa., Tyrone—Bank and Office—G. S. Idell, archt., 1705 Chestnut St., Phila., taking bids 5 story, 60 x 100 ft. rein.-con. and steel, plain foundation, for Farmers Natl. Bank. $200,000.

N. C., Charlotte—Store—July 3, by Efird Department Store, 208 Fayetteville St., 6 story, 99 x 188 ft. $500,000. L. Asbury, Charlotte, archt.

N. C., Hookerton—High Schools—July 15, by Bd. Educ. Greene Co., Snow Hill, constructing high school here and high school at Waltonsburg. $200,000. G. L. Preacher & Co., Healy Bldg., Atlanta, Ga., and Raleigh, archts.

Tenn., Nashville—Office—June 30, by McKim, Mead & White, archts. and engrs., 101 Park Ave., New York, brick, stone and steel, plain foundation, here, for Caldwell & Co., 214 Union St. $1,000,000.

O., Cleveland—Clubhouse—Slovenian Natl. Home, c/o F. Somrak, 5800 Prosser Ave., taking bids 2 story, 175 x 178 ft., brick, steel and concrete, plain foundation, St. Clair Ave. and East 65th St. $200,000.

O., Dayton—High School—July 13, by Bd. Educ., Roosevelt High School, 3 story, rein.-con., and brick, concrete pile foundation. $250,000. Schenck & Williams, Mutual Home Bldg., archts.

Ind., South Bend—Bank and Office—Amer. Trust Co. taking bids 4 story, 90 x 125 ft. rein.-con., brick and steel. $250,000, K. M. Vitzthum & Co., 21 East Van Buren St., archts.

Mich., East Lansing—College—July 5, by H. H. Halladay, secy. Michigan Agricultural College, 3 story, rein.-con., brick and steel addition, campus. $250,000. E. A. Boyd, 127 West Allegan St., Lansing, archt.

Mich., Houghton—High School—July 15, by School Dist. 1, 3 story, concrete, brick and tile, plain foundation. $400,000. Van Leyen, Schilling, Keough & Reynolds, 3440 Cass Ave., Detroit, archts.

Mich., Plymouth—Penal Institution—July 10, by J. D. Stutzman, supt. Detroit House of Correction, 1441 Alfred St., Detroit. 3 story, 76 x 420 ft. administration building, 3 story, 32 x 328 ft. cell block, 1 and 2 story, 408 x 840 ft. industrial building, and 105 x 130 ft. prison power house, all rein.-con. brick and steel, plain foundation. $2,500,000. A. Kahn, 1000 Marquette Bldg., Detroit, archt.

Wis., Ashland—Bank—July 11, by Ashland Natl. Bank and Kelly & Shefchik, archts., Masonic Bldg., 1 story, brick, concrete and stone, plain foundation. $150,000.

Wis., Janesville—Theatre—July 10, by M. Tullgren & Sons, archts., 425 East Water St., Milwaukee, 1 story, 60 x 198 ft. and 15 x 70 ft., brick and concrete, plain foundation, West Milwaukee St., for D. Jeffris Theatre Co., 14 West Milwaukee St. $150,000.

Wis., Madison—Arcade Store—[illegible]. M. Homer, archt., 1 East Main St., taking bids 2 story, 88 x 101 ft., brick, rein.-con. and steel, plain foundation, Mifflin St., for Madison Realty Co., 1 East Main St. $150,000. Noted June 8.

Wis., Milwaukee—Synagogue—H. H. Bruns, archt., 845 26th St., taking bids 70 x 105 ft., brick, tile and concrete, plain foundation, 10th and Lee Sts., for Beth Israel Congregation, c/o S. Michel, 1803 Grand Ave., chn. building com. $150,000.

Wis., Schofield—School—July 10, by Bd. Educ., 2 story, 70 x 95 ft., high and grade school, brick, rein.-con. and tile, plain foundation. $150,000. Oppenhamer & Obel, Spencer Bldg., Green Bay, archts.

N. D., Fargo—School—July 17, by Bd. Educ., 2 story, rein.-con., brick, tile and stone, 16th St. and 3rd Ave. $15,000. Keith & Kurke, Equity Bldg., archts. Noted May 18.

Wash., Wenatchee—County Comrs. Chelan Co. taking bids 4 story, 80 x 140 ft., rein.-con. [illegible]. V. S. Shannon, Symons Bldg., Spokane, archt.

Cal., Gilroy—Schools—Gilroy Grammar School Dist., voting $[illegible] bond issue, [illegible] school Dist. 17, 6 and 14 room school, both 1 story, [illegible] respectively. Wythe & Wyatt, Crocker Bank Bldg., San Jose, archts.

BIDS RECEIVED

N. Y., New York—Dock Sheds—Amerty Rd. opened bids June 22, constructing drill [illegible] Pier, 11 and 14 and [illegible] Post & [illegible] 5th Ave. [illegible] Pier, 11 Park Ave., $[illegible]; [illegible] Pier, 11 Park Ave., $[illegible]; [illegible] Vanderbilt Ave., $[illegible]. Noted June 15.

Buildings (Continued)

N. Y., New York –School—Bd. Educ., 500 Park Ave., opened bids June 19, P. S. 80, East 120th St. near 1st Ave., from T. A. Clarke Co., 122 Livingston St., Brooklyn, $487,300; Concord Constr. Co., 476 Seneca Ave., Brooklyn, $491,000; P. J. Brennan & Son, 624 Madison Ave., $498,200. Noted June 15.

Minn., St. Paul -High School—Dept. Educ. opened bids June 9, 3 story, 150 x 250 ft. school with 2 story, 48 x 90 ft wing, rein.-con., brick and tile, Isabel and Congress Sts., from Gauger-Korsmo Constr. Co., 301 Endicott Bldg. $368,944; F. C. Norlander, 408 Metropolitan Bank Bldg., $373,485; W. J. Hoy Co., Metropolitan Opera House Bldg., $390,134.

Wis., Stevens Point –High School—School Bd. opened bids June 23, 2 story, brick, concrete and tile, plain foundation, from Immel Constr. Co., 200 North Main St., Fond du Lac, $124,483; Finor Bros., 50 State St., Oshkosh, $127,500, Otrich-Shropshire Co., Stevens Point, $132,473. Noted June 15.

CONTRACTS AWARDED

Mass., Brockton –School—St. Patricks Parish, 3 story, 50 x 125 ft. brick and steel with 45 x 50 ft. ell, Bartlett St., to J. B. Dolan, 43 Tremont St., Boston, $150,000.

Mass., Dalton—Community and Auditorium—Crane Memorial Com., 2 story, brick and steel, plain foundation, to D. H. Pike, Renne Ave., Pittsfield. Archts. est. $150,000. Noted Oct. 14.

Conn., Greenwich—Business—B. Harris Constr. Co., 288 Atlantic St., will build 4 story, 50 x 160 ft. brick, stone and steel, Greenwich Ave., by day labor. $150,000. Private plans.

Conn., New Haven—Apartment—F. Von Beren, 185 Church St., 6 story, 55 x 120 ft. brick, stone, terra cotta and steel, plain foundation, Chapel St., to Natl. Constr. Co., Malley Bldg. Archts. est. $200,000.

N. Y., Batavia—High School—Bd. Educ., 3 story, 144 x 200 ft., brick and steel, Ross St., to Laur & Mack Contg. Co., Highland and College Aves., Niagara Falls, $385,420. Noted May 25.

N. Y., Brooklyn—Apartment—S. and M. Diamond, c/o E. M. Adelsohn, archt. and engr., 1778 Pitkin Ave., 4 story, 50 x 110 ft., brick, steel and stone, plain foundation, Benson and 20th Aves., by day labor. $150,000.

N. Y., Brooklyn—Office—S. Ageloff, 26 Court St., will build 2 story, 110 x 200 ft., brick, steel and stone, plain foundation, De Kalb Ave. and Flatbush Ave. extension, by day labor. Archts. est. $300,000. M. Klein, 37 Graham Ave., archt. and engr.

N. Y., Buffalo—Bank, Store and Office—E. B. Green & Sons, archts., 75 Niagara St., constructing Genesee Bldg., 14 story, Main and Genesee Sts., to Turner Constr. Co., 244 Madison Ave., New York.

N. Y., New York — Apartment — Daar Hartman Constr. Co., c/o I. L. Crausman, archt. and engr., 2035 Southern Blvd., 5 story, brick, steel and stone, plain foundation, Grand Ave., by day labor. $200,000.

N. Y., New York—Bank—C. W. Brazer, archt. and engr., 1133 Bway, brick, steel and stone, plain foundation, Bowery, to W. L. Crow Constr. Co., 103 Park Ave., for Citizens Savings Bank, 38 Bowery. Archts. est. $400,000. Noted June 1.

N. Y., New York—Court House—Bd. Estimate and Apportionment, Municipal Bldg., superstructure of court house within area bounded by Centre, Worth, Baxter and Pearl Sts., to G. A. Fuller Co., 175 5th Ave., $4,139,000. Noted June 15.

N. Y., New York—Office, etc.—Lockwood, Green & Co., archts. and engrs., 101 Park Ave., 7 story, office and printing plant, brick, steel and concrete, plain foundation, 219 West 40th St., to J. Stewart & Co., 30 Church St., for New York Tribune, Inc., 154 Nassau St. Archts. est. $500,000. Noted June 1.

N. Y., New York—School—St. Josephs Roman Catholic Church, 1949 Bathgate Ave., 4 story, brick, steel and stone, plain foundation, Bathgate Ave., to Fountain & Choate, 110 East 23rd St. Archts. est. $150,000. Noted April 20.

Pa., McKees Rocks — School — St. Marys Roman Catholic Congregation, 2 story, 87 x 149 ft. brick and steel, Church and Guthrie Sts., to J. A. Bergman & Son, 414 Dinwiddie St., Pittsburg. Engrs. est. $150,000.

Pa., Phila. — Armory and Recreation — Girard College, Girard Ave. and Corinthian St., 2 story, 145 x 308 ft. brick and steel, plain foundation, Girard Ave. and Corinthian St., to Irwin & Leighton, 126 North 12th St. Archts. est. $500,000. Noted June 1.

Pa. Phila. — Convent — H. D. Dagit & Sons, archts., 34 South 17th St., 3 story, 35 x 120 ft. brick, steel and stone, plain foundation, 24th and Lehigh Aves., to Mitchell-Houseworth Co., 2512 North 27th St., for St. Columbas Catholic Church, 24th and Lehigh Aves Archts. est. $150,000. Noted Feb. 9.

Pa., Phila.—Sales, etc.—Traylor Eng. Co., Broad and Lehigh Aves., 8 story, 125 x 205 ft. rein.-con. and brick, plain foundation, Broad and Lehigh Aves., to W. Steele & Sons, 16th and Arch Sts.

Pa., Warminster—School—Christ Home for Children, 2 story, 45 x 100 ft. brick and stone, to A. Betcher, Hatsboro.

N. C., Gastonia—Bank—Third Natl. Bank, 7 story, 52 x 110 ft., steel, granite and brick, to J. A. Jones Constr. Co., Realty Bldg., Charlotte, $290,000. Noted April 6.

N. C., Lexington—Theatre—Lexington Theatre Co., constructing theatre, 1,500 seating capacity, including 3 stores, 18 offices and large arcade, Main St., to Harbin Constr. Co., Lexington, $128,880.

N. C., Thomasville—High School—School Bd., constructing 2 story, general contract to C. V. York, Citizens Bank Bldg., Raleigh, $152,500. Noted June 1.

N. C., Winston-Salem—Auditorium—Constructing auditorium to North Eastern Constr. Co., Charlotte, $350,000. Noted March 16.

La., New Orleans — Medical — W. L. Stevens, archt., Bordeaux Apts., 8 story, rein.-con., brick and terra cotta, Prytania and Aline Sts., to Doullut & Williams, Whitney Bldg., $400,000.

O., Cleveland — School — Holy Family Church, East 131st St. and Chapelside Ave., superstructure of 2 story, 110 x 164 ft., brick, steel and concrete, to W. J. Pierek, 7016 Euclid Ave. Archts. est. $200,000.

O., Columbus—Hospital—Bd. Trustees Children's Hospital, 4 story, 147½ x 154 ft., brick, concrete and terra cotta, Stone and 17th Sts., to D. W. McGrath & Sons, 255 East Broad St., $325,000.

O., Columbus—High Schools—Bd. Educ., Ilgh and Town Sts., general contract Washington Gladden High School, 3 story, 200 x 400 ft., along Scioto River, and Edward Orten High School, 2 story, 278 x 327 ft., Arcadia Ave., both brick, stone and concrete, to R. H. Evans & Co., Perris Bldg., $849,430 and $663,900 respectively. Noted June 22.

O., East Cleveland (Cleveland, P. O.)—Commercial—Office and Apartment—Eucor Co., c/o F. Jones, 820 Guardian Bldg., Cleveland, 2 story, 200 x 200 ft., brick steel and concrete, Euclid and Superior Aves., here to H. H. Walker Co., 16005 Hazel Rd., Cleveland. Archts. est. $250,000. Noted June 1.

O., Lodi—High and Grade School—Bd. Educ., 2 story, 75 x 143 ft., brick, steel and concrete, plain foundation, to Hearn Constr. Co., 4501 Euclid Ave., Cleveland. Archts. est. $150,000.

O., Martins Ferry—High School—Bd. Educ. general contract 2 story, 90 x 100 ft., brick and steel, to Parish Bros., 217 Wick Ave., Youngstown, $150,650; heating and ventilating, to W. J. School Co., Youngstown, $36,954. Noted Dec. 8.

O., Wickliffe—School—Bd. Educ., 2 story, brick, steel and concrete addition, to F. W. Mark Constr. Co., Leader-News Bldg., Cleveland, $95,900. Noted June 22.

O., Wooster—High School—Bd. Educ., 2 story, 62 x 168 ft., brick and steel addition, plain foundation, to Long & Bogner, Wooster. Noted June 22.

Mich., Ann Arbor—Laboratory, etc.—Bd. Regents of Michigan University, 4 story, 189 x 248 ft. laboratory and engineering shops, rein.-con., brick and steel, plain foundation, here, to H. G. Christman & Co., 315 Stevens Bldg., Detroit. $700,000. Noted April 13.

Mich., Detroit—Office—C. H. Crane, archt., 542 Griswold St., 10 story, rein.-con., brick and steel, plain foundation, Woodward Ave., to A. W. Kutsche, 535 Griswold St. $400,000. Noted April 20.

Mich., Detroit—Office—S. S. Kresge Co., Kresge Bldg., 6 story, 60 x 60 ft. rein.-con., brick and steel, plain foundation, Grand River Ave., to Martin & Krausman Co., 1101 Vinton Bldg. $175,000. Noted April 20.

Wis., Manitowoc—High School—School Bd. brick, concrete and tile, plain foundation, to T. Stark & Co., 130 Muskego Ave., Milwaukee. $410,700. Tower and additional terrazzo work added to original bid. Noted June 22.

Ia., Davenport—Library—Bd. Library Trustees, altering and building addition, brick and tile, to J. Soller & Son, 337 Masonic Temple Bldg., $145,417. Noted May 25.

Ia., Des Moines—Office—Liberty Building Co., 12 story, steel, rein.-con., brick and Bedford stone, 6th and Grand Aves., to J. A. Benson Constr. Co., 422 Valley Natl. Bank Bldg., $1,000,000.

Minn., Minneapolis—Church and School—First Baptist Church, c/o W. B. Riley, 10th St. and Harmon Pl., 3 story, 112 x 147 ft. rein.-con., brick, stone and tile, 11th St. and Harmon Pl., to J. and W. A. Elliott Co., 906 Lumber Exchange Bldg., $180,000. Noted April 6.

Minn., Minneapolis—Library—State Bd. of Control, St. Paul, 6 story, 400 x 400 ft. rein.-con., brick and tile, State University Campus, here, to C. Skooglum, 502 Ryan Bldg., St. Paul. $926,856. Noted June 15.

Wash., Seattle—Church—Fourth Church of Christ Scientists, completing 5 story, 120 x 120 ft. concrete, steel and terra cotta, 8th and Seneca Sts., to N. McDonald, 339 Henry Bldg. Archts. est. $150,000.

Cal., San Francisco—Market—W. Houghtaling, constructing 1 story, brick and concrete, 8th and Market Sts., to G. Wagner, 251 Kearny St. $300,000. Cost plus percentage basis. Noted May 18.

Ont., Hamilton—Store, etc.—L. R. Steele & Co., Ltd., Royal Bank Bldg., converting 3 story building into store and cafeteria, concrete, brick and steel, general contract to W. H. Cooper, Clyde Bldg., $120,000; electrical work, to Salibury Electrical Co., 112 King St. W., Toronto. Total est. $150,000.

Ont., Preston—Sanitarium—Watt & Blackwell, archts., Bank of Toronto Bldg., London, 2 story, 40 x 370 ft. concrete, tile and stucco, to C. Braun, 295 King St. W., Kitchener, for Preston Sanitarium Co. Archts. est. $225,000. Noted June 8.

Federal Government Works

PROPOSED WORK

Cal., Livermore—Hospital—U. S. Veterans' Bureau, Room 1044, Arlington Bldg., Wash., D. C., having plans prepared by M. O'Brien, archt., 68 Post St., San Francisco, 30 rein.-con. and frame hospital buildings, on Cresta Blanca, 5 mi. from here. Noted June 8.

BIDS DESIDED

Mass., Lowell—Alterations—July 14 by Treas. Dept., Wash., D. C., alterations to U. S. Post Office, here. J. A. Wetmore, acting superv. archt.

Mass., Northampton—Foundations—July 3, at Office Director U. S. Veterans Bureau, Room 1044 Arlington Bldg., Wash., D. C., concrete foundations for 9 patient buildings, here; adv. this issue.

N. Y., Oswego—Cornice, etc.—July 19, Treas. Dept., Wash., D. C., restoring cornice, replacing roof construction, etc., on U. S. Post Office, here. J. A. Wetmore, acting superv. archt.; adv. this issue.

Ala., Tuskegee — Fire Alarm System — July 18 by Treas. Dept., Wash., D. C., for fire alarm system at U. S. Veterans Hospital, here. J. A. Wetmore, acting superv. archt.

Wis., Sheboygan –Mailing Shed—July 20, by Treas. Dept., Wash., D. C., new mailing shed at U. S. Post Office, here. J. A. Wetmore, acting superv. archt.; adv. this issue.

Minn., Albert Lea—Extension to Workroom, etc.—July 12 by Treas. Dept., Wash., D. C., for extension to workroom, here, new mailing vestibule, changes in Post Office screen, wire mesh partitions, etc, J. A. Wetmore, acting superv. archt.

Cal., Presidio (San Francisco P. O.)—Pump House, etc.—J. W. Roberts, Post Office Bldg., San Francisco, receiving bids for pump house, pump equipment and fire protection system, at Marine Hospital, here, for Treas. Dept., Wash., D. C.

Cal., San Francisco—Equipment—July 5, at U. S. Engineer Office, 240 Montgomery St., 2 sets evaporator equipment for dredges Sacramento and San Joaquin, to supply feed water for boilers and portable water for domestic use.

BIDS RECEIVED

Mass., Nantucket—Radio Compass House —Spec. 4638—Bureau Yards & Docks, Navy Dept., Wash., D. C., radio compass house. Naval Radio Station at Surfside, here, from W. F. Martens, 112 Cutler Bldg., Rochester, N. Y., $4,480; H. L. Gibbs, 5 Milk St., $5,500 (40 days); G. E. Ward, 417 East 24th St., New York, $5,176 (60 days). Noted June 22.

Pa., Phila.—Dredging—U. S. Engineer, 815 Witherspoon Bldg., 1321 Walnut St., dredging in Delaware River at Ft. Mifflin, 48,400 cu.yd. scow measurement, exclusive of allowable overdepth, and 6,200 cu.yd., maximum allowable overdepth, from Amer. Dredging Co., 510 Mariner & Merchant Bldg., $0.34 per cu.yd.; Delaware Dredging Co., 316 Insurance Exch. Bldg., $0.274. Noted June 15.

Va., Yorktown—Alternators, etc.—Spec. 4612—Bureau Yards & Docks, Navy Dept., Wash., D. C., alternators and auxiliary equipment at Navy Mine Depot, here, (1) work complete, from Westinghouse Electric Mfg. Co., 803 Hibbs Bldg., Wash., D. C., $9,500 (150 days); Electro-Mechanical Co.,

Federal Government (Continued)

South Calvert St., Baltimore, Md., $10,147, (2) $9,230; Carroll Electric Co., 714 12th St., Wash., D. C., $11,250 (150 days). Noted June 8.

Va., Yorktown—Remodeling, etc.—Spec. 4627—Bureau Yards & Docks, Navy Dept., Wash., D. C., remodeling and installing Diesel oil engines, here, (1) work complete from Amer. Eng. Co., Aramingo and Cumberland Sts., Phila., Pa., (1) $10,750 (150 days); Newport News Iron Wks., Newport News, (1) $11,200 (150 days), (2) $1,300; Shevlin Eng. Co., 110 West 34th St., New York, (1) $12,560 (150 days), (2) $1,305.

North Carolina—Repairs, etc.—Spec. 4661—Bureau Yards & Docks, Navy Dept., Wash., D. C., repairs and improvements to Naval Radio Compass Stations, at Foymers Hill, Cape Lookout and Cape Hatteras, also at Hog Island, Va., (1) work complete, from H. M. Lucas, 115 Maple St., Portsmouth, Va., (1) $5,787 (60 days) (2) $2,405 (3) $844 (4) $1,788 (5) $750; L. H. Harlan, 203 East Main St. Charlottesville, Va., (1) $14,642 (60 days) (2) $5,436 (3) $2,450 (4) $4,898 (5) $1,858.

Mont., Great Falls—Canals, etc.—U. S. Recl. Serv., Sun River Project, 118,000 cu. yd. canal excav., 21,000 cu.yd. excav. for structures, 1,850 cu.yd. rein.-con., 2,500 lin. ft. vitr. and concrete pipe, etc., from F. Coolidge, Laramie, Wyo., $66,539. Noted April 27.

CONTRACTS AWARDED

Mass., Hingman—Repairing Roof—Spec. 4680—Bureau Yards & Docks, Navy Dept., Wash., D. C., repairing roofs here, to Johns-Mansville, Inc., 55 High St., Boston, $55,784.

N. Y., Brooklyn—Repaving—Spec. 4675—Bureau Yards & Docks, Navy Dept., Wash., D. C., furnishing labor to repave Pier D, here, to Tide Water Roofing Co., Inc., 40 Sullivan St., New York, $3,842 (30 days). Noted June 15.

N. Y., New York—Steel Docks, etc.—Spec. 4677—Bureau Yards & Docks, Navy Dept., Wash., D. C., steel docks and closing panel Building 29, here, to C. Meads & Co., 217 West 14th St., $5,616. (60 days).

Pa., Phila.—Operating Device—Spec. 4674—Bureau Yards & Docks, Navy Dept., Wash., D. C., motor driven sash operating devices at Navy Yard, here, to David Lupton Sons Co., Inc., Allegheny and Tulip Sts., $6,422 (45 days). Noted June 15.

Pa., Phila.—Steam Line, etc.—Spec. 4668—Bureau Yards & Docks, Navy Dept., Wash., D. C., steam piping and concrete trench Navy Yard, here, to N. Chamelin, 1404 North 18th St., $39,030 (120 days). Noted June 15.

Pa., Phila.—Underpinning Storehouse—Spec. 4676—Bureau Yards & Docks, Navy Dept., Wash., D. C., underpinning aircraft storehouse, Naval Aircraft Factory, League Island, here, to Triest Contg. Corp., 126 East 59th St., New York, $227,270, (270 days). Noted June 1

Md., Annapolis—Seawall—Spec. 4621—Bureau Yards & Docks, Navy Dept., Wash., D. C., seawall at Naval Academy, here, to McLean Contg. Co., Fidelity Bldg., Baltimore, $14,350 (120 days). Noted June 22.

D. C., Wash.—Fuel Oil Tanks—Spec. 4646—Bureau Yards & Docks, Navy Dept., Wash., D. C., oil tanks and [illegible] Potomac and Cristobal tanks [illegible] at Coco Solo to W. B. Kyle, 848 Call Bldg., San Francisco, Cal., $129,000 (160 days). Noted June 8.

D. C., Wash.—Roofing—Spec. [illegible] Bureau Yards & Docks, Navy Dept., Wash., D. C., roofing Magnet Barracks at Navy Yard, here, to G. E. Wright, Inc., 1454 Monadnock Bldg., Chicago, $22,700 (120 days). Noted June 8.

Va., Norfolk—Steam Main—Spec. [illegible] Bureau Yards & Docks, Navy Dept., Wash., D. C., steam piping [illegible] Navy Yard, here, to J. W. Danforth, 72 Ellicott St., Buffalo, N. Y., $10,948 (120 days). Noted June 8.

Va., Quantico—Pavement—Spec. [illegible] Bureau Yards & Docks, Navy Dept., Wash., D. C., concrete pavement at Marine Barracks, here, to [illegible] Co., Inc., 25 Church St., New York, $43,[illegible] (120 days). Noted June 8.

N. C., North Island—Radio Compass Station—Spec. [illegible] Bureau Yards & Docks, Navy Dept., Wash., D. C., radio compass station, Naval Air Station, North Island, San Diego, Cal., to [illegible] Co., 1611 Pennsylvania Bldg., Philadelphia, Pa., $[illegible] (120 days). Noted June 8.

Fla., Pensacola—[illegible] Bureau Yards & Docks, Navy Dept., Wash., D. C., [illegible] Navy Yard, here, to Warren Bros. Co., 50 Church St., Cambridge, Mass., $[illegible] (120 days). Noted June 8.

Cal., Mare Island—Power House Extension—Spec. 4664—Bureau Yards & Docks, Navy Dept., Wash., D. C., extension to power house here, to J. Pringle, 621 Georgia St., Vallejo, $8,800 (120 days). Noted June 15.

Miscellaneous

PROPOSED WORK

Retaining Wall and Fill—Springfield, Mass.—New York, New Haven & Hartford R.R., South Sta., Boston, plans rein.-con. retaining wall and solid fill, near and along the new Connecticut River Bridge. H. L. Ripley, c/o owner, engr.

Transmission Line, etc.—Newstead, N. Y.—Genesee Light & Power Co., Batavia, plans extension of service into Newstead, street lighting in Pembroke, and general improvement to sub-station at Attica. $53,700. Engineer not announced.

Tractor—Salamanca, N. Y.—City plans to purchase large tractor. To exceed $1,000.

Retaining Walls—Pittsburgh, Pa.—City, c/o C. H. Finley, dir. Pub. Wks., plans 300 ft. concrete retaining wall in 2 sections. $26,000.

Transmission Line—Nashville, N. C.—Plans 9 mi. transmission line from Rocky Mount to here. Mees & Mees, Charlotte, engrs.

Park and Playground, etc.—Dover, O.—Plans $30,000 bond issue for park and playground, to include dancing pavilion, boat house, bath house and 3,000 seat baseball grounds, etc.

Hydro-Electric Development—Ely, Minn.—Minnesota Utilities Co., Eveleth, plans hydro-electric development, 12,000 h.p., 5 miles east of here. Work includes electrical transmission system, concrete and steel dam, large power house on shores of Falls Lake, etc. $1,750,000. R. M. Hesketh, Eveleth, secy. and mgr.

Gas Line—Mill Valley, Cal.—Pacific Gas & Electric Co., 445 Sutter St., San Francisco, had surveys made constructing high pressure gas transmission line from here to Sausalito. $192,000. Private plans.

Electric Light and Distribution System—St. John, N. B.—Plans electric light and distribution system, cost between $850,000 and $900,000. H. Phillips, c/o New Brunswick Contg. Co., St. John, engr. in charge.

BIDS DESIRED

Turbines, etc.—Cohoes, N. Y.—July 10, by C. L. Cadle, supt. Pub. Wks., Albany, furnishing and delivering 2 hydraulic turbines with governor equipment and extra parts also 2 water wheel driven generators and other electrical equipment in proposed power house at Crescent Dam, here, Contrs. A-1 and A-2; adv. this issue.

Park—Elmira, N. Y.—Cashmere Grotto No. 11, M.O.V.P.E.R., Masonic Temple, taking bids constructing new Park first unit to include 125 x 170 ft. wood and steel building, $40,000. H. M. Haskell, Hett Bldg., Elmira, archt. Noted June 8.

Concrete Mixer—Jamestown, N. Y.—Bd. Estimate & Review taking bids large concrete mixer, $5,800. L. Bergman, city engr.

Bituminous Road Surfacing Material—New York, N. Y.—July 6, by W. J. Flynn, acting pres. Bronx Boro, furnishing and delivering 35,000 gal. bituminous road surfacing material (for hot use).

Timber, etc.—Pecksville, N. Y.—July 7, by State Bd. Armory Comrs., 158 State St., Albany, furnishing timber, sheathing, flooring, exterior facing lumber, etc., for stable, State Camp of Instruction, near here. F. W. Wood, [illegible] Bldg., Syracuse, archt.

Ornamental Lights—Long Branch, N. J.—July 5, installing ornamental lights on Liberty St., Union, 2nd and Rockwell Aves., from Bway to Union Ave. F. C. Quinn, city clk.; adv. this issue.

Cranes—Pittsburgh, Pa.—[illegible]

Cranes—Pittsburgh, Pa.—[illegible]

Engine Generator Unit—Belhaven, N. C.—[illegible]

Oil Engine Generator, etc.—Sarasota, Fla.—[illegible] clk.

Concrete Vitrified Brick or Asphalt Block—Tallahassee, Fla.—[illegible] Tallahassee, engr.

Hydro-Electric Development — Dotham, Ala.—Aug. 15, by E. O. Jones, mayor and City Council, constructing hydro-electric project. Ludlow Engrs. Inc., Winston-Salem, engrs.; adv. this issue.

Steam and Water Piping—Starkville, Miss.—July 8, by State Bond Impvt. Comm., Jackson, furnishing and installing complete system of steam and water piping in power house at A. & M. College, here. Link & Truebblood, 1520 Chemical Bldg., St. Louis, Mo., archts. C. Link, Jackson, supervising archt.

Dump Truck, etc.—Akron, O.—July 3, by B. J. Hill, city purch. agt., one 5 ton dump truck and 1 car of pig lead.

Subway—Michigan—July 6, by State Hy. Dept., Lansing, subway under Michigan Central tracks and grading 0.396 road, incl. 1,406 cu.yd. rein.-con., 20,600 lb. reinforcing steel, 15,442 cu.yd. excav., etc., Jackson Co.

Electric Traveling Crane—Milwaukee, Wis.—July 7, by J. H. Fowles, secy. Sewerage Comn., 508 Market St., 20 ton electric traveling crane.

Wharf—Grosse Ile, Que.—July 6, by Dept. Pub. Wks., Ottawa, addition to eastern wharf at Grosse Ile Quarantine Sta. $26,000. K. M. Cameron, c/o Dept. Pub. Wks., Ottawa, engr.

Conduits — Montreal, Que. — Electrical Comn. receiving bids for placing conduits in streets west of Bleury St. to line of Beaver Hall Hill and east of St. Lawrence St. to Berri St. $250,000.

Barge—Quebec, Que.—July 5, by Dept. Marine & Fisheries, Ottawa, one steel single screw Hopper Barge, 210 ft. long, 35 ft. wide, 950 cu.yd. capacity, 1,250 hp.

Cinder Carrying System—London, Ont.—Taking bids system for carrying cinders from incinerator across river about 1,000 ft. H. A. Brazier, city engr.

BIDS RECEIVED

Foundation—Detroit, Mich.—Art Comn., 704 East Jefferson Ave., opened bids for foundation, incl. grading, excav., underground drainage, and water system for art institution, from A. J. McLean Co., 300 Holden Bldg., $104,85[illegible]; Thompson-Starrett Co., 333 State St., $105,000; A. W. Kutche Co., 535 Griswold St., $109,874.

Tunnel — San Francisco, Cal. — Bd. Pub. Wks., constructing Pulgas Tunnel, Hetch Hetchy Project, Contr. 85, from Grant-Smith Co., Balboa Bldg., $683,050; Utah Const. Co., Phelan Bldg., $710,582; F. Rolandi, 550 Montgomery St., $744,850. Noted June 15.

CONTRACTS AWARDED

Inorganic Dust, etc.—New York, N. Y.—J. Miller, pres. Manhattan Boro, Municipal Bldg., furnishing and delivering 3,000 ton inorganic dust, to New York Trap Rock Co., 101 Park Ave., $[illegible] 1,000 cu.yd. paving grits to [illegible] Sand & Gravel Co., 152 West 42nd St., $1,800; 500,000 gal. refined asphalt, to Standard Oil Co. of New York, 26 Bway., $26,500. Noted June 15.

Subway—Erie, Pa.—City and Pennsylvania R.R., grading, draining and constructing city's portion of retaining walls, in connection with Cherry St. subway, to W. Bancroft, Jr., Erie. Engrs. est. $105,000. Noted June 8.

Power Lighting and Signal System—Norfolk, Va.—For power, lighting and signal system for grain elevator at Sewalls Point, to Electro Mechanical Co., 432 North Calvert St., Baltimore, Md. [illegible]

Mechanical Equipment—Goldsboro, N. C. [illegible]

Electric Distribution and Lighting System—Ada, Minn. [illegible] and [illegible] about $20,000. Engrs. est $25,000. Noted June 1.

Transmission Line—Andale, Kan.—For [illegible] to Chapin, Jr., 1806 East 29th St., Kansas [illegible]

Transmission Line and Distribution System—Lawrence, Neb. [illegible] to Hackett & Cooper, Bankers Life Bldg., Lincoln, $13,310. Noted June 15.

Electric Distribution System—Hillsboro, N. D. [illegible]

Gas Line—San Antonio, Tex. [illegible]

Swimming Baths, Ottawa, Ont. [illegible]

SEARCHLIGHT SECTION

OFFICIAL PROPOSALS

Copy: Official Proposals reaching our New York Office by 10 A. M., Tuesday can usually be printed in the issue out Thursday.

Rate:
40 Cents a Line an Insertion

Plans and Specifications for inspection by distant bidders may be filed at any of the Engineering News-Record offices without charge.

THESE ADVERTISEMENTS ARE OFFICIAL NOTICES THAT BIDS ARE WANTED FROM BIDDERS EVERYWHERE.

OFFICIAL PROPOSALS

Bids: July 25.

Piggery and Incinerating Plant

Buffalo, N. Y.

Sealed proposals will be received at the office of this department, Room 3, Municipal Building, until 11:00 o'clock July 25, 1922, for the following:

1st. For a tract of land not less than 200 nor more than 600 acres in area, adjoining a railroad and within fifteen miles of the Buffalo City Line, for the operation and maintenance of a piggery. Bidders must give a full description of the property, price per acre or terms for a lease for a period of years, subject to purchase by the city, and give to the city the right to purchase the same at the price mentioned in said bid, for a period of six months from the date of the opening of such bid.

2nd. For a tract of land not less than 10 acres, adjoining a railroad and not over fifteen miles from the Buffalo City Line, for the operation and maintenance of an incineration or reduction plant. Bidders must give a full description of the property, price per acre or terms for a lease for a period of years subject to purchase by the city, and give to the city the right to purchase the same, at the price mentioned in said bid, for a period of six months from the date of the opening of such bid.

3rd. For the necessary machinery and equipment for the incineration or reduction of all garbage collected by the City of Buffalo, which machinery and equipment must have a capacity of 200 tons per day. Bidders must submit detailed plans and specifications showing their method of incineration or reduction, including the cost of operation per ton, the commercial value of the residue, the names of cities where similar plants are being operated and a guaranty that no obnoxious gases or odors will be created through operation. No proposal will be considered unless it be accompanied by a certified check, payable to the order of the Department of Public Works, in an amount equal to ten per cent of the cost of said machinery and equipment, or a bond in conformity with law, which bond shall be fifty per cent of the sum named in the proposal.

4th. For the necessary machinery and equipment for the incineration or reduction of some of the garbage of the City of Buffalo, which said machinery and equipment must have a capacity of at least 50 tons per day. Bidders must submit detailed plans and specifications showing their method of incineration or reduction, including the cost of operation per ton, the commercial value of the residue, the names of cities where similar plants are being operated and a guaranty that no obnoxious gases or odors will be created through operation. No proposal will be considered unless it be accompanied by a certified check payable to the order of the Department of Public Works, in an amount equal to ten per cent of the cost of said machinery and equipment, or a bond in conformity with law, which bond shall be fifty per cent of the sum named in the proposal.

Any desired information in regard to the above can be had on application at the office of the Commissioner of Public Works, Room 3, Municipal Building, on and after this date.

This department reserves the right to reject any and all bids and waive any informalities.

The above bids are requested pursuant to action of the Council of the City of Buffalo taken on the 24th day of May, 1922, by resolution No. 27 of said date.

ARTHUR W. KREINHEDER,
Commissioner of Public Works.
June 19, 20, 26, 27. City of Buffalo.

OFFICIAL PROPOSALS

Bids: July 5.

Five Sections of State Highway

Baltimore, Md.

Sealed proposals for building five sections of State Highway, as follows:

CARROLL COUNTY—Contract CL-39—One section of State Highway from Eldersburg to Freedom, a distance of 2.0 miles—(Concrete).

FREDERICK COUNTY—Contract F-55—One section of State Highway through Emmitsburg, a distance of 0.53 miles—(Concrete).

HOWARD COUNTY—Contract HO-22—One section of State Highway through Ellicott City, a distance of 0.4 miles—(Concrete).

BALTIMORE COUNTY—Contract B-52—One section of State Highway from Jacksonsville to Sweet Air, a distance of 1.34 miles—(Concrete).

ST. MARYS AND CHARLES COUNTIES—Contract SM-17 and CH-24—One section of State Highway from New Market toward Dentsville, a distance of 4.0 miles—(Gravel).

will be received by the State Roads Commission at its offices, 601 Garrett Building, Baltimore, Maryland, until 12 m., Standard Time, on the 5th day of July, 1922, at which time and place they will be publicly opened and read.

Bids must be made upon the blank proposal form which, with specifications and plans, will be furnished by the Commission upon application and cash payment of $1.00, as hereafter no charges will be permitted.

No bids will be received unless accompanied by a certified check for the sum of five hundred ($500) dollars, payable to the State Roads Commission.

The successful bidder will be required to give bond, and comply with the Acts of the General Assembly of Maryland, respecting contracts.

The Commission reserves the right to reject any and all bids.

By order of the State Roads Commission this 15th day of June, 1922.

J. N. MACKALL, Chairman.
L. H. STANART, Secretary.

Bids: July 11.

Sluice-gates, Hydraulic Cylinders etc.

CONTRACT 208

New York City.

Sealed bids will be received by the Board of Water Supply, at its offices, twenty-second floor, Municipal Building, Park Row, Centre and Chambers Streets, New York City, until 11 a.m., Eastern Standard time, on Tuesday, July 11, 1922, for Contract 208, for furnishing and delivering sluice-gates, hydraulic cylinders, fittings and appurtenances for the intake shaft of the Shandaken tunnel, all as set forth in the specifications. All deliveries shall be made f.o.b. at the Grand Gorge station on the Ulster and Delaware railroad, Delaware County, New York.

At the above place and time the bids will be publicly opened and read. Pamphlets containing information for bidders, forms of bid and contract, specifications, contract drawings, etc., can be obtained at the office of the Secretary at the above address, by depositing the sum of ten dollars ($10) in cash or its equivalent for each pamphlet. For further particulars apply to the office of the Chief Engineer at the above address.

GEORGE J. GILLESPIE
President.
JAMES P. SINNOTT,
PHILIP F. DONOHUE,
Commissioners, Board of Water Supply.
BENJ. F. EINBIGLER, Secretary.

OFFICIAL PROPOSALS

Bids: July 7.

Highway Work Route 4—Section 17

Toms River, N. J.

NOTICE IS HEREBY GIVEN that sealed bids will be received by the County of Ocean for the following: Construction of State Highway, Route 4, Section 17, Main Street, Barnegat.

Estimate of reinforced cement concrete pavement is 12,921 sq.yd.

Work is to be performed under County Reimbursement Act, Chapter 183, Laws of 1918, and amended by Chapter 317, Laws of 1920.

Bids will be received at the Court House, at Toms River, N. J., on July 7th, 1922, at 11 a.m., Standard Time.

Drawings, specifications and form of contract and bond for the proposed work are on file in the office of J. M. Abbott, County Engineer, at Toms River, and in the office of the State Highway Department, Trenton, New Jersey, and may be inspected by prospective bidders. Plans will be furnished on deposit of ten ($10.00) dollars upon application to J. M. Abbott, County Engineer. Bids must be made on the standard proposal forms in the manner designated therein and as required by the specifications, enclosed in sealed envelopes, addressed to the Board of Chosen Freeholders of the County of Ocean and bearing the name and address of the bidder and the name and section of the route on the outside. Bid must be accompanied by a certified check drawn to the order of T. B. Crammer, County Treasurer, for not less than ten (10%) per cent of amount of the bid, provided that said certified check shall not be less than $500.00 nor more than $20,000.00, and be delivered at the above place on or before the hour named. Copies of the standard proposal form will be furnished on application to J. M. Abbott, County Engineer.

Each bidder must accompany his bid with a certificate from a surety company duly authorized to do business in this State, stating that such surety company will provide said bidder with a bond in such sum as is required in and in accordance with the provisions of said specifications, conditioned for the faithful performance of the provisions of the contract and specifications. Each bidder must also accompany his bid with a statement of equipment properly filled out.

By order of a resolution of the Board of Chosen Freeholders of the County of Ocean passed at a meeting held on June 8th, 1922.

D. O. PARKER, Clerk.

Bids: July 7.

Sewage Treatment Plant

Geneva, Ohio.

Sealed bids for the construction of a Sewage Treatment Plant will be received by the Village Clerk to 12 o'clock noon, on July 7, 1922.

Plans and specifications may be seen at the office of the Clerk or may be obtained from Burgess and Niple, Engineers, 223 East Broad St., Columbus, Ohio, on deposit of ten dollars, of which five dollars will be refunded on return of plans and specifications within ten days after letting. A bond or certified check in the sum of ten per cent of the amount of the bid shall accompany the proposal. The Village reserves the right to reject any and all bids, and to waive informalities.

The Village of Geneva, Ohio.
W. E. MORGAN, Clerk.

OFFICIAL PROPOSALS

Bids: July 11.

State Road Work

Charleston, W. Va.

Sealed proposals will be received by the State Road Commission of West Virginia at its office in Charleston, West Virginia, until 10 o'clock A.M. on the 11th day of July, 1922, and at that time and place publicly opened and read, for the repair of bridge and the construction of sections of state road, also for cleaning, furnishing and applying Tar Cold Surface Application on Sections of State Roads, cover coat chips to be furnished and applied by State.

PROJECTS

3066—Cabell County—Repair of Salt Rock Bridge No. 707.

3063—Wyoming County—Mullins-Elmore Road 4.8 miles grading, drainage structures and paving 718 feet with brick, balance with concrete or concrete base with Bituminous concrete, Warrenite or Rock Asphalt surface as alternates.

3156—Nicholas County—Main Street Summersville 0.5 mile grading, drainage structures and paving with Bituminous Macadam.

3019—Preston County—Kingwood-Terra Alta Road, 10 miles grading, drainage structures and paving with Bituminous Macadam.

3135-B—Kanawha County—Hughes Creek to Lock 2, 2.75 miles for grading and drainage structures.

34 and 60—Monroe County—4.3 miles cleaning and Tar Cold Surface application.

94 and 2006—Fayette County—11.1 miles cleaning and Tar Cold Surface application.

1 and 2003—Greenbrier County—7.9 miles cleaning and Tar Cold Surface application.

2039, 2040, 2042, 2043, 2044—Mercer County—22.1 miles cleaning and Tar Cold Surface Application.

72—Hampshire County—3.3 miles cleaning and Tar Cold Surface application.

62—Hardy County—7.7 miles cleaning and Tar Cold Surface application.

64—Jefferson County—3 miles cleaning and Tar Cold Surface application.

67—Berkeley County—7.3 miles cleaning and Tar Cold Surface application.

1131—Berkeley County—1 mile cleaning and Tar Cold Surface application.

2092—Mineral County—2 miles cleaning and Tar Cold Surface application.

(Note: Projects 72, 62, 64, 67, 1131 and 2092 will be covered by one contract.)

Proposals will be received only upon State Standard Forms in accordance with plans, specifications and estimates of quantities thereof, which plans, forms, plans, profiles and estimates may be secured from the office of the State Road Commission at Charleston, West Virginia, or at the office of the Division Engineer in charge of the construction work to be let.

Each proposal must be accompanied by certified check in the amount required for 5 per cent of the total amount of the proposal and not less than $500.00.

The right is reserved to reject any and all proposals.

STATE ROAD COMMISSION
H. E. CARSKADON, Secretary.

Bids: July 21.

Rebuilding Bridge Floor

Sealed proposals for rebuilding the floor of the steel viaduct of Valuable Bridge and wood block paving with brick on the other two approach spans of Logan County Court House, Logan, W. Va., will be received by the County Court of Logan County, W. Va., at the office of the Clerk of said Court, until 10 o'clock A.M. on the 21st day of July, 1922, and will be opened and read.

Each bid must be accompanied by certified check for 5 per cent of the amount of the proposal, payable to the order of the Board of County Commissioners of Logan County, West Virginia, as a guarantee that the bidder will enter into contract and give bond as required by law.

Plans and specifications may be seen at the office of the said Commissioner.

Bids: July 14.

Highway Route No. 16 Section No. 2

Somerville, N. J.

Notice is hereby given that sealed bids will be received by the County of Somerset for the following: The construction of State Highway Route No. 16, Section No. 2, from Mine Mount Road to Bedminster Corner, consisting of 38,419 square yards of "Surface Type C One Course Reinforced Cement Concrete Pavement," with drains and appurtenances.

Work is to be performed under County Reimbursement Act, Chapter 183, Laws of 1918 and amended by Chapter 317, Laws of 1920.

Bids will be received at the Court House at Somerville on Friday, July 14, 1922, at 11 A.M., Daylight Saving time (10 A.M., Eastern Standard time).

Drawings, specifications and form of contract and bond for the proposed work are on file in the office of H. C. Van Emburgh, County Engineer, at Somerville Court House and in the office of the State Highway Department, Trenton, New Jersey, and may be inspected by prospective bidders. Plans will be furnished on deposit of Ten Dollars ($10.00) upon application to H. C. Van Emburgh, County Engineer. Bids must be made on the standard proposal forms in the manner designated therein as required by the specifications, enclosed in sealed envelopes, addressed to the Board of Chosen Freeholders of the County of Somerset and bearing the name and address of the bidder and the name and section of the route on the outside. Bid must be accompanied by a certified check drawn to the order of Edwin Garretson, County Treasurer, for not less than ten per cent (10%) of amount of the bid, provided that said certified check shall not be less than Five Hundred Dollars ($500.00) nor more than Twenty Thousand Dollars ($20,000.00), and be delivered at the above place on or before the hour named. Copies of the standard proposal form will be furnished on application to H. C. Van Emburgh, County Engineer.

Each Bidder must accompany his bid with a certificate from a surety company duly authorized to do business in this State, stating that such surety company will provide said bidder with a bond in such sum as is required in and in accordance with the provisions of said specifications, conditioned for the faithful performance of the provisions of the contract and the specifications. Each bidder must also accompany his bid with a statement of equipment properly filled out.

By order of resolution of the Board of Chosen Freeholders of the County of Somerset passed at a meeting held on Tuesday, June 13, 1922.

WM. S. WOODRUFF, Clerk.

Bids: July 11.

Street Paving

Newton, N. J.

Sealed proposals will be received by the Town of Newton for the paving of High Street in the Town [illegible] with a reinforced concrete pavement. Estimated amount of surface pavement required is [illegible] square yards and need in [illegible] Newton, [illegible] 1922, at 12 o'clock noon, Standard Time.

Drawings, specifications and forms of [illegible] prepared by W. J. Hardin, Town Engineer. [illegible] mission have been filed in the office of the said Engineer at Newton, N. J., and of the [illegible] bidders during business hours. Bidders will [illegible] tion and blue prints of the drawings by the Engineer on proper notice and payment [illegible] the manner designated therein and required [illegible] bidder and name of the road [illegible] side. Addressed to the Town of [illegible]

[illegible]

[illegible]

[

OFFICIAL PROPOSALS

Bids: July 7.

Highway Work Route 4—Section 18

Toms River, N. J.

NOTICE IS HEREBY GIVEN that sealed bids will be received by the County of Ocean for the following: Construction of State Highway, Route 4, Section 18, in the Borough of Tuckerton.

Estimated amount of cement concrete pavement is 17,600 sq.yd.

Work is to be performed under County Reinmbursement Act, Chapter 183, Laws of 1918, and amended by Chapter 317, Laws of 1920.

Bids will be received at the Court House, at Toms River, N. J., on July 7th, 1922, at 11 a.m., Standard Time.

Drawings, specifications and form of contract and bond for the proposed work are on file in the office of J. M. Abbott, County Engineer, at Toms River, and in the office of the State Highway Department, Trenton, New Jersey, and may be inspected by prospective bidders. Plans will be furnished on deposit of ten ($10.00) dollars upon application to J. M. Abbott, County Engineer. Bids must be made on the standard proposal forms in the manner designated therein and as required by the specifications, enclosed in sealed envelopes, addressed to the Board of Chosen Freeholders of the County of Ocean and bearing the name and address of the bidder and the name and section of the route on the outside. Bid must be accompanied by a certified check drawn to the order of T. B. Crammer, County Treasurer, for not less than ten (10%) per cent of amount of the bid, provided that said certified check shall not be less than $500.00 nor more than $20,000.00, and be delivered at the above place on or before the hour named. Copies of the standard proposal form will be furnished on application to J. M. Abbott, County Engineer.

Each bidder must accompany his bid with a certificate from a surety company duly authorized to do business in this State, stating that such surety company will provide said bidder with a bond in such sum as is required in and in accordance with the provisions of said specifications, conditioned for the faithful performance of the provisions of the contract and specifications. Each bidder must also accompany his bid with a statement of equipment properly filled out.

By order of a resolution of the Board of Chosen Freeholders of the County of Ocean passed at a meeting held on June 8th, 1922. D. O. PARKER, Clerk.

Bids: July 11.

County Road Work

Newton, N. J.

Notice is hereby given that sealed bids will be received by the County of Sussex for the following work.

No. 1. Paving Fredon Newton Road. Estimated amount of surface pavement 7,800 sq.yd. reinforced concrete.

No. 2. Paving Branchville Dingmans Road. Estimated amount of surface pavement 10,983 sq.yd. reinforced concrete.

And opened and read in public at Freeholders Office, Newton, N. J., on July 11th, 1922, at ten-thirty (10:30) a.m., Standard Time.

"Drawings, specifications and forms of bid, contract and bond for the proposed work, prepared by Harvey Snook, County Engineer, and approved by the State Highway Commission, have been filed in the office of the said Engineer at Newton, N. J., and of said State Highway Commission, Trenton, N. J., and may be inspected by prospective bidders during business hours. Bidders will be furnished with a copy of the specifications and blue prints of the drawings by the Engineer on proper notice and payment of cost of preparation. Bids must be made on the standard proposal forms in the manner designated therein and required by the specifications, must be enclosed in sealed envelopes, bearing the name and address of bidder and name of road on the outside, addressed to The County of Sussex and must be accompanied by a Surety Company Certificate and a certified check for not less than ten (10) per cent of the amount bid, provided said check shall not be less than $500.00 nor more than $20,000.00 and be delivered at the place and on the hour above named. The Standard proposal form is attached to the specifications, copies of which will be furnished on application to Engineer. The right is reserved to reject any or all bids.

"By order of the County of Sussex."

(Signed) WILLIAM S. VOUGHT, Clerk.

OFFICIAL PROPOSALS

Bids: July 18.

Pier Sheds and Grain Conveyor Gallery

CONTRACT No. 10

Portland, Maine.

Sealed bids for the construction of the North and South Sheds and Grain Conveyor Gallery at and near the State Pier, Portland, Maine, will be received by the Directors of the Port of Portland and by the Grand Trunk Railway Company of Canada at the office of the Directors, 67 Commercial Street, Portland, Maine, until 1 p.m., Eastern Standard Time (2 p.m. Daylight Saving Time) on Tuesday, July 18, 1922, at which time and place the bids will be publicly opened and read aloud.

The pier sheds will have steel frames with wooden roofs and the North Shed will have a wooden floor on steel stringers. The Grain Conveyor Gallery will have steel frame and concrete floor. The siding of both sheds and the Grain Conveyor Gallery will be of asbestos protected metal.

Before the award of the contract any bidder may be required by the Directors to show that he has the necessary experience, ability, equipment and financial resources to perform the work within the time stipulated and in a manner satisfactory to the Engineer.

The bid must be accompanied by a properly certified check for the sum of twenty thousand ($20,000) dollars.

A bond in the sum of one hundred fifty thousand ($150,000) dollars of a surety company satisfactory to the Directors, will be required for the faithful performance of the contract.

A more complete description of the work to be done is given in the Notice to Bidders, the forms of Bid, Contract, Bond, the Specifications and the Contract Drawings.

Copies of the foregoing may be inspected at the office of the Directors of the Port of Portland, at Portland, and may be obtained from the Engineers, Fay, Spofford & Thorndike, Boston, Mass. The address of the Engineer up to and including June 30 is 15 Beacon Street, Boston 9, Mass., and on and after July 1, 200 Devonshire Street, Boston 9, Mass.

A charge of fifteen ($15) dollars will be made for a complete set of the Notice to Bidders, forms of Bid, Contract, Bond, the Specifications and the Contract Drawings.

Receipt of bids will be subject to the conditions stated in said Notice to Bidders.

The right is reserved to reject any or all bids.

HENRY F. MERRILL, President,
BERTRAND G. McINTIRE,
FRED W. RUNKER,
JAMES Q. GULNAC,
ALEXANDER T. LAUGHLIN,
Directors of the Port of Portland,
FAY, SPOFFORD & THORNDIKE,
Engineers.
June 17, 1922.

Bids: July 11.

Central Ferry Bridge

Olympia, Washington.

NOTICE IS HEREBY GIVEN that sealed bids will be received at the office of the Supervisor of Highways of the State of Washington at Olympia, Wash., until 10 o'clock a.m., July 11, 1922, and then publicly opened for the construction of a steel bridge with concrete substructure across the Snake River at Central Ferry, Washington. The bridge consists of one 263-ft. through truss, seven 169-ft. deck trusses and 185 linear feet of concrete approach. Approximate quantities are:

3,000 cu.yds. Foundation Excavation.
4,270 cu.yds. Concrete.
210,000 pounds Reinforcing Steel.
1,900,000 pounds Structural Steel.

Each bid must be accompanied by a certified check payable to the State Treasurer for five per cent of the amount of the bid. The right is reserved to reject any and all bids. If upon acceptance of the bid, the bidder fails and neglects within ten (10) days from date of notification of such acceptance to enter into a contract and furnish the necessary bond the certified check will be forfeited, cashed and the proceeds paid into the Public Highway Fund of the State Treasury. The check of all unsuccessful bidders will be returned after the contract is entered into and the bond given.

Plans and specifications may be obtained from the office of the Supervisor of Highways, Olympia, Washington.

JAMES ALLEN,
Supervisor of Highways,
Olympia, Washington.

OFFICIAL PROPOSALS

Bids: July 14.

Highway Route No. 9 Section 9a

Belvidere, N. J.

Notice is hereby given that sealed bids will be received by the County of Warren for the following: Construction of State Highway Route No. 9, Section No. 9a, Still Valley to Bloomsbury. Estimated amount of reinforced coment concrete pavement is 35,050 square yards.

Work is to be performed under County Reimbursement Act, Chapter 183, laws of 1918, and amended by Chapter 317, laws of 1920.

Bids will be received at the Court House at Belvidere, N. J., on FRIDAY, JULY 14, 1922, AT 1 O'CLOCK P.M., STANDARD TIME.

Drawings, specifications and form of contract and bond for the proposed work are on file in the office of Harry W. Vetter, County Engineer, at Belvidere, N. J., and in the office of the State Highway Department, Trenton, New Jersey, and may be inspected by prospective bidders. Plans will be furnished on deposit of ten dollars ($10.00) upon application to Harry W. Vetter, County Engineer. Bids must be made on the standard proposal forms in the manner designated therein and as required by the specifications, enclosed in sealed envelopes, addressed to the Board of Chosen Freeholders of the County of Warren and bearing the name and address of the bidder and the name and section of the route on the outside. Did must be accompanied by a certified check drawn to the order of H. O. Carhart, County Treasurer, for not less than ten per cent (10%) of amount of the bid, provided that said certified check shall not be less than $500.00 nor more than $20,000.00 and be delivered at the above place on or before the hour named. Copies of the standard proposal form will be furnished on application to Harry W. Vetter, County Engineer.

Each bidder must accompany his bid with a certificate from a surety company duly authorized to do business in this State, stating that such surety company will provide said bidder with a bond in such sum as is required in and in accordance with the provisions of said specifications, conditioned for the faithful performance of the provisions of the contract and specifications. Each bidder must also accompany his bid with a statement of equipment properly filled out.

By order of a resolution of the Board of Chosen Freeholders of the County of Warren passed at a meeting held on June 14, 1922.

MORRIS S. FAUST, Clerk.

Bids: July 8.

Bridge Construction

Salem, N. J.

Notice is hereby given that sealed bids will be received by the County of Salem for the construction of Bridge 57 M. F. O. O W on Route 6 State Highway System, over Fenwick Creek at Salem, N. J., to replace the old Covered Bridge, with two spans of 33 feet 8 inches each, wing walls, balustrades and asphalt block pavement.

The work includes erection and maintenance of a temporary bridge and the use of about 1,400 cubic yards of concrete. Engineer's estimate of cost about $60,000.00.

Bids will be received at the Court House, Salem, New Jersey, Saturday, July 8, 1922, at 10 a.m., Standard Time, and publicly opened and read immediately thereafter.

Plans, specifications and further information may be obtained from H. B. Keasbey, County Engineer, Salem, New Jersey, or the State Highway Department, Trenton, N. J.

Plans will be furnished on deposit of ten dollars ($10.00) upon application to Howard B. Keasbey, County Engineer, Salem, N. J.

ERVIN G. OCHS,
Clerk.

June 15, 1922.

Bids: July 17.

Agricultural Building

Urbana, Ill.

Sealed proposals for General Work on the New Agricultural Building to be erected for the University of Illinois, at Urbana, will be received at the office of James M. White, Supervising Architect, 256 Administration Building, Urbana, Ill., up to 3 p.m., Monday, July 17, 1922.

Plans and specifications may be obtained after June 20 from the office of the Supervising Architect upon deposit of Ten dollars ($10).

OFFICIAL PROPOSALS

Bids: July 6.

Drive Pipe

Memphis, Tenn.

Proposals will be received by the Memphis Artesian Water Department at its offices, 105-107 North Second Street, Memphis, Tennessee, until 12 o'clock noon Thursday, July 6, 1922, for furnishing f.o.b. Memphis, Tennessee:

5400 Lineal Feet 12 in. Drive Pipe with recessed couplings and thread protectors, approximate weight 51 lbs. per foot.

1150 Lineal Feet 18 in. outside diameter Drive Pipe with recessed couplings and thread protectors, approximate weight 81 lbs. per foot.

1500 Lineal Feet 8 in. Drive Pipe with recessed couplings and thread protectors, approximate weight 30 lbs. per foot.

1500 Lineal Feet 6 in. Drive Pipe recessed couplings and thread protectors, approximate weight 10 lbs. per foot.

25 12 in. Screw Couplings.

25 18 in. Screw Couplings.

Time of delivery, together with price, will be given due consideration in award of contract.

The Commissioners reserve the right to reject any or all bids. Address proposals to Board of Water Commissioners, Memphis Artesian Water Department, Memphis, Tennessee. Mark "Bid on Well Pipe."

W. H. HARRISON,
General Superintendent.

Bids: July 13.

Highway Work

Somerville, N. J.

Notice is hereby given that sealed bids will be received by the Borough of Somerville for the following: Construction of State Highway, Route No. 9, Section 0.7, Main Street, Somerville. Estimated amounts are as follows: Reinforced Cement Concrete Pavement, 12,933 sq.yd.; Armored Cement Concrete Curbing, 5,283 lin.ft. New Granite Block on a cement concrete foundation is 3,076 sq.yd.

Work is to be performed under Reimbursement Act, Chapter 246, laws of 1921.

Bids will be received at the Borough Hall at Somerville, N. J., on Thursday, July 13, 1922, at 7 p.m. (Standard Time).

Drawings, specifications and form of contract and bond of the proposed work are on file in the office of W. J. Hardin, Borough Engineer, at Newton, N. J., and Borough Collector's Office, Somerville, N. J., and in the office of the State Highway Department, Trenton, New Jersey, and may be inspected by prospective bidders. Plans will be furnished on deposit of ten dollars ($10) upon application to W. J. Hardin, Borough Engineer. Bids must be made on the standard proposal forms in the manner designated therein and as required by the specifications, enclosed in sealed envelopes, addressed to the Mayor and Council of the Borough of Somerville and bearing the name and address of the bidder and the name and section of the route on the outside. Bids must be accompanied by a certified check drawn to the order of J. K. Brokaw, treasurer, for not less than ten per cent (10%) of amount of the bid provided that said certified check shall not be less than $500 nor more than $1,000 and be delivered at the above place on or before the hour named. Copies of the standard proposal forms will be furnished on application to W. J. Hardin, Borough Engineer, or J. K. Brokaw, Borough Treasurer.

Each bidder must accompany his bid with a certificate from a surety company duly authorized to do business in this State, stating that such surety company will provide said bidder with a bond in such sum as is required in and in accordance with the provisions of said specifications conditioned for the faithful performance of the provisions of the contract as therein specified. Each bidder must also furnish with his bid a statement of experience properly filled out.

By order of a resolution of the Borough Council of the Borough of [illegible] passed at a meeting held on May 29, 1922.

(SIGNED) J. B. VARICK,
Borough [illegible]

OFFICIAL PROPOSALS

Bids: July 5.

Concrete Road Construction

Ridgefield Park, N. J.

Sealed bids or proposals for the improvement of Pershing Court in the Village of Ridgefield Park, N. J., will be received by the Board of Commissioners of said Village, at the Municipal Building, 234 Main St., Ridgefield Park, N. J., on Wednesday, July 5, 1922, at the hour of 8 P.M., Eastern Standard Time (9 P.M. Daylight Saving Time), ONLY.

Plans, details, profiles, specifications, approximate quantities and instructions to bidders, are on file with the Village Clerk at the Municipal Building, and may be examined any day, except Saturday, between the hours of 10 A.M. and 4 P.M.

The Board of Commissioners reserves the right to reject any or all bids.

(Signed) Board of Commissioners of the
Village of Ridgefield Park.
By M. D. STARKER,
Village Clerk.

Dated June 12, 1922.

Sealed bids or proposals for the improvement of Chestnut Street in the Village of Ridgefield Park, N. J., will be received by the Board of Commissioners of said Village, at the Municipal Building, 234 Main St., Ridgefield Park, N. J., on Wednesday, July 5, 1922, at the hour of 8 P.M. Eastern Standard Time (9 P.M. Daylight Saving Time), ONLY.

Plans, details, profiles, specifications, approximate quantities and instructions to bidders, are on file with the Village Clerk at the Municipal Building, and may be examined any day except Saturday, between the hours of 10 A.M. and 4 P.M.

The Board of Commissioners reserves the right to reject any or all bids.

(Signed) Board of Commissioners of the
Village of Ridgefield Park.
By M. D. STARKER,
Village Clerk.

Dated June 12, 1922.

Bids: July 20.

Developing Water Supply

East Orange, N. J.

Notice is hereby given that sealed bids will be received in accordance with the law by the Board of Water Commissioners of the City of East Orange, New Jersey, at 8:00 o'clock p.m., Daylight Saving Time, on Thursday, the 20th day of July, A.D. 1922, at the office of the Board of Water Commissioners, 438 Main Street, East Orange, New Jersey, for furnishing materials and performing the labor required for developing a supply of water of not less than two million (2,000,000) gallons per twenty-four (24) hours from driven wells, in accordance with plans and specifications on file in the office of the Board of Water Commissioners, 438 Main Street, East Orange, New Jersey, and also in the office of the Consulting Engineers, Nicholas S. Hill, Jr., and S. P. Ferguson, 112 East 19th Street, New York City.

Copies of the plans and specifications may be obtained either from the office of the Board of Water Commissioners or from the Consulting Engineers, upon depositing Twenty-five ($25.00) Dollars, which sum will be refunded upon the return of the plans and specifications in good condition within ten (10) days after the 29th day of July, 1922, or else the entire deposit will be forfeited.

The work to be done includes all materials and labor, tools, plant and equipment necessary for construction, installing and completing ready for operation the following elements:

A. BUILDINGS AND STRUCTURES.

(1) Brick and concrete addition to the existing West Side pumping station, having slate roof on steel trusses and [illegible] 24' x 50' x 30' high.

(2) Three (3) [illegible] reinforced concrete well houses of the design now specified to be erected on the property of the City of East Orange known as the Dickinson Farm.

(3) One (1) reinforced concrete well chamber.

B. MACHINERY AND EQUIPMENT.

(1) 1—[illegible] horizontal [illegible] type [illegible] pump of [illegible] M.G.D. capacity [illegible] with condensing equipment.

(2) 2—[illegible] vertical [illegible] centrifugal [illegible] pumps driven at [illegible] r.p.m. by [illegible] electric motors [illegible] each.

(3) 1—[illegible] motor driven centrifugal [illegible] unit of [illegible] M.G.D. capacity [illegible] with condensing equipment.

(4) 3—or more motor driven centrifugal or reciprocating deep well pumps with a capacity of 0.75 to 1 M.G.D. each.

(5) 2—Condensers and vacuum pumps for unaflow steam engines.

(6) All piping and appurtenances incidental and necessary to the installation of the above equipment.

C. ELECTRIC EQUIPMENT.

(1) Electric transformers, switchboards, interior and exterior wiring and appurtenances.

(2) Electric transmission wood pole line, approximately twelve thousand (12,000') feet in length, complete with twenty-three hundred (2,300) volt power cable, and cable and wires for distant control and telephone circuits.

D. DRIVEN WELLS.

(1) Three (3) or more driven wells of a depth of approximatey one hundred and twenty-five (125') feet and of diameters specified.

E. PIPE AND APPURTENANCES.

(1) Furnishing and delivering eight thousand (8,000') feet of twenty (20") inch reinforced concrete or cast iron pipe together with special castings, valves, etc.

(2) Laying and installing complete eight thousand (8,000') feet of reinforced concrete or cast iron pipe complete with specials, valves, etc.

The work to be performed under the specifications is divided into fourteen sections, classified according to the character of the work and materials to be furnished.

Bidders will be allowed to bid on one or more sections.

Proposals must be accompanied by a certified check or bid bond from a reliable surety company authorized to do business in the State of New Jersey and satisfactory to the Board of Water Commissioners, in amount equal to twenty-five (25%) per cent of the proposal. The certified check will be retained to pay for any damage or loss to the City, or the liability of the bond will accrue, in case the successful bidder shall neglect or refuse to enter into a contract in accordance with his proposal.

The Board of Water Commissioners reserves the right to consider bids for ten (10) days after their receipt before awarding any contract and the right is reserved to accept any bid or combination of bids, or to reject any or all bids.

Board of Water Commissioners, City of East Orange, New Jersey.

By ROSWELL M. ROPER,
Secretary.

Bids: July 12.

Highway Work

Camden, N.J.

Notice is hereby given that sealed bids will be received by Charles F. Wise, Chairman of the Road Committee, for the construction of a portion of King's Highway, in the Township of Delaware, in the County of Camden, with a reinforced concrete surface estimated amount of concrete surface pavement required is 20,784 square yards and opened and read in public at the Court House, Camden, N. J., on Wednesday July 12th, 1922, at a.m. Daylight Saving Time.

"Drawings, specifications and forms of bid, contract and bond for the proposed work, prepared by John J. Albertson, County Engineer and approved by the State Highway Commission, have been filed in the office of the said engineer at the Court House, Camden, N. J., and of said State Highway Commission, Trenton, N. J., and may be inspected by prospective bidders during business hours. Bidders will be furnished with a copy of the specifications and blue prints of the drawings by the engineer on proper notice and payment of cost of [illegible] The bid must be made on the standard proposal forms in the manner designated therein and required by the specifications, must be enclosed in sealed [illegible] addressed to the [illegible] and bearing the name and address of the bidder and the name and section of the route on the outside. Bids must be accompanied by a [illegible] check drawn to the order of [illegible] for not less than ten per cent (10%) of amount of the bid provided that said certified check shall not be less than $500 nor more than $1,000 and be delivered at the above place on or before the hour named. Copies of the standard proposal forms will be furnished on application to [illegible]

[illegible] of the Board of Chosen Freeholders.

FRED W. GEORGE, Clerk.

OFFICIAL PROPOSALS

Bids: Aug. 15.

Hydro-Electric Project

Dotham, Ala.

Sealed proposals will be received by the Mayor and City Council of the City of Dothan, Alabama, until 2 o'clock p.m., Tuesday, August 15th, 1922, for constructing a Hydro-Electric Project with appurtenances, and furnishing materials and equipment, at High Bluff on the Choctawhatchee River about eight (8) miles from Hartford, Ala., in sections 9 and 4 of township 2N, Range 23E, Geneva County, Alabama. The work consists of the construction of an earth dam, a concrete spillway, abutments and power house, and the furnishing and placing of machinery.

The principal approximate quantities involved are the following:

51,000 cu.yds. of excavation.
380,000 cu.yds. of embankment.
18,500 cu.yds. of concrete of different classes.
1,900,000 pounds of reinforcing steel.
354,000 pounds of structural steel work.

Turbines, generators, transformers and auxiliary power house equipment for a present installation of approximately 3,000 bhp. capacity in two units.

A transmission line twenty-one and one-half (21½) miles long at 44,000 volts pressure.

Plans and specifications are on file at the office of the City Clerk at Dothan, Alabama, and at the office of The Ludlow Engineers at Winston-Salem, N. C., where they may be examined by prospective bidders.

Copies of the plans covering the construction details of this project and two copies of the specifications attached to the form of proposal and contract will be furnished by The Ludlow Engineers, Winston-Salem, N. C., upon application by prospective bidders accompanied by a check for twenty-five ($25.00) dollars to cover the cost, or, separate prints, and extra copies of specifications and form of proposal, etc., at one ($1.00) dollar each.

Each bid must be accompanied by a certified check for approximately five (5%) per cent of the bid.

Proposals will be received at the City Hall, Dothan, Alabama, and opened publicly wih the right reserved to accept any bid or to reject any or all bids as the best interests of the City may appear.

Plans and supervision by THE LUDLOW ENGINEERS, INC. Winston-Salem, N. C.

E. O. JONES, Mayor.
R. W. LISENBY, City Clerk.

Bids: July 7.

Timber, Sheathing, Flooring, etc.

Albany, N. Y.

Proposals for furnishing timber, sheathing, flooring, exterior facing lumber, etc., for the construction of Stable, State Camp of Instruction, near Peekskill, N. Y., will be received by the State Board of Armory Commissioners, at its office, 158 State Street, Albany, N. Y., until three o'clock p.m. (daylight saving time) on Friday, July 7, 1922, and then and there publicly opened and read.

Proposals must be made on proposal forms and enclosed in envelopes, both of which are furnished by the State, envelopes to be sealed and endorsed as directed in the proposal forms.

Proposal forms and envelopes may be obtained and copies of specification consulted at the above described office of the Board, at the State Camp of Instruction, near Peekskill, N. Y., and at the State Arsenal, 463 Seventh Avenue, New York City.

The right is reserved hereby to reject any or all bids.

STATE BOARD OF ARMORY COMMISSIONERS.
(Per) FRANKLIN W. WARD, Secretary.
Dated: June 24, 1922. Albany, N. Y.

Bids: July 19.

Turbine and Accessories

New Orleans, La.

Sealed proposals will be received by the Sewerage and Water Board of New Orleans, up to 12 o'clock noon, Wednesday, July 19, 1922, for furnishing one 6,000 kw. turbine and accessories.

Specifications and blank forms of proposals may be obtained at Room 303, No. 526 Carondelet Street, New Orleans.

The right is reserved to reject any or all bids.

A. G. MOFFAT, Secretary
GEO. G. EARL, General Superintendent,
May 11, 1922.

OFFICIAL PROPOSALS

Bids: July 24.

Disposal Works

Hackensack, N. J.

The Hackensack Improvement Commission, the governing body of the City of Hackensack, Bergen County, New Jersey, request proposals for the construction and equipment of disposal works, flotation basins, force mains, a pumping station and certain other works, establishments and fixtures appurtenant thereto.

The foregoing works are more particularly described and set forth in the plans and specifications on file with Lemuel Lozier, Engineer of the Commission, and with the Clerk of the Commission.

The plans and specifications, information for bidders, forms of proposals and contracts, forms of bonds required, and other information can be seen at the office of Lemuel Lozier, Engineer of the Commission, Room 3, Bank Building, Main and Mercer Streets, Hackensack, New Jersey; copies of such plans and specifications may be obtained by bidders on making a deposit of $100, which deposit will be refunded upon the return of the plans and specifications in good condition.

All bids must be made upon a form of proposal to be obtained from the Engineer of the Commission, and must give the prices both in writing and figures, and must give such other information and be signed in the manner indicated on the form of proposal. All bids shall be accompanied by a certified check for $10,000 payable to the "Hackensack Improvement Commission."

Checks of the unsuccessful bidders will be returned immediately upon the award of the contract. The check of the successful bidder will be returned to the bidder upon the execution of the contract and the furnishing of the bonds required, within ten days after the date of the award thereof, or within such extended time as may be determined by the Commission. In case of failure to execute the required contract, and furnish the required bonds within such time, such check shall be forfeited to the Hackensack Improvement Commission as liquidated damages.

The proposals herein required shall be presented to the Hackensack Improvement Commission, at the Municipal Building, 346 State Street, Hackensack, Bergen County, New Jersey, on Monday, the 24th day of July, 1922, at 8 p.m., Daylight Saving time, 7 p.m. Standard Time.

No bids will be received prior to said hour, and none thereafter. The proposals shall be submitted in sealed envelopes or packages as follows:

"Proposal for Sewage Disposal Plant, Contract No. 1."

The Hackensack Improvement Commission reserves the right to reject any or al bids.

HACKENSACK IMPROVEMENT COMMISSION,
SPENCER D. BALDWIN, Mayor.
WILLIAM SCHAAF, Clerk.

Bids. July 28.

Municipal Light Plant

Homestead, Fla.

Sealed proposals will be received by the Mayor and Town Council, Homestead, Fla., on or before 8 P. M. Friday, July 28, 1922, and then publicly opened, for furnishing machinery equipment and supplies and installation and constructing certain building for electric light plant for the said town in accordance with plans and specifications on file in the engineer's office at Homestead, Florida.

The electric light system includes furnishing of two complete steam turbo-generator sets 300 KW, 3 phase, 60 cycle, 2300 volts, one ten panel switchboard, two boilers 150 to 200 H.P., one ten ton crane installation, building and all accessories.

Alternate bids will be received for equipment of equal capacity.

Each proposal must be accompanied by a certified check for 2% of the amount of the bid, made payable to the City Clerk, R. E. Edwards, Town of Homestead, Florida, as evidence of good faith.

Specifications, forms of proposals and general plan may be obtained from the engineer's office Homestead, Fla.

The right is reserved to reject any or all bids.

S. E. LIVINGSTON, Mayor
R. E. EDWARDS, Clerk
B. M. DUNCAN, Engineer,
Town of Homestead.

OFFICIAL PROPOSALS

Bids: July 11.

Concrete Filter Plant Substructures Contract No. 1

Buffalo, N. Y.

Sealed proposals for the construction of a coagulating basin, clear water reservoir, filter boxes, substructure of pumping station, conduits and other appurtenances in connection with the filter plant for the City of Buffalo, N. Y., will be received by the Commissioner of Public Works at his office in the Municipal Building, Buffalo, N. Y., until eleven a.m., daylight saving time, on Tuesday the eleventh day of July, 1922.

Copies of the plans and specifications may be seen at the office of the Engineer of the Filtration Division, Bureau of Water, Porter Avenue, Buffalo, N. Y., and copies of the plans, specifications, contract and form of proposal may be obtained at this office upon the deposit of $25.00 for each set furnished, which sum will be refunded if the plans and specifications are returned within 30 days after bids have been received and acted upon. Plans and specifications may also be seen at the office of Fuller & McClintock, Consulting Engineers, 170 Broadway, New York.

Proposals must be made on the blank forms furnished and must be sealed and endorsed—"Proposal for Filter Plant Substructures." Each proposal must be accompanied by a certified check in the amount of $150,000.00.

The principal estimated quantities are approximately as follows:

Earth excavation, 350,000 cu.yds.
Earth embankment, 110,000 cu.yds.
Rock excavation, 7,000 cu.yds.
Concrete masonry, 50,000 cu.yds.
Steel reinforcement, 3,500 tons.
Placing piping and iron and steel work furnished by the City, 580 tons.

The principal structures are a reinforced concrete coagulating basin about 304 ft. x 408 x 26 ft. average depth, a reinforced concrete clear water reservoir 330 ft. x 510 ft. x 25 ft. average depth, and 40 reinforced concrete filter boxes each about 33 ft. x 50 ft. x 9 ft. deep.

The work is located in the City of Buffalo, on the water front south of Jersey Street.

The City reserves the right to reject any or all bids in case this is deemed to be for the interest of the City.

GEORGE C. ANDREWS.
Engineer, Filtration Division.

Bids: July 11.

Street Paving

Covington, Va.

Sealed proposals will be received by the Mayor of Covington, Va., up to 7:30 p.m. Tuesday, July 11th, 1922, at the Council Chamber, Masonic Building, Covington, for furnishing all labor and materials and constructing the following amount of Paving; approximate estimate:

4300 Cubic Yards Grading,
8480 Square Yards Sheet Asphalt, concrete base and 3 inch top,
1450 Square Yards Hill-Side Brick Paving, concrete case,
280 Square Yards Plain Vitrified Brick Paving, concrete base,
5050 Lin. Feet Plain Concrete Curb, 20 inches deep, set on Slag,
320 Lin. Feet Armored Circular Curb, 20 inches deep, set on Slag,
5350 Lin. Feet Concrete Gutter 18 inches wide,
92 Lin. Feet Concrete Gutter 24 inches wide,
244 Lin. Feet Concrete Margin Curb,
9 30-Inch Cast Iron Frames and Grates for Inlets,
60 Vertical Feet of Brick Work for Inlets,
220 Lin. Feet 12 in. T. C. Pipe Connecting Inlets.

Specifications and information concerning the work may be obtained on application to C. P. Barnett, Consulting Engineer, Covington, Virginia. A deposit of $5.00 will be required for each copy of specifications and on return of same the deposit will be refunded.

A certified check for $500.00 made payable to the order of B. R. Hoper, Mayor of Covington, Va., must accompany each bid.

The Town reserves the right to reject any or all bids. Bids will be made on a basis of cash payments for all work done.

C. P. BARNETT,
Consulting Engineer

OFFICIAL PROPOSALS

Bids: July 19.

Excavation of Reservoir

Saugerties, N. Y.

Sealed proposals for the excavation of about thirty thousand cubic yards of material, the cleaning and necessary additional excavating for and the laying of an eighteen inch temporary water main for a distance of about eight hundred feet, the construction of a cofferdam across the inlet and other work incidental to the increasing the present storage capacity of the Saugerties Village Reservoir situated at Blue Mountain in the Town of Saugerties, County of Ulster, N. Y., will be received by the Board of Water Commissioners of the Village up to two o'clock daylight savings time, in the afternoon on the 19th day of July, 1922, at their office on Market Street, Saugerties, N. Y., at which place and hour the bids will be publicly opened and read.

Specifications, proposal blanks, forms of contract and bond and information for bidders may be seen at the Board of Water Commissioners, Market Street, Saugerties, N. Y., and copies of same may be obtained upon application to J. F. Loughran, Civil Engineer, Kingston, N. Y., upon deposit of five dollars, which deposit will be refunded when specifications are returned in good condition.

A certified check of five per cent (5%) of the amount of the bid made payable to the Board of Water Commissioners, Saugerties, N. Y., must accompany the bid as a guarantee that the contract will be entered into if awarded.

A bond in the sum of one hundred per cent (100%) of the contract price will be required.

The Board of Water Commissioners reserve the right to reject any or all bids as it may deem to be for the best interest of the Village of Saugerties, N. Y.

J. CHARLES SUDDERLEY,
President.
E. CLARK REED, Secretary.
J. F. LOUGHRAN, Engineer.
Dated: June 9, 1922.

Bids: July 25.

Barge Canal Terminals

Albany, N. Y.

Sealed proposals will be received by the undersigned at his office in the Capitol at Albany, N. Y., until twelve o'clock noon of Tuesday, July 25, 1922, at which place and hour they will be publicly opened and read, for the construction of Barge Canal terminals pursuant to the provisions of Chapter 746 of the Laws of 1911, and amendatory laws, and Chapter 492 of the Laws of 1922, as follows

—1—

TERMINAL CONTRACT NO. 89

For paving a portion of the terminal site, constructing railroad and crane tracks, electrical work and details incidental thereto, at Syracuse.

Contract plans, sheets 1 to 4 inclusive.

—2—

TERMINAL CONTRACT NO. 92

For dredging a portion of the Henry Street slip at Gowanus Bay, Borough of Brooklyn, New York City.

Contract plans, sheet No. 1.

Copies may be seen, and detailed specifications, engineer's estimates of quantities, proposal blanks, form of contract and bonds required, and other information for proposers may be had at the office of the Superintendent of Public Works at Albany, N. Y. at the office of the Assistant Superintendent of Public Works for the Middle Division at Syracuse, N. Y., at the office of the Assistant Superintendent of Public Works for the Western Division at Rochester, N. Y., at the offices of the Superintendent of Public Works, Erie Basin Terminal, Buffalo, N. Y. and Terminal Bulkhouse, Pier 6, East River, New York City.

Blueprint copies of plans will be furnished by the State Engineer and Surveyor upon the receipt at his office in the Capitol Building, Albany, N. Y., of payment at the rate of fifteen cents (15c.) per sheet. No refund will be made for any blueprints which may be returned.

Monthly estimates will be paid on the basis of ninety per cent (90 per cent) of the work done at the contract prices. Each proposal for said work must be accompanied by a certified deposit in the form of a draft or certified check upon some good banking institution in the city of Albany or New York, issued by a national or state bank or trust company in good credit within the state and payable at sight to the Superintendent of Public Works for five per centum (5 per cent) of the amount of the proposal.

The person whose proposal shall be accepted will be required to execute a contract and furnish bonds within ten days from the date of notice of award delivered to him or them in person or mailed to the address given in the proposal.

Upon execution of the contract and approval of bonds, the certified check or draft will be returned to the proposer unless the same shall have been presented for collection prior to such time in which case the amount of the deposit will be refunded by the Superintendent of Public Works.

The deposits of bidders other than the one to whom the award of contract shall be made will be returned immediately after the award has been made.

The bond required for the faithful performance of the contract shall be in such sum as shall be fixed by the Superintendent of Public Works, which sum shall not be less than twenty per centum (20 per cent) of the estimated cost of the work, according to the contract price, and an additional bond, known as the labor bond, in the sum of ten per centum (10 per cent) of the amount of the estimated cost of the work according to the contract price, will be required as security that the contractor will pay in full at least once in each month all laborers employed by him upon the work specified to be done in the contract.

In the event that more than one surety company is offered as surety on said bonds co-insurance only will be accepted.

Each proposal must be addressed to the Superintendent of Public Works, Albany, N. Y., and must be endorsed on the envelope with the name of the construction for which the proposal is made.

Award, if made, will be made to the person or persons whose proposal shall be lowest in cost to the state for doing the work, and which shall comply with all provisions required to render it formal. Before any award shall be made the lowest bidder will be required to satisfy the Superintendent of Public Works of his ability to provide suitable equipment and materials for the proper performance of the work.

The right is reserved to reject all proposals and readvertise and award the contract in the regular manner if, in the judgment of the undersigned, the interests of the state will be enhanced thereby

CHARLES L. CADLE,
Superintendent of Public Works.
June 22, 1922

Bids: July 10

Equipment for New York Canals

Albany, N. Y.

Sealed proposals will be received by the undersigned at his office in the Capitol at Albany, N. Y., until twelve o'clock noon of Monday, July 10, 1922, at which place and hour they will be publicly opened and read, for furnishing certain equipment for the New York State canals pursuant to the provisions of Chapter 532 of the Laws of 1922, as follows:

A—1—

CRESCENT POWER HOUSE,
COHOES, N. Y.

For furnishing and delivering two hydraulic turbines with governor equipment and extra parts for proposed power house at Crescent dam, Cohoes, N. Y.

Sheets 1 and 2 inclusive.

B—1—

CRESCENT POWER HOUSE,
COHOES, N. Y.

For furnishing two water wheel driven [illegible] and other electrical equipment [illegible] power house at Crescent [illegible] N. Y.

Sheets 1 and 2 inclusive.

[illegible] and detailed specifications, engineer's estimate of quantity, proposal blanks, forms of contract and bonds required, and other information for proposers may be had at the office of the Superintendent of Public Works at Albany, N. Y., at the office of the Assistant Superintendent of Public Works for the Eastern Division at Troy, N. Y., at the office of the Assistant Superintendent of Public Works for the Middle Division at Syracuse, N. Y., at the office of the Superintendent of Public Works for the Western Division at Rochester, N. Y., at the office of the Assistant Superintendent of Public Works for the Middle Division at Utica, N. Y., at the office of the Superintendent of Public Works, Erie Basin Terminal, Buffalo, N. Y. and Terminal Warehouse, Pier 6, East River, New York City, copies of detail plans or drawings may be obtained from the State Engineer and Surveyor at Albany, N. Y. upon payment [illegible] of the cost of producing them.

Monthly estimates will be paid on ninety per cent (90 per cent) of the work done at the contract prices. Every proposal for [illegible] must be accompanied by a money deposit in the form of a draft or certified check upon some good banking institution in the city of Albany or New York, issued by a national or state bank or trust company in good credit within the state and payable at sight to the Superintendent of Public Works for five per centum (5 per cent) of the amount of the proposal.

The person whose proposal shall be accepted will be required to execute a contract and furnish bonds within ten days from the date of notice of award delivered to him or them in person or mailed to the address given in the proposal.

Upon execution of the contract and approval of bonds, the certified check or draft will be returned to the proposer unless the same shall have been presented for collection prior to such time in which case the amount of the deposit will be refunded by the Superintendent of Public Works.

The deposits of bidders other than the one to whom the award of contract shall be made will be returned immediately after the award has been made.

The bond required for the faithful performance of the contract shall be in such sum as shall be fixed by the Superintendent of Public Works, which sum shall not be less than twenty per centum (20 per cent) of the estimated cost of the work, according to the contract price, and an additional bond known as the labor bond, in the sum of ten per centum (10 per cent) of the amount of the estimated cost of the work according to the contract price, will be required as security that the contractor will pay in full at least once in each month all laborers employed by him upon the work specified to be done in the contract.

In the event that more than one surety company is offered as surety on said bonds co-insurance only will be accepted.

Each proposal must be addressed to the Superintendent of Public Works, Albany, N. Y., and must be endorsed on the envelope with the name of the construction for which the proposal is made.

Award, if made, will be made to the person or persons whose proposal shall be lowest in cost to the State for doing the work, and which shall comply with all provisions required to render it formal. Before any award shall be made the lowest bidder will be required to satisfy the Superintendent of Public Works of his ability to provide suitable equipment and materials for the proper performance of the work.

The right is reserved to reject all proposals and readvertise and award the contract in the regular manner, if, in the judgment of the undersigned, the interests of the state will be enhanced thereby

CHARLES L. CADLE,
Superintendent of Public Works.
June 21, 1922.

Bids: July 5.

Street and Public Improvements

Reading, Pa.

Sealed proposals will be received at the office of the City Clerk, Reading, Pa., until 9:45 a.m. (Daylight Saving Time), Wednesday, July 5, 1922, for the following work:

APPROXIMATE QUANTITIES.

18,000 sq.yd. sheet asphalt paving on concrete base.
1,025 sq.yd. laying granite block paving.
1,060 sq.yd. brick paving for gutters.
1,550 sq.yd. concrete base.
170 lin.ft. concrete radius corners.
18 lin.ft. [illegible]
Remodeling six (6) catch basins.
Constructing three (3) new catch basins and appurtenances.

Plans and specifications may be obtained by prospective bidders by making a deposit of ten dollars ($10) with the City Treasurer, City Hall, Reading, Pa., and by furnishing the information which will be desired. Deposit made for plan and specifications will be returned to those bidding.

Proposals must be marked "Proposal for Street Paving" and addressed to the City Clerk, City Hall, Reading, Pa.

Contractors will be required to comply with [illegible] relative to Workmen's Compensation Insurance [illegible] Department by the said contractors that they have accepted the provisions of the said Act, and has insured his liability [illegible] bid.

By order of

WILLIAM L. STRAUB,
City Clerk.

PAUL N. B. BIRCH, City Engineer.
June 17, 1922.

OFFICIAL PROPOSALS

Bids: Aug. 4.

Bridge Superstructure, Machinery and Electrical Equipment

Seattle, Wash.

Sealed proposals will be received by the Board of Public Works of the City of Seattle, up to 10 o'clock a.m., Friday, August 4th, 1922, in room 234, County-City Building, for the fabrication and erection of the Super-structure, Machinery and Electrical Equipment of a Steel Bascule Bridge and two Side Spans over the West Waterway at West Spokane Street, under authority of Ordinance No. 43397.

The structure will comprise a double-leaf bascule span 288 feet center to center of trunions, 2 approach spans each about 140 feet long and a steel girder span about 136 feet long. The width of the bascule span will be 45 feet center to center of trusses and of the side spans 52 feet center to center of trusses, and of the girder span about 40 feet.

No proposal will be considered except as same is made strictly in conformity with the advertisement therefor and upon the forms of proposals furnished by the Board of Public Works, bound together with the specifications, general clauses and form of contract which must be submitted unbroken and unaltered in every particular.

This improvement shall be made in accordance with the respective plans and specifications now on file in the offices of the Secretary of the Board of Public Works and the City Engineer, respectively.

The successful bidder will be required to file with the City Comptroller a bond in the sum specified in the specifications.

Each bid must be accompanied by money, a satisfactory surety company bid bond approved by the Mayor and City Comptroller as to sufficiency and the Corporation Counsel as to form, or a certified check payable to the order of the City Comptroller of the City of Seattle for a sum not less than five (5) per cent of the total amount of bid, and no bid will be considered unless so accompanied.

A deposit of Ten Dollars ($10.00) will be required for each set of plans and specifications, which will be returned upon return of the plans in good order.

Special attention of bidders is called to the State Law and City Charter regarding the number of hours constituting a day's work, minimum wage scale, American citizenship and heads of families.

The Board of Public Works reserves the right to reject any or all bids.

By order of the Board of Public Works.
C. B. BAGLEY,
Secretary.

First publication June 20, 1922.

Bids: July 11.

Highway Work

Albany, N. Y.

Sealed proposals will be received by the undersigned at their office, No. 55 Lancaster Street, Albany, N. Y., at one o'clock p.m. on Tuesday, the 11th day of July, 1922, advanced standard time which is twelve o'clock noon eastern standard time, for the improvement of highways in the following counties:

Cattaraugus.....(one highway: 4.15)
Chenango.....(one highway: 8.82)
Delaware.....(two highways: 7.59 & 7)
Madison.....(one highway: 1.60)
St. Lawrence.....(one highway: 10.14)
Washington.....(one highway: 0.62)
Wyoming.....(one highway: 4.68)
Yates.....(one highway: 2.92)

ALSO FOR THE RECONSTRUCTION OF THE FOLLOWING:

Chenango.....(one contract: 1.27)

Maps, plans, specifications and estimates may be seen and proposal forms obtained at the office of the Commission in Albany, N. Y., and also at the office of the division engineers in whose division the roads are to be improved or reconstructed. The addresses of the division engineers and the counties in which they are in charge will be furnished upon request.

The especial attention of bidders is called to "General Information for Bidders" in the itemized proposal, specifications and contract agreement.

HERBERT S. SISSON,
Commissioner.

J. C. FINCH,
Secretary.

OFFICIAL PROPOSALS

Bids: July 18.

Concrete Flood Gate and Appurtenances

Little Rock, Ark.

Sealed proposals will be received by the Secretary of the Farelly Lake Levee District at the Marion Hotel, Little Rock, Ark., until 2 p.m., Tuesday, July 18, 1922, for the construction of a Concrete Flood Gate and Appurtenances at Big Bayou Meto, Gillett, Arkansas County, Ark. Following are the approximate quantities:

Excavation	50,000 cu.yd.
Round foundation piles	24,000 lin.ft.
Steel sheet pile cut off walls	20,000 sq.ft.
Concrete	6,500 cu.yd.
Reinforcing steel	200 tons
Gates and accessories	150 tons
Hand rail, 2-in. GI pipe and fittings	1,500 lin.ft.
Hand rail, 1½-in. GI pipe and fittings	1,000 lin.ft.
Hoisting apparatus	30 tons

Detail plans, specifications and blank forms of proposal are on file at the office of A. W. Dobyns, Attorney, Little Rock, Ark., and at the office of Ayres & Miller, McCall Building, Memphis, Tenn.

Detail plans, specifications and proposal forms will be furnished upon application accompanied by a certified check for twenty ($20) dollars.

Each proposal shall be accompanied by a certified check for fifteen thousand ($15,000) dollars made payable to the Secretary of the Board.

This check is to be conditioned that, if the bid is accepted, a contract will be entered into and the performance of same secured within ten (10) days after notification of acceptance of bid. Successful bidder will be required to furnish a surety bond in an acceptable surety company in the sum of fifty (50%) per cent of the contract price.

The right is reserved to reject any or all bids and to waive any technical defects, as the interests of the district may require.

The Engineers, or their assistants, will be at Gillett, Ark., from July 10 to July 15 to show prospective bidders over the work.

JOHN M. GRACIE, Chairman
Board of Commissioners.
J. B. QUINN, Secretary,
Gillett, Arkansas.
AYRES & MILLER, Engineers,
McCall Building, Memphis, Tennessee.

Bids: July 12.

Road Work

Atlantic City, N. J.

Sealed bids will be received by the Board of Chosen Freeholders of Atlantic County, N. J., at 12 o'clock noon (Daylight Saving Time) on July 12, 1922, during a regular meeting of said Board at the Freeholders' meeting room in the Guarantee Trust Bldg., Atlantic City, N. J., for the reconstruction of a section of Mays Landing-Downstown Road known as Hamilton Township Section, in the County of Atlantic and State of New Jersey, with a Warrenite-Bitulithic pavement on a six inch 1-3-5 concrete base; estimate amount of surface pavement and concrete base required is 88,070 sq.yd., together with gravel shoulders, excavation and embankment, drainage provisions, guard rail and other items; said bids to be opened and read in public at the aforesaid time and place.

Drawings, specifications and form of bid, certificate of surety, contract and bond, covering proposed work, are on file in the office of the County Engineer at 636 Guarantee Trust Bldg., Atlantic City, N. J., where they may be inspected and a prospective bidder may secure a copy of the specifications and blueprints of the plans upon the deposit of $10, and this deposit will be refunded provided the plans and specifications are returned to the County Engineer's Office in good condition by noon on July 12, 1922. Each bid must be made on the standard proposal form in the manner required by the specifications and must be accompanied by a certified check, or cash, in the amount of $20,000.

A contract will be awarded, if awarded at all, within one month of the date of receiving bids and such award will be made subject to the sale and delivery of bonds to be issued for the purpose of financing the reconstruction. The right is reserved to reject any or all bids.

By Order of the Board of Chosen Freeholders of Atlantic County, N. J.
F. W. WILLETTS, Clerk.

OFFICIAL PROPOSALS

Bids: July 14.

Highway—Route No. 1 Section No. 13

Trenton, N. J.

NOTICE IS HEREBY GIVEN that sealed bids will be received by the State Highway Commission of New Jersey for the construction of the following:

Route No. 1—Section No. 13 from Highland Park to Stelton Road, Middlesex County; estimated amount of Warrenite Bitulithic Pavement on a nine (9) inch Portland Cement Concrete foundation, 32,811 Square Yards.

Bids will be received at the office of the State Highway Commission at the Broad Street Bank Building, Trenton, New Jersey, on Friday, July 14th, 1922, at 11 A.M. Standard Time, and opened and read immediately thereafter.

Drawings, specifications and form of bid, contract, and bond for the proposed work are on file in the office of the State Highway Department, Trenton, New Jersey, and may be inspected by prospective bidders. Plans will be furnished on deposit of Ten Dollars ($10.00) upon application to the State Highway Department, 9th floor, Broad Street Bank Building, Trenton, New Jersey. Bids must be made on the standard proposal forms in the manner designated therein and as required by the 1922 specifications, same to be enclosed in sealed special addressed envelopes bearing the name and address of bidder and the name and section of the route on the outside, and must be accompanied by a certified check drawn to the order of the Treasurer of the State of New Jersey for not less than ten per cent (10%) of the amount of the bid, provided that said certified check shall not be less than $500.00 or more than $20,000.00, and be delivered at the above place on or before the hour named. Copies of the standard porposal form and special addressed envelope will be furnished on application. Bids not enclosed in special envelopes will be considered informal and will not be opened.

Each bidder must accompany his bid with a certificate from a surety company duly authorized to do business in this State, stating that such surety company will provide said bidder with a bond in such sum as is required in and in accordance with the provisions of said specifications, conditioned for the faithful performance of the provisions of the contract and specifications. Each bidder must also accompany his bid with a Statement of Equipment properly filled out.

By order of the State Highway Commission.

A. LEE GROVER,
Chief Clerk.

Bids: July 5.

Ornamental Lights

Long Branch, N. J.

Public notice is hereby given that sealed proposals are invited and will be received for installing Ornamenetal Lights on Liberty Street, Union Avenue, Second Avenue from Broadway to Union Avenue; Rockwell Avenue from Broadway to Union Avenue by the Board of Commissioners of the City of Long Branch, N. J., July 5, 1922, at 8 o'clock in the evening in the City Council Chambers, or as soon thereafter as the matter may be brought on. Plans and specifications as approved by the Board of Commissioners are on file in the office of the City Clerk and may be obtained any time during business hours, upon a deposit of $10, which said amount will be returned at the time the bids are opened, upon surrender of said plans and specifications in good condition.

All bids must be sealed marked, "Bids for Ornamental Lighting," and addressed to Frank C. Quinn, City Clerk. No bid will be considered unless accompanied by a certified check for ten per cent of the amount bid on the proposed work, drawn to the order of Frank L. Howland, treasurer, or cash in equal amount. The Board of Commissioners reserve the right to reject any or all bids if deemed to the best interest of the Board so to do.

FRANK C. QUINN, City Clerk.
Dated: Long Branch, N. J.,
June 20, 1922.

OFFICIAL PROPOSALS

Bids: July 6.

Highway Bridge

Annapolis, Md.

Sealed proposals will be received by the Board of County Commissioners of Anne Arundel County, Maryland, until 12 p.m., July 6, 1922, for the construction of a Highway Bridge across South River at Riverview to a point connecting the Public Road at Tuckers Landing.

In general the contract is to include a bridge 1,680 feet long with not less than a 14 foot clear driveway and with a draw span, fenders, abutments, and approaches complete in every detail and ready for operation.

It is the intention of the Board of County Commissioners to construct the most permanent and complete highway bridge possible under provisions of an act passed by the General Assembly of Maryland authorizing the construction of the said bridge at a cost not to exceed ($50,000) fifty thousand dollars.

Each bidder must submit his own plans and specifications with his bid, and must furnish bond for the proper and satisfactory completion of the contract.

More exact and complete information may be had by application to the County Road Engineer, Annapolis, Md.

The right is reserved to reject any or all bids if deemed to the best interests of the County to do so.

COUNTY COMMISSIONERS OF ANNE ARUNDEL COUNTY.
S. O. TILGHMAN,
Clerk.

Bids: July 14.

Curb, Gutters and Sewers

Ann Arbor, Mich.

Sealed proposals will be received by the Board of Public Works, Ann Arbor, Michigan, through the City Clerk, on or before 7:30 p.m., Eastern Standard Time, July 14, 1922, for the construction of concrete curb and gutter in curb and gutter Districts Nos. 24 to 49 inclusive, also for the construction of lateral sewer in Lateral Sewer District No. 112 and for a storm sewer on Brooks St., from Pearl St. to Miller Ave. Approximate quantities are as follows:

53,200 lin.ft. combined curb and gutter.
680 lin.ft. 10 in. vitrified pipe.
1,200 lin.ft. 12 in. vitrified pipe.
1,240 lin.ft. 15 in. vitrified pipe.
250 lin.ft. 18 in. vitrified pipe.
480 lin.ft. 22 in. vitrified pipe.
2,000 cu.yds. excavation and backfilling.

Plans and specifications are on file in the City Engineer's Office. A certified check for 5% of the bid must accompany each bid as guarantee of good faith of bidder and the Board of Public Works reserves the right to reject any and all bids.

ISAAC G. REYNOLDS,
City Clerk.

OFFICIAL PROPOSALS

Bids: July 12.

Waterworks

Vero, Fla.

Sealed proposals will be received by the City Council of the City of Vero, Fla., at the City Hall until 8 P.M. July 12, 1922, for a Water Works System. Separate bids will be received as follows:

SECTION 1. "Watermains." This will include cast iron pipe as follows: 1070 ft. of 10-in., 3840 ft. of 8-in. and 9360 ft. of 6-in.; 37 fire hyddrants and gate valves as follows: 1 10-in., 3 8-in., and 4 6-in.

SECTION 2. "Water Tower." This will include a 75,000 gal. steel tank on a 108 ft. tower, cast-iron riser pipe, and concrete foundations.

SECTION 3. "Pumping Plant." This will include motor driven centrifugal fire and service pumps of 750 and 500 G.P.M. capacity respectively, concrete foundations, piping and valves and a corrugated iron building.

SECTION 4. "Water Treatment Plant." This will include a continuous lime-soda softener of 12,500 gal. per hr. capacity, of reinforced concrete construction, and a spray nozzle aerator with a reinforced concrete basin and a 210 G.P.M. low lift pump.

SECTION 5. "Artesian Well." This will include the drilling and casing of an 8-in. well approximately 650 ft. deep.

The City reserves the right to award contract to separate bidders on the separate sections of the work, or to reject any or all bids, and to waive defects.

All bids must be upon the blank forms provided in the Proposal, Specifications and Contract.

Each bid must be accompanied by a certified check for 5% of the amount of the bid, and the Contractor must provide a construction bond for 25% of his bid.

Plans, specifications and form of contract and bond may be examined at the office of Carter and Damerow, Engineers for the City, at Vero, Fla., or sets may be obtained from them by making a deposit of Twenty-five (25) Dollars, Fifteen (15) Dollars of which will be refunded on their return within fifteen (15) days following the date of opening of bids.

FRED E. KING, Mayor.
GEO. M. WILLING, Clerk.

Bids: July 17.

Heating, Plumbing and Electrical Work

Urbana, Ill.

Sealed proposals for the Heating and Ventilating, Plumbing and Electrical Work on the New Agricultural Building to be erected for the University of Illinois at Urbana, will be received at the office of James M. White, Supervising Architect, 256 Administration Building, Urbana, up to 3:00 p.m. Monday, July 17, 1922.

Plans and specifications may be obtained after June 30th from the office of the Supervising Architect upon deposit of Ten Dollars ($10.00).

OFFICIAL PROPOSALS

Bids: July 14.

Highway—Route No. 1 Section No. 14

Trenton, N. J.

NOTICE IS HEREBY GIVEN that sealed bids will be received by the State Highway Commission of New Jersey for the construction of the following:

Route No. 1—Section No. 14 from Stelton Road to Metuchen, Middlesex County; estimated amount of Warrenite Bitulithic Pavement on a nine (9) inch Portland Cement Concrete foundation, 49,855 Square Yards.

Bids will be received at the office of the State Highway Commission, at the Broad Street Bank Building, Trenton, New Jersey, on Friday, July 14th, 1922, at 11 A.M., Standard Time, and opened and read immediately thereafter.

Drawings, specifications and form of bid, contract and bond for the proposed work are on file in the office of the State Highway Department, Trenton, New Jersey, and may be inspected by prospective bidders. Plans will be furnished on deposit of Ten Dollars ($10.00) upon application to the State Highway Department, 9th floor, Broad Street Bank Building, Trenton, New Jersey. Bids must be made on the standard proposal forms in the manner designated therein and as required by the 1922 specifications, same to be enclosed in sealed special addressed envelopes bearing the name and address of bidder and the name and section of the route on the outside, and must be accompanied by a certified check drawn to the order of the Treasurer of the State of New Jersey for not less than ten per cent (10%) of the amount of the bid, provided that said certified check shall not be less than $500.00 or more than $20,000.00, and be delivered at the above place on or before the hour named. Copies of the standard proposal from and special addressed envelope will be furnished on application. Bids not enclosed in special envelopes will be considered informal and will not be opened.

Each bidder must accompany his bid with a certificate from a surety company duly authorized to do business in this State, stating that such surety company will provide said bidder with a bond in such sum as is required in and in accordance with the provisions of said specifications, conditioned for the faithful performance of the provisions of the contract and specifications. Each bidder must also accompany his bid with a Statement of Equipment properly filled out.

By order of the State Highway Commission.

A. LEE GROVER,
Chief Clerk.

Bids: July 18.

Water Works Improvements

Wilmington, N. C.

Sealed proposals will be received until 12 o'clock noon on the 18th day of July, 1922, at the office of the Commissioner of Public Works, Wilmington, N. C., for furnishing materials for and the work of constructing additions to the present water purification plant and extending the water intake line approximately two miles.

The work will include approximately 650 ft. of 24 in. cast iron ball and socket pipe laid under the Cape Fear River at a depth of 26 ft., and also 10,350 ft of 42 in. wood, cast iron, or concrete pipe laid at an average depth of approximately 9 ft. below water level to Toomers Creek.

Bids will be considered on parts of the work separately or on the furnishing of materials independent from the construction work.

A certified check to the amount of 5% will be required with each bid and the right is reserved to reject any or all bids.

Plans and specifications may be obtained upon a deposit of $50.00 from the Carolina Engineering Co., Engineers, 411 Southern Building, Washington, D. C., or from

E. C. CANTWELL,
Commissioner of Public Works.

June 21, 1922.

You Think You Know Values—But—?

¶If in purchasing a steam shovel you were considering one at $5000 and another at $10,000 and the $10,000 one would save the amount of the other at 5% per year, would you buy the highest priced one because it would pay for itself and then pay you 5% on your investment? ¶Well then just apply the same argument. When you have a choice of the greatest bond service and Surety Contract Bond protection at no more than the same price and Surety Service that is only a fair average, you deserve the maximum of a highly specialized service. Surety Service is the one big thing that counts. ¶It might pay you well to read that over again.

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When you require a contract bond insist that the Ætna write it and you will be well and promptly served
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HARTFORD, CONN. AGENTS EVERYWHERE

OFFICIAL PROPOSALS

Bids, July 10.

Sewerage and Water System

Lebanon, Tennessee.

Sealed bids will be received by the City of Lebanon, Tennessee, at the office of City Clerk until 4 p.m., July 10, 1922, for the Construction of a Sewerage System and Disposal Plant, also Extension of Water System with a Steel Reservoir Tank, as per plans and specifications furnished by A. B. Clenny, City Engineer.

All bids must be sealed, and addressed to A. B. Clenny, Engineer, Lebanon, Tennessee, and marked "Sewerage and Water Bids."

Plans and specifications may be obtained from City Engineer upon deposit of twenty five ($25.00) dollars, refundable upon return of same.

Cashier's check in the sum of five (5%) per cent of total amount bid, payable to order of A. B. Clenny, Engineer, must accompany bids.

Bond with approved sureties for fifty (50%) per cent of the amount of contract will be required of successful bidder.

The City Commissioners reserve the right to reject any or all bids.

A. B. CLENNY,
City Engineer.

Bids, July 10

Concrete Power House

Ada, Ohio.

The Ohio Northern University, Ada, Ohio, has postponed awarding of a contract for a 45 x 75 reinforced concrete power house until July 10, 1922. A deposit of $5.00 is required for a set of plans and specifications. The full amount will be refunded upon return of the set.

For further information write to
C. C. CARPENTER, Engineer,
Ada, Ohio.

U. S. GOVERNMENT

UNITED STATES ENGINEER OFFICE, Baltimore, Md. Sealed proposals will be received here until 1 p.m., July 7, 1922, and then opened, for dredging Wicomico River, Maryland. Further information on application.

U. S. GOVERNMENT

TREASURY DEPARTMENT, Supervising Architect's Office, Washington, D. C., June 24, 1922.—SEALED PROPOSALS will be opened in this office at 3 p.m., July 20, 1922, for construction of new mailing shed at United States Post Office, Sheboygan, Wis. Drawings and specification may be obtained from the Custodian at the building, or at this office, in the discretion of the Supervising Architect. Jas. A. Wetmore, Acting Supervising Architect.

PROPOSALS FOR STEEL LADDER, PIPE, ETC.—U. S. Engineer Office, 329 Custom House, New Orleans, La.—Sealed proposals will be received here until 11 a.m., July 17, 1922, and then opened, for constructing and delivering steel ladder, pipe, gears and shafting for U. S. dredge "Gulfport." Further information on application.

SEALED PROPOSALS will be received and publicly opened in the office of the Director of the U. S. Veterans' Bureau, Room 1044 Arlington Building, Vermont Ave. and H. St., N.W., Washington, D. C. July 3, 1922, at 11 a.m. for the construction of concrete foundations for nine (9) patient buildings for 400 bed Hospital to be built at Northampton, Mass. Plans and specifications may be obtained upon deposit of $50.00 from the office of the Quartermaster General, Room 2306 Munitions Building, Washington, D. C., or from the office of the Constructing Quartermaster, Chamber of Commerce Building, Northampton, Mass.

TREASURY DEPARTMENT, Office of the Supervising Architect, Washington, D. C., June 19, 1922—Sealed proposals will be opened in this office at 3 p.m., July 19, 1922, for restoration of stone cornice and replacing of roof construction, etc., for the United States Post Office and Customhouse, at Oswego, N. Y. Drawings and specifications may be obtained from the Custodian at Oswego, N. Y., or at this office in the discretion of the Supervising Architect. Jas. A. Wetmore, Acting Supervising Architect.

U. S. GOVERNMENT

U. S. ENGINEER OFFICE, Pittsburgh, Pa. Sealed proposals will be received here until 12 noon (Eastern time) July 19, 1922, and then opened, for furnishing and delivering one steel derrick boat hull. Further information on application.

OFFICE, CONST. Q. M., Chanute Field, Rantoul, Ill. Sealed proposals will be received here until 10 a.m., July 10, 1922, for construction of boiler house and heating system. Deposit $15 required to insure return of plans and specifications. Further information on application.

U. S. ENGINEER OFFICE, Buffalo, N. Y. Sealed proposals will be received here until 11 a.m. (Standard Time), July 17, 1922, and then opened, for constructing rubble mound extension of west breakwater, Ashtabula Harbor, O. Further information on application.

U. S. ENGINEER OFFICE, P. O. Box 72, Louisville, Ky. Sealed proposals will be received here until 2 p.m., Central Time, July 17, 1922, and then opened, for furnishing and delivering Metal Work for Navigable Pass for Dam No. 44, Ohio River. Further information on application.

U. S. ENGINEER OFFICE, 250 Old Land Office Building, Washington, D. C. Sealed proposals will be received here until 12 m., July 17, 1922, and then opened for the construction of item a; item b, section No. 1; item b, section No. 2; and item c of Division No. 1; Division No. 2; and Division No. 3, of the water supply conduit for the District of Columbia. Further information on application.

U. S. ENGINEER OFFICE, P. O. Box 72, Louisville, Ky. Sealed proposals will be received here until 2 p.m., Central Time, July 18, 1922, and then opened for furnishing and delivering steel sheet piling for Dam No. 44, Ohio River. Further information on application.

PROPOSALS FOR 4 DIESEL ELECTRIC SEAGOING HOPPER DREDGES—Office, Chief of Engineers, Room 2802, Munitions Bldg., Washington, D. C. Sealed proposals will be received here until 12 o'clock noon, August 2, 1922, and then opened for the construction of 4 Diesel Electric Seagoing Hopper Dredges. Further information on application.

POSITIONS VACANT

A LARGE structural company has openings in its drawing room for several checkers and detailers; give full experience in applying. P-555 Eng. News-Record, Real Estate Trust Bldg., Phila., Pa.

COMPANY in Toronto, Canada, controlling several utilities in foreign countries, seeks experienced electrical designing draftsman familiar with making plans for large indoor and outdoor stations to take charge of drafting force. Please give full experience record, salary expected and time when free to begin. P-583, Eng. News-Record.

DRAFTSMEN, several, experienced, structural beam and column detailers for apartment and loft buildings; New York City; state age, nationality, experience and salary expected. P-467, Eng. News-Record.

DRAFTSMEN, detailers and checkers on shop detailing for structural steel. Morava Construction Co., 85th and Stewart Ave., Chicago, Ill.

ENGINEER wanted; capable technical man wanted to take off all kinds structural and reinforcing steel and miscellaneous items from plans and make shop details. Must be experienced. Address W. G. Thomas, Pres. Pidgeon-Thomas Iron Co., Memphis, Tenn.

ENGINEER or surveyor familiar with coordinate system of computations on subdivision work and who can make neat tracing wanted, one who has had experience and able to furnish good references; permanent position. John M. Farley, White Plains, N. Y.

ESTIMATORS—Engineering News-Record would like to get in touch with several quantity estimators in New York competent to make an analysis of materials in building and other construction work. High grade service is involved calling for broad experience and vision. The work will require only a small amount of time but will extend over one or two months. Kindly write to A. W. Welch, 10th Ave. at 36th St., New York.

POSITIONS VACANT

ESTABLISHED engineering and construction firm capitalized at $50,000.00, doing $200,000.00 business annually at 10% net margin, desires services of two young engineers. One for re-inforced concrete designing and estimating, the other on irrigation and drainage work. Territory covers Southwest Texas and Mexico. Tremendous future in this particular territory. Each must take one fifth interest in the firm, $10,000.00 investment required. An unusual opportunity for young college man who wants to grow with the firm. Write to manager Blue Flag Industries, San Antonio, Texas.

GOING concern in Cheboygan, Mich., desires to interest capable man familiar with structural sheet metal and bridge construction work. Must have technical experience and able to produce results. Someone with capital to take interest in business preferred. P-268, Eng. News-Record, Leader-News Bldg., Cleveland, O.

SEVERAL structural steel draftsmen wanted. Apply Hay Foundry and Iron Works, Newark, N. J.

Several Experienced

Structural Steel Draftsmen

for detailing and checking. Give experience, salary expected and when you can report for work.

Lackawanna Bridge Works Corp.
Box 991, Buffalo, N. Y.

POSITIONS VACANT

MAN wanted to teach structural engineering in an Eastern college; teaching and practical engineering experience preferred. Address, with full particulars concerning education, experience and salary desired, P-547, Eng. News-Record, Real Estate Trust Bldg., Phila., Pa.

STRUCTURAL steel draftsman and checkers with experience in bridge and structural work. State age, experience, nationality and salary expected. Permanent positions for experienced men. Anthracite Bridge Company, Scranton, Pa.

STRUCTURAL concrete designer and detailer, having some experience in designing and detailing on reinforced concrete buildings, to prepare working plans,, bar lists and bending details. Preference given to young technical graduate. State age, experience, references and salary expected. P-515, Eng. News-Record.

STRUCTURAL engineer wanted by large manufacturing concern. Applicant must be experienced in designing, checking and estimating reinforced concrete structures of all types. Excellent opportunity for advancement to the man who can make good. Apply by letter stating age, whether married or single, education, experience in detail, salary expected, and when you can report if employed. P-598, Eng. News-Record.

WANTED—Engineer and draughtsman, familiar with the design of street and sewer castings to design complete line of manhole frames and covers, sewer inlets, gratings, catch basins, etc. P-473, Eng. News-Record, Leader News Bldg., Cleveland, O.

WANTED: A man to serve as resident engineer on a sewer job in a town of 3,000 in Indiana or Arkansas. Give in handwriting experience, education, references, age and sample drawing if convenient Address Consulting Engineer, 924 Chemical Bldg., St. Louis, Mo.

WANTED — First-class detailers and checkers of structural steel for buildings and bridges. Virginia Bridge & Iron Co., Roanoke, Va.

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A LEADING organization desiring to fill an important position, for obvious ethical and other reasons, cannot invite directly the candidacy of any particular man. Similarly, no well-connected man will exploit personally his own qualifications, no matter how receptive he may be to overtures. The undersigned has been retained by a national clientele for many years, as a medium for negotiating preliminaries in such cases. Your permission to send booklet discussing the problem and describing the service, will in no degree obligate or compromise you. Strictly confidential. R. W. Bixby, Inc., 384 Lockwood Building, Buffalo, N. Y.

PROFESSORS, assistant professors and instructors of technical and engineering subjects wanted immediately for colleges and universities. Write fully; no advance charges. Educators' Department, H. H. Harrison & Co., Employment Service, 19 S. La Salle St., Chicago, Ill.

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Engineers and [illegible] of proven ability looking for [illegible] serve extremely at factory. Our Mr. H. H. Harrison has conducted many negotiations for you suitable executives, as he has successfully done for thousands of others since 1901. Inquiries invited.

The National Business Bourse, Inc.
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POSITIONS WANTED

Civil Engineers

CIVIL engineer, Cornell graduate, seven years' varied practical experience, railroad, industrial construction, design, highways; now employed as resident engineer on highway work in Ohio Valley, Miss. Salary $225 per month. PW-508, Eng. News-Record, Old Colony Bldg., Chicago, Ill.

CIVIL engineer, technical education, 34, 12 years' experience, townsite and industrial plant layout and construction, railway construction, irrigation and highway engineering, plane table topography. C. J., 208 N. Myers St., Charlotte, N. C.

CIVIL engineer and draftsman, age 32, married, 12 years' experience canal, highway and municipal engineering, hydrographic, topographic, city and general surveying, capable of handling field parties, neat, accurate and conscientious, desires permanent position in Eastern states; best of references; salary $160. PW-553, Eng. News-Record.

CIVIL engineer, graduate, age 27; 5 years' experience highway engineering and concrete construction and design; available at once. PW-548, Eng. News-Record.

CIVIL engineer; 12 years' railroad highway and building experience; university graduate; report immediately. Wire or write P. O. Box 228, Elkhart, Ind.

CIVIL engineer, 18 years' experience in design and construction of large works, will consider teaching mathematics, mechanics, hydraulics, or physics. PW-570, Eng. News-Record, Old Colony Bldg., Chicago, Ill.

CIVIL engineer and surveyor, American, single, technical graduate, age 37; broad experience, embracing industrial plants, docks, sewers and foundations; go anywhere. Box 1750 Montgomery Ave., New York, N. Y.

POSITIONS WANTED

CIVIL engineer, 28, single, graduate, 5 years' experience estimating, cost engineering, design and construction of reinforced concrete and steel structures, good building experience, employed, desires responsible position with contractor in New York City or Washington, D. C. PW-605, Eng. News-Record.

CIVIL engineer, 37; 14 years' experience, partly as contracting engineer; 4 years roads and paving; desires responsible connection, good on municipal work preferred. PW-606, Eng. News-Record, Old Colony Bldg., Chicago, Ill.

CIVIL engineer with 10 years' experience in harbor construction, who can take charge from beginning of plans to completion in the field, seeks new connection in his specialty of port improvements, dredging, pier and warehouse construction and repair. PW-610, Eng. News-Record.

CIVIL engineer, capable and experienced in railroad work as locating engineer or chief of party. Fifteen years in the tropics. Speaks, reads and writes Spanish. Familiar with sugar mill construction. Will accept position anywhere. South America preferred. PW-588, Eng. News-Record, Real Estate Trust Bldg., Phila., Pa.

CIVIL engineer, graduate, 14 years' broad experience, design and construction, docks, sewers, subways, power and industrial plants, hydro-electric developments. PW-573, Eng. News-Record.

CIVIL engineer of fifteen years' experience, wants position as city or county engineer. Have always made good. RWJ, Box 204, Rutherfordton, N. C.

Draftsmen and Designers

REINFORCED concrete and structural steel designer, experienced, oil refineries, power plants, gas plants, buildings. PW-586, Eng. News-Record, Real Estate Trust Bldg., Phila., Pa.

Estimators

[illegible] estimator and engineer, 25 years' experience, quantities and prices all trades, superintends, for maximum economy, every detail from soliciting to completion of contracts. PW-597, Eng. News-Record.

HIGHER ENGINEERING

(BY MAIL)

The EDUCATION that [illegible] the most [illegible] AFTER school or college days are over. EXPERIENCE is the [illegible] and the [illegible] sources from which [illegible] to get the [illegible] WILSON COURSES in Engineering [illegible] that enables men to break [illegible] the start. Thorough knowledge of your [illegible]

Literature [illegible]

Reinforced Concrete Design and Estimating.
Structural Steel Designing and Estimating.
Structural Drafting and Steel Design (Combined)
Concrete Drafting and Estimating
Structural Engineering (1 and 2 above)
Bridges (Steel and Concrete)

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Learn "Line" and "Grade" by Actual Practice.

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POSITIONS WANTED

Mechanical

MECHANICAL engineer and superintendent, experienced in cement plants, material handling and general plant design and construction. PW-472, Eng. News-Record.

MECHANICAL engineer, 13 years' experience in factory equipment, layout installation and maintenance, familiar with boiler economy, power generation and distribution in large manufacturing plants. PW-490, Eng. News-Record, Real Estate Trust Bldg., Phila., Pa.

MECHANICAL and structural tracer, 6 years' experience, some experience detailing, and student of engineering course by mail, desires permanent position with chance for advancement. Can also take charge of tracing department. PW-591, Eng. News-Record, Real Estate Trust Bldg., Phila., Pa.

MECHANICAL engineer, 26, M. I. T. 1922. Three years' government experience drafting and designing, 1918-1921. Would like opportunity to start in hydroelectric development, construction work or plant maintenance. PW-593, Eng. News-Record.

Structural

STRUCTURAL engineer, graduate, 20 years' experience with bridge and railroad companies, detailing, designing, estimating, desires position. PW-478, Eng. News-Record.

STRUCTURAL and concrete steel designing draughtsman, ten years' excellent experience, technical graduate, wants position. PW-601, Eng. News-Record, Real Estate Trust Bldg., Phila., Pa.

Surveying

INSTRUMENTMAN and draftsman, age 32, married, ten years' experience on all classes of surveys, desires position, preferably in eastern states. PW-592, Eng. News-Record, Old Colony Bldg., Chicago, Ill.

Superintendents

BUILDING construction superintendent desires connection with a first class firm. Advertiser has 20 years' experience on all kinds of buildings and types of construction; can handle either field or office; am at present employed, require two weeks to make change. PW-458, Eng. News-Record.

BUILDING construction superintendent, 20 years' experience on all kinds of buildings and type of construction; married. At present employed, desires connection with a first class firm. Can handle either field or office. Require two weeks to make change. Go anywhere in U. S. PW-611, Eng. News-Record.

BUILDING superintendent, 15 years' practical experience in all kinds of building construction. Salary reasonable. PW-585, Eng. News-Record, Old Colony Bldg., Chicago, Ill.

CONCRETE road superintendent, age 38, married; at present in Southeastern state; 16 years on heavy construction roads, dams, power plants, railroads; available thirty days' notice; salary or salary and bonus. PW-546, Eng. News-Record, Real Estate Trust Bldg., Phila., Pa.

CONSTRUCTION superintendent, 16 years broad experience, embracing industrial buildings, apartments, office buildings, hotels and general construction. Good executive, familiar with buying and costs. Location immaterial. Salary commensurate with results. Good reasons for desiring to make change. PW-524, Eng. News-Record, Leader-News Bldg., Cleveland, O.

CONSTRUCTION superintendent or foreman. Desires connection. Experienced on design and erection of power plant, gas plant, oil refineries. PW-587, Eng. News-Record, Real Estate Trust Bldg., Phila., Pa.

ENGINEER-Superintendent, age 34, technical education, 13 years' experience, highway, railroad, street and bridge construction, in charge either as engineer or superintendent, now employed as engineer in southern state. Desire permanent position with consulting engineer, contractor or industrial plant in Wilmington, Baltimore, Washington, Richmond or Norfolk section. Scotch by birth; hustler. PW-596, Eng. News-Record, Real Estate Trust Bldg., Phila., Pa.

EXPERT superintendent, estimator, organizer and pusher on roads, sewers, railways and heavy excavation. Superintendent, 2508 Maryland Ave., Baltimore, Md.

GENERAL superintendent; long experience in all kinds of building construction. Salary, $5,500. PW-569, Eng. News-Record.

SCHOOL construction superintendent. Any architect requiring an experienced man with good references address PW-289, Eng. News-Record.

SUPERINTENDENT on road construction, age 29; ten years' experience; certified member American Association of Engineers; formerly engaged as resident engineer with State highway commission in charge of the construction of bituminous, macadam, bituminous concrete, sheet asphalt and concrete roads and streets; now employed as timekeepeer and material man with large road contractor. Salary $200 and expenses. Available on one week's notice. Will call for interview within 200 miles of Philadelphia. PW-465, Eng. News-Record, Real Estate Trust Bldg., Phila., Pa.

SUPERINTENDENT or foreman, 18 years on waterworks construction work; understands all classes of pipe, heavy rock excavating. A1 mechanic, steam, electrical, and gas pumps. A1 references. PW-513, Eng. News-Record.

SUPERINTENDENT of construction will be open for position Aug. 15th; wide experience in all types of reinforced concrete construction, office buildings and school work; can furnish complete organization; references from leading contractors in country. PW-560, Eng. News-Record, Leader-News Bldg., Cleveland, O.

SUPERINTENDENT highway construction, experienced in all kinds of road-building, steam-shovel, quarry, heavy pipe-line and trolley work. Successful in handling large jobs and forces of men. PW-578, Eng. News-Record.

SUPERINTENDENT; 17 years' experience in full charge; best references. PW-574, Eng. News-Record, Real Estate Trust Bldg., Phila., Pa.

SUPERINTENDENT or general foreman of structural steel work, shop or erection, 19 years of experience; am well qualified, a hustler, 35 years old. Also willing to invest some money in a growing concern. Williamson, P. O. Box 302, Laundale, Ohio.

SUPERINTENDENT, road construction, age 30; nine years' experience; former resident engineer with State highway department in charge of construction. Available immediately. PW-607, Eng. News-Record, Old Colony Bldg., Chicago, Ill.

SUPERINTENDENT, 35, technical, buildings, bridges, railroads and structures, masonry, earthwork, surveys. Open for reasonable offer, any capacity with reputable company. PW-590, Eng. News-Record.

SUPERINTENDENT or carpenter foreman, 15 years' practical experience in building construction; pile driving; coffer dams; excavations, foundations; reinforced concrete, etc. PW-613, Eng. News-Record.

SUPERINTENDENT'S assistant, 29, technical graduate, 7 years' general construction. New York or vicinity. Highest credentials. Available on 2 weeks' notice. PW-612, Eng. News-Record.

WANTED—A position as general superintendent on either highway or city paving work. Thoroughly experienced and at present employed. PW-498, Eng. News-Record.

Miscellaneous

ARCHITECTURAL engineering graduate M. I. T. 1922. Specialized in reinforced concrete design. Desires position with a reputable concern. Broader experience than the average graduate; married, 25 years of age. Would consider sales proposition in some line connected with the building industry. Available immediately. Francis Geo. Davidson, 30 Medfield St., Boston, Mass.

ASSISTANT engineer, experienced on highway construction, municipal work, concrete, surveys. Registered engineer. Ready immediately. PW-602, Eng. News-Record.

C. C. N. Y. student in building construction, seeks on opening in construction. Location immaterial. PW-582, Eng. News-Record.

CONSTRUCTION manager and general superintendent; broad experience in general building construction. Experienced estimator-solicitor and purchaser, familiar with phases of contracts. PW-559, Eng. News-Record, Leader-News Bldg., Cleveland, O.

CONSTRUCTION engineer and job manager, 12 years' experience in railroad, oil field and refinery construction; speaks Spanish and is experienced in handling Latin-American labor. PW-497, Eng. News-Record.

CONSTRUCTION engineer, general industrial plants in their entirety, both mechanical and structural. 18 years' experience, available two weeks. PW-603, Eng. News-Record, Real Estate Trust Bldg., Phila., Pa.

CONTRACTING engineer, aged 44, married, with 20-year experience in building construction; thorough knowledge of costs, estimating, securing of contracts, purchasing and general superintending; industrial construction New England district preferred. PW-543, Eng. News-Record.

ENGINEER, 19 years' varied experience design, construction and improvement work largely with chemical industries, desires to establish connection having prospects for permanence with growing manufacturing concern or with consulting engineers; highest references. PW-558, Eng. News-Record, Leader-News Bldg., Cleveland, O.

ENGINEER, technical graduate, wide experience in design, construction and maintenance of steam electric power plants and industrial works, investigations, efficiency engineering, test and report work; location no object. PW-576, Eng. News-Record.

V. Cioffi & Son

Skilled and unskilled laborers supplied in short notice. Commissaries Keepers.

153 Bowery, New York City

The Erie Employment & Supply Co.

8701 Union Ave., Cleveland, Ohio

Boarding Camps, and Commissaries, operated for Railroads, Manufacturers, Contractors, Coal Mines, etc. We furnish laborers, mechanics and all classes of skilled help. Employment offices at Cleveland, O., Cincinnati, O., Toledo, O., Columbus, O., St. Louis, Mo., Indianapolis, Ind., Chicago, Ill., Danville, Ill., and Buffalo, N. Y.

POSITIONS WANTED

GENERAL construction superintendent and estimator desires connection with first class firm. Advertiser has 20 years of practical and theoretical experience on all types of construction. Am employed at present, require one month to change. PW-609, Eng. News-Record.

GENERAL foreman (Italian), hustler, not afraid to work; 20 years' experience on first-class work, sewers, waterworks, tunnels and foundation a specialty. PW-614, Eng. News-Record.

OVER twenty years' practical experience dam building, marked ability building heavy timber cofferdams for all purposes, handling difficult rivers; quick or still water, experienced diver; thoroughly understands handling water, all riggery and heavy equipment, good organizer, large followings; like connections with difficult work. PW-408, Eng. News-Record.

INSPECTING engineer, 28, technical graduate 1916, single, recently connected with engineering concern directing charge inspectors, traveling representative interviewing officials various fabricating (steel) and manufacturing plants throughout the eastern and central states regarding clients contracts for materials, machinery and equipment, smoothing out discrepancies in design between sub-contractors on construction previous to fabrication, passing inspection, running tests, in strict accordance with the specifications and expediting shipment of same. Exceptional references. Location immaterial. F. W. F., 635 75th St., Brooklyn, N. Y.

EXTRA WORK WANTED

ENGINEER desires extra work; surveys, map drafting, computations; evenings, Saturdays and Sundays, full time August and September. EWW-549, Eng. News-Record.

STRUCTURAL steel designing, detailing, checking by graduate engineer. J. P., Room 206, 147 East 125th St., New York City.

TUTORING

CIVIL engineer teaches arithmetic, algebra, geometry trigonometry, draughting, mechanical, structural, surveying, building construction; prepares engineering positions. Mendell, 50 E. 42d St., N. Y.

PROFITABLE practical individual instruction engineering and drafting by competent practising engineer and ex-chief draftsman. T-564, Eng. News-Record.

SALESMEN AVAILABLE

SALESMAN; machinery experience. References; age 35. SA-595, Eng. News-Record.

AGENTS AND SALESMEN

Resident Salesmen

Towns 10,000 and up, sewer, road material, or contracting experience, to close municipalities on patented storm sewer equipment. Liberal commission. Sanitary Catch Basin Company, Indianapolis, Ind.

Sales Engineer

Wanted to represent nationally known manufacturer of standardized material handling machines, conveyors and loaders, in Western New York State Territory. Equipment has wide application in both industrial and construction fields and especially road building. Prefer individuals who are at present handling few established non-competing lines. Commission basis. AS-589, Eng. News-Record, Old Colony Bldg., Chicago, Ill.

CONCRETE MIXERS AND CONTRACTORS' EQUIPMENT

Sales engineers with showroom and fully equipped repair plant will consider representing manufacturers for New York and Eastern territory. Excellent references and credit. Now acting as sole agents for leading manufacturer. Salesmen and engineers of ten years' experience.

WUNSCH & terKUILE,
302 McDougal St., Brooklyn, N. Y.

WANTED

Responsible Agency to Handle

ATLAS Mixers, Etc.

in Indiana, also agency wanted in Minnesota and North and South Dakota.

ATLAS ENGINEERING CO.
Milwaukee Wisconsin

REPRESENTATION AVAILABLE

Building Material Sales Organization

With established headquarters in New York and representatives in various parts of the East is open for a proposition. Do you manufacture building materials or equipment for which sales representation or agency is desired? RA-600, Eng. News-Record.

AGENCIES WANTED

Boston Dealer

In structural iron and steel wants Boston or New England territory agency for manufacturers of any kind of material used in building construction. Accustomed to taking quantities direct from plans and contract for the same. Many years' experience. AW-599, Eng. News-Record.

WORK WANTED

Structural Designing

Detailing and checking, tonnage or cost-plus basis. WW-608, Eng. News-Record, Leader-News Bldg., Cleveland, O.

PATENT ATTORNEYS

PATENTS—Send for form "Evidence of Conception" to be signed and witnessed. Form fee schedule, information, free. Lancaster and Allwine, 262 Ouray Bldg., Washington, D. C.

BOOKS AND PERIODICALS

Back Issues for Sale

Engineering News and Engineering Record, 1885 to 1921, inc.; Journal Association Engineering Societies, 1898 to 1913, inc. E&P-561, Eng. News-Record.

OFFICE SPACE FOR RENT

Wanted—Engineer

To share architect's office. Splendid light, complete services. Suite 1211, 105 West 40th St., New York City.

FOR SALE

Five Baker Manex Wheelers

For sale, all in good condition. Wm. D. Kelly, R. R. 4, Frankfort, Ind.

Scrapers and Tractor

3—1 yd. Baker Manex self loading scrapers. 1—5 ton Holt tractor. Used less than 4 months. FS-447, Eng. News-Record.

Shovel and Cars at Sacrifice

Revolving shovel $3,000. Rental $325 mo. 2-24" gauge Koppel cars $45 each. 1,500 ft. 24" gauge industrial track 25 cts. ft. 1—1,200 yd. asphalt plant, R.R. type. All in first class condition. F. H. Tobias, 901 Ogden Ave., N. Y. City. Tel. Jerome 2313.

Transit

Keuffel & Esser Engineers Transit, $146.00; used [illegible] days, cost $211.00. Write for photograph and full description. FS-604, Eng. News-Record, Old Colony Bldg., Chicago, Ill.

WANTED

Wanted To Buy

[illegible] to charter [illegible] 3 wheel steam [illegible] State make, age, price in first letter. W-594, Eng. News-Record, Leader-News Bldg., Cleveland, O.

BUSINESS OPPORTUNITIES

Splendid Opportunity

[illegible] Macon Concrete Roller Company.

Structural Draftsmen

Designing, Detailing, Plan Making

[illegible]

Agencies Wanted for

SOUTH AMERICA

A firm of importers and engineers located in Rio de Janeiro, with branches in Buenos Aires and Montevideo, and agents in all principal cities, desires to enter into negotiations with American concerns.

Specializing in all kinds of Machinery and Construction Material.

Willing to take on representations for all South America.

ATLANTICA LTDA

Avenida Rio Branco, 9, Rio de Janeiro

BUSINESS OPPORTUNITIES

Foreign Representative

Civil engineer going abroad will negotiate representation, act as agent or make business survey. BO-584, Eng. News-Record.

Limestone Quarry For Sale

Located on Huntingdon and Broad Top Mountain R.R., with siding facilities and easy trucking distance to State Highway. Quarry contains fluxing stone for furnace purposes, as well as ballast for railroad and State Highway. Orders on books sufficient to operate for balance of the year. Plant is in full operation and fully equipped. Paying proposition. Can be seen and investigated by calling on Warrior Lime & Stone Co., 401 Penn St., Huntingdon, Pa.

MISCELLANEOUS

Contracts Wanted

For steam shovel work. Have two type "B" high lift Erie shovels, with caterpillar traction. Will rent or contract. Washburne Engineering Co., Locust Valley, L. I.

Contracts Wanted

General contractors for United States and Latin America; purchasing agents for materials and machinery. Marck Engineering and Contracting Co., 373 Fulton St., Brooklyn, N. Y.

Trench Work Wanted

Have Austin trenching machine practically new. Will rent or take contracts. Washburne Engineering Co., Locust Valley, L. I.

ENGLISH FACTORY AVAILABLE

Works, Manchester, England. Area approximately 8000 sq. ft. on one floor. Capable of additional floor of 5000 sq. ft. Five minutes trolley or twelve minutes walk center of Manchester. Free rail delivery area, easy access ship canal. Suit motor garage or engineering and combining workshop and showroom. Rental £750 per annum. Apply

T. J. BENJAMIN, Solicitor
60 Castle Street, Liverpool, England.

FOR SALE

QUARRY

The finest Quarry property in eastern Pennsylvania. Established in 1780. Will divide or lease on Royalty.

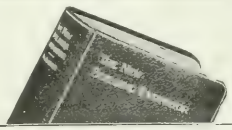
C. I. LEIPER, Swarthmore, Pa.

A CHANCE TO BUY A MACHINE BUSINESS

A new labor-saving machine, used by builders, contractors and others, has been successfully introduced in the Eastern city where it was developed. The machines cost less than $300 to build and the owners have leased them to contractors at $25 to $40 per week. It is the only successful machine in its field.

The owners offer this business for sale to a purchaser able to market these machines on a country-wide scale. A manufacturer or a sales organization reaching building contractors can add this to its line with great profit. An individual with the requisite sales experience, ability and moderate capital may find here the opportunity to engage in a profitable business on his own account.

The Engineering Business Exchange
30 Church St., New York City

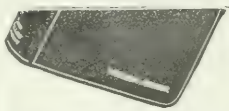


1922 Edition

READY FOR DELIVERY JULY 15

New Building Estimators' Handbook

By William Arthur



Over 1000 pages, 5½ x 7. Many tables and illustrations—Flexible leather $6.00.

DO YOU prepare your estimates from information based on actual, present-day conditions? Don't stake your profits on guesswork—let this new guide book eliminate the possibility of any loss.

This 1922 Edition has been brought sharply up-to-date to give actual time, labor and material required on every operation in all classes of work. The first printing will be ready June 30. At that time we will send you this 1922 *ESTIMATOR* for 5 days' FREE EXAMINATION if you return the coupon now. Send no money, just the coupon.

U. P. C. Book Company, Inc.
243 W. 39th Street, New York

Send me as soon as published Arthur's NEW BUILDING ESTIMATORS' HANDBOOK for 5 days' FREE EXAMINATION.

I will either return the book to you at the end of 5 days or remit its cost of $6.00.

Name .....

Address .....

E. N.-R. Subscriber 6-29-22

Bids July 28.

Light Plant Machinery For Sale

Homestead, Fla.

Sealed proposals will be received by the Mayor and Town Council Homestead Fla. on or before 8 p. m. Friday July 28 1922 and then publicly opened for, two complete electrical units, as follows:

Unit 1—1 De La Vergne Engine, Type D. H. oil, 225 r.p.m., 60 B.H.P., Westinghouse Generator, 40 kva., 3 ph., 60 cy., A.C., with switchboard and all accessories.

Unit 2—Fairbanks-Morse Type O, 75 kva., 257 r.p.m., 3 ph., 60 cy., A.C., 2300 v., Fairbanks-Morse Engine 100 hp., style V., 257 r.p.m., with switchboard and all accessories.

Each proposal must be accompanied by a certified check for 2 per cent of the amount of the bid, made payable to the City Clerk, R. E. Edwards, Town of Homestead, Florida, as evidence of good faith.

Specifications, forms of proposals, and general plan may be obtained from the engineer's office, Homestead, Florida.

The right is reserved to reject any or all bids.

S. E. LIVINGSTON, Mayor.
R. E. EDWARDS, Clerk.

B. M. Duncan, Engineer,
Town of Homestead.

NEW AND USED SURVEYING INSTRUMENTS AT FACTORY PRICES

Satisfaction guaranteed or money refunded. Write for complete list and catalogue of our high grade instruments and supplies for civil engineers, surveyors, mining, builders, contractors, etc.; 40 years' experience in repairing instruments of all makes at reasonable prices. Prompt service.

WISSLER INSTRUMENT CO.
607 N. Broadway, St. Louis, Mo.

Second-Hand Transits and Levels

Guaranteed in Good Order and Adjustment

Write for New Bargain List

WILLIAMS, BROWN & EARLE, INC.
918 Chestnut St., Philadelphia, Pa.
Department D

ATTENTION, ENGINEERS AND BRIDGE CONTRACTORS

Mail us check or money order for $5.00 and we will mail you complete set of BRIDGE DESIGNS AND SCHEDULES giving SCALE WEIGHTS of approximately 400 steel bridges, with 12 to 18 ft roadways, wood and concrete floors. All engineers and bridge contractors should have one. Guaranteed or money returned.

SOUTHWESTERN ENGINEERING CO.
Box 865, Oklahoma City

Steam Shovel for Rent

¾-yd Thew Shovel in fine condition.

Located at Corning, N. Y.

JAS. S. BRADEN, 30 Church St., N. Y.

EXCAVATION

Steam Shovels for rent with crews or work taken by contract.

Dinkeys and cars or teams furnished.

H. C. AMBLER
3717 Old York Road Philadelphia, Pa

FOR RENT AND SALE

STEAM SHOVEL

Traction ¾ yd. THEW shipper shaft type, in fine condition, for rental proposition. Traction ¾-yd. THEW steam shovel, combination boom, for sale

HENRY A. OTTO
Woolworth Bldg., Lancaster, Pennsylvania

Buy from the Largest Dealers in the United States

SELECT FROM A $2,000,000 STOCK OF GOVERNMENT MERCHANDISE

Needed Supplies in Army Goods

No. 1704. Gov't Feed Bags — Extra heavy canvas, heavy leather bottom, 60-in. adjustable head st p. Price per dozen, $3.00. Cases of 50 bags, $2.70 per doz.

No. 1816. Government Bunks—Real Tiger double deck bunks. All steel. Gov't cost between $10 and $15. In perfect condition. Price, each, $4.50

No. 1817. Government Liberty Steel Cots Collapsible, new. Painted either gray or black. 2 ft. 6 in. by 6 ft. 4 in. Price each, $1.75

No. 1818. Gov't new folding Canvas Cots — Covered with 30-ounce waterproof khaki Duck — on a hardwood frame. Price, per doz., $32.50

No. 154. Gov't Water Buckets—Collapsible, extra heavy, leak-proof canvas. 40 to a case. Price, doz., $3.60

No. 1702. Gov't Waterproof Duck —No. 6, thought to be 30-oz. wt., khaki color. Comes in 150 yard bolts. Price F. O. B. Louisville, Ky., or Chicago, per yard 27½c. Less than bolt lots, 35c

No. 1509. Gov't Sibley Stoves—New. Burn wood. Wonderful heaters. Conical shape. Price each, $1.00.

No. 1810. Gov't Overalls and Jumpers — Brand new in original government bales of 50. No. 220 Denim Overalls bibless, loops for belts and buttons. Sizes up to 44. Jumpers buttoned or slip-over Dungaree style; sizes up to 50. Prices, per dozen, Overalls $6.50; Jumpers $6.00

No. 571. Gov't Roasters—heaviest black iron, Bakers, Roasters or Drip Pans. Extra strong and reinforced. Sizes 30x23, 27 x 24, 21 x 21, 24 x 16, 22 x 11, 21 x 10. Prices, any size, per dozen, $3.00

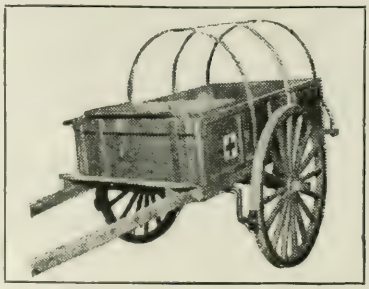
No. 811. Gov't Stencil Outfits— 1 set of 1-in. alphabets, 1 set of 1-in. figures, 1 set of 1½-in. alphabets, 1 set of 1½-in. figures, 1 can marking paste, 1 marking brush—all in wooden cabinet. Price complete, $1.00

No. 807. Gov't Stencils—30 pieces —brass, alphabets. Price per set, 35c

No. 805. Gov't Stencils—12 pieces —brass figures 1 in. long. Price per set, 20c

No. 1900. Gov't Hip Boots—First quality rubber. Sizes 7 to 11. One dozen pairs to case of a size. Price by the case, per pair, $2.25. 10 dozen lots, 2 dozen of each size, per pair, $2.00.

No. 84. Gov't Castile Soap—Genuine imported white. In 4-lb. bars, 18 bars, or 72 lbs. to the case. Price per bar, 60c. Per case, $9.00



No. 1701. Gov't Carts or Trailers—New. Strongest ingenuity could produce. Every conceivable reinforcement. The box is 8 ft. long, 4 ft. wide, 21 in. deep, about 1¾ in. thick. Wheels iron covered and about 3 in. thick; 60-in. diam. with 16 massive, solid spokes, 3 stakes for canvas cover. Shafts, chain tugs, seat, footboard, back chain and poles, etc. Best trailer money can buy. Gov't cost about $200.00. Immediate shipments, Price F. O. B. Hawthorne, Ill., [Chicago suburb], $25.00.

No. 158. Gov't Pyramidal Tents—Standard 12 and 16 ounce duck, Army tents. 16 ft. by 16 ft., 3 foot high side wall. 11 ft. high at center. White or khaki. Reclaimed but guaranteed perfect. Poles not included. Price, $14.

No. 1700. Gov't Tarpaulins—Genuine government 30-ounce waterproof duck. Heaviest mfd. Any size up to 150 x150 ft. Sizes below always in stock.

8 ft. x 10 ft. 6 in.	$ 5.60
10 ft. 6 in. x 12 ft.	8.40
10 ft. x 15 ft.	10.50
12 ft. x 14 ft.	12.25
14 ft. x 16 ft.	16.80
16 ft. x 20 ft.	22.40
20 ft. x 40 ft.	56.00

Any other size you desire at 7c per sq. ft.

Other Army Goods Values

Government Huck Towels — All brand new—bleached, 16x33. No. 884, per doz., $1.25. Bleached linen finish, hemmed ends, 17½x36. No. 77, per doz., $1.37½. Same quality but extra heavy, 17 x 33. No. Memphis, per doz., $1.50. Heavy bleached, 17x35, No. 537, per doz., $1.40. Soft finished hemmed, bleached, 17½ x 35, No. Griffin, per doz., $1.15. Extra heavy bleached, hemmed, 17 x 38, No. 1634, per doz., $1.30. New line. Price per doz. for 11 bales of each number, 6 doz. to bale, $1.08 F. O. B. Atlanta, Ga.

No. 156—Gov't Ponchos — Rubberized, waterproof. Reclaimed but perfect. 50 to bale. In bale lots, price each, 75c. Less than bale lots, 85c.

No. 99. Gov't Slickers—Brand new black raincoats, full length, sizes to 46, $1.75

No. 413. Gov't Mattress Covers— Brand new. Extra heavy twill muslin. In doz. lots, price each, 40c.

No. 1710. Gov't Pup Tents — Heavy khaki, waterproof. Complete with poles, each, new, $1.75. Same tent, not new but good condition, 90c.

No. 1711. Gov't Pup-Tent Poles —New. Best quality. Packed 720 to case.

Price per dozen	60c
Price each by the case	3½c
Price each in lots of 2,500	2½c
Price each in lots of 10,000	1½c
Price each by the carload	1½c

No. 1981. Gov't. Mess Kits—Army style. Reclaimed. Aluminum meat cans, cover and handle. Per doz., $1.20.

No. 1902—**Gov't Finest Black** Chrome Leather Navy Boots, 17 inches high. Sizes 7 to 12. Per pair, $3.00.

No. 152 — **Gov't Class B. Khaki** Breeches, per doz., $4.50.

No. 1812. Gov't Navy Wool Underwear. Medium weight, over 75% pure wool. Shirts sizes 36, 40, 42, 44. Drawers 34, 36, 38, 40. Shirts $6 per doz., drawers, $5.50.

No. 1952. Gov't Heavy Wool Sox. 25 dozen to bale. Gray, white or blue. Dozen, $1.80.

No. 1963. Gov't Reclaimed Aluminum canteens, per dozen, $1.50.

No. 567. Gov't Heavy Duck Pistol Belts, per dozen, 90c.

No. 1814. Gov't Rainproof, Windproof suits, coat, hood and trousers, fastening snug at wrists, ankles, waist and throat, $1.75 per suit in cartons of 2 small, 6 medium and 3 large suits. $3 each in smaller lots.

No. 1924 — **Gov't Leggings and** breeches laces, toughest produced. Good for high lace shoes and boots. Leggings laces, 10 gross per pack, $1.00 per gross. Breeches laces, 5 gross per pack, $4.75 per gross.

No. 439—Gov't all leather blanket roll straps. Reclaimed but perfect. Per doz. 60c

GALLANT MERCANTILE COMPANY

111 South Market Street
Chicago, Illinois, U. S. A.

TERMS: Strictly net cash — no dating—no discount—merchandise returnable if not satisfactory.

All prices F. O. B. Chicago Unless otherwise stated

References: Foreman Bros. Banking Co., Chicago, or any Mercantile Agency

ORDER BY NUMBER AS WELL AS BY NAME

SEARCHLIGHT SECTION

USED EQUIPMENT AND NEW

Offered for Re-sale

Space for these advertisements is sold by the advertising inch, 20 inches to a page. The price per inch is based on total space used—multiply ad space by number of insertions.

RATE PER INCH:
1 to 3 inches.....$5.00 an inch
4 to 7 inches..... 4.80 an inch
8 to 14 inches..... 4.70 an inch

An inch is measured vertically on one column—three columns to a page. Any space may be used measured by the even inch in height by 1, 2, or 3 columns in width.

RATES FOR LARGER SPACES, OR SPACE ON A YEARLY BASIS, FURNISHED ON REQUEST.

E. N. R.

FOR RENT

PAVER

1—Four Bag Lakewood, boom and bucket. Complete with Batch Meter and Batch Transfer Derrick.
Good Condition. Available July 15th.

75—Four Bag Lakewood Batch Boxes.

122,000 ft. Lakewood Heavy Duty Track.
Available Immediately.

MICHAEL STAUB
Pitman, N. J.

WANTED AT ONCE

1—Locomotive crane caterpillar traction, full circle, revolving type; ¾ cu. yd. capacity.

1—100-ft. steel concrete tower, and metal chutes.

Address, A. PHELPS & SONS
Knoxville, Iowa.

WANTED

Steel Sheet Piling

For construction work in Central District. 1200 feet varying in length from 15 feet to 35 feet.

Sklanberg Construction Co.
First National Bank Bldg., Chicago, Ill.

Steel Sheet Piling
FOR RENT
Bought and Sold

J. R. WEMLINGER & CO., Inc.
149 Broadway, New York

Wanted—Pile Driver

Water Machine, second hand or new, scow about 25 x 50, hammer 3000 lb., leads 60 ft

NEW YORK DOCK CO.
Joralemon and Furman Sts., Brooklyn, N. Y.

WANTED TO BUY

Cummer Iroquois or Warren 1250 yard

ROAD PLANT

Or would buy dryer only.
Box 1031 Amarillo, Texas

WANTED

PAN CONVEYOR

30 to 35 ft long. Mail details and price.

STANDARD ELECTRIC MACHY. CO.
7 and 9 E. Hill St., Baltimore, Md.

WANTED

A Model 31 or Model 36 Marion Revolving Scraper Bucket Excavator, mounted on Caterpillar trucks.

The American Agricultural Chemical Co.
2 Rector Street, New York, N. Y.

WANTED

8 inch Sand Dredging Pump or Complete Outfit. Must stand investigation and be a bargain.

W-580, Engineering News-Record
1570 Old Colony Bldg., Chicago, Ill.

FOR SALE

CONTRACTOR'S MISCELLANEOUS EQUIPMENT

6—11 x 16 Vulcan Locomotives, 36-in. gauge.

80—1-yd two way 36-in. gauge Dump Cars, steel draft beam.

1—Double Truck 36-in. gauge W. W. S Spreader (New).

10—Double Trucks 36-in gauge Flat Cars 26 ft. to 30 ft. long.

2—No. 41 Marion Steam Shovels, No. 2296 and No. 2923.

1—No. 60 Marion Steam Shovel. No. 2382.

2—Steam Driven Ingersoll-Rand Compressors, Imperial Type 10. 1—888 ft. and 1—599 ft.

25—Ingersoll-Rand Tripod Drills, F-93.

1—28-in. x 8-ft. Planer.

1600-ft. ⅝-in. x 24-in. Pipe, lengths 15 ft. to 40 ft. (Lap weld).

2—Matt-son Air Lock, Concrete Lock, shafting and medical lock.

100 tons 60-lb. Rails.

200—3-in. House Shoring Jacks.

1—Elevator for handling bagged cement.

1—Belt Conveyor for sand and gravel.

15—5-ton Pierce-Arrow Trucks.

RODGERS & HAGERTY
INCORPORATED
70 East 45th St., New York

LOCOMOTIVES

2—9 x 14 American Saddle Tank, 36-in. gauge, Hartford inspection 135 lb. (Bargain for quick removal.) Philadelphia location.

KEYSTONE GRADER

No. 4, complete with excavating scoop, ditching scoop, boom and clamshell bucket.

KOEHRING PAVER

No. 18E, half caterpillar, boom and bucket, batch meter. Rated capacity of 28 cu. ft. loose material, 18 cu. ft. of wet concrete. In very good condition.

Complete Line New and Used Equipment

CONTRACTORS' EQUIPMENT
CONBOY CO.
CONSTRUCTION MACHINERY.

Perry Building *Philadelphia*

Electric Locomotive Crane

1—Browning 15-ton, 10 ft. gauge, 50 ft. boom 1½-yd. bucket, including one 20-ton hopper scale car. Located in Philadelphia.

HOISTING MACHINERY CO.
50 Church St., New York

FOR SALE

Steel Superstructure

of West Main Street Bridge over Erie Canal in City of Rochester, N. Y. Two Arch Chord Trusses, 20 web members to each chord. Is 139½ feet long with 43 foot roadway and 11 foot sidewalks on each side of roadway. Weight approximately 120 Tons. This bridge is in excellent condition and can be re-erected for use as a street or highway bridge. It is now in service but is to be removed on account of the construction of a subway. We can furnish detailed plans of the structure.

SCOTT BROTHERS
31 Exchange Street, Rochester, N. Y.

For Sale or Rent

LOCOMOTIVE CRANE

1—Orton & Steinbrenner 8-wheel, M.C.B., 40-ft. boom, 1-yd. clam shell bucket. Ready for immediate shipment.

MIDWESTERN COMPANY
532 Marquette Bldg., Chicago.

HOISTS DERRICKS

ELECTRIC HOIST AND DERRICK $1700

Price F.O.B. Cars, Hog Island, Pa.

You Save at Least $2000

These Hoists and Derricks are standard late models, manufactured by The American Hoist & Derrick Co., St. Paul, Minn. They are almost new, and every one is GUARANTEED to be in first-class running order.

DIMENSIONS OF DERRICKS

Mast.....16 in. square, 40 ft. high.

Boom.....Made of (2) 14 in. sq. timber 48 ft. long spliced to lengths of 80 ft. with (2) ⅞ in. and (2) 1¼ in. truss rods.

Stiff Legs..14 in. sq., 62 ft. long or 16 in. sq., 50 ft. long, will furnish either length desired, capacity 5 to 12 tons. Bull wheel 16 ft. dia. Principal sheaves 16 in. dia. and 14 in. single blocks.

The Cable which was formerly used will be given with each purchase of a Hoist and Derrick.

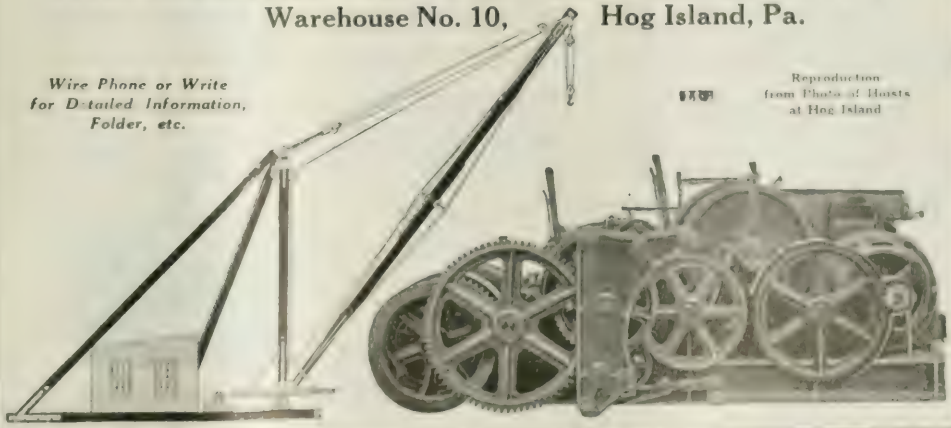
The Hoists have two drums and swingers, and are complete with Starting and Control Equipment. The MOTORS are Otis A. C., 60 cycle, 3 phase, 440 volt, slip-ring induction type and, if desired, may be changed to suit the individual current requirements of purchasers at cost.

These Hoists and Derricks are assembled on the Grounds at Hog Island and may be inspected at any time. This Equipment is being sold complete and in units of a Hoist or Derrick if desired. Immediate shipment can be made anywhere, but QUICK ACTION IS IMPERATIVE.

THE ELECTRIC HOIST & DERRICK COMPANY

Warehouse No. 10, Hog Island, Pa.

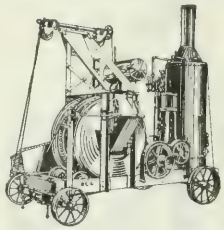
Wire Phone or Write for Detailed Information, Folder, etc.



Reproduction from Photo of Hoists at Hog Island

"WE BUY—REBUILD—SELL—OR RENT"

All the Equipment listed below is owned by us and may be inspected at one of our own warehouses.



CONCRETE MIXERS

45—Concrete Mixers. Sizes 28S, cap. 1 yd., 21S, cap. ¾ yd.; 14S, cap. ½ yd., and 10S, cap. 1/3 yd. With steam or electric power, with side loaders or batch hoppers. Following makes: Marsh-Capron, Koehring, Milwaukee, Ransome, Smith, Smith-Chicago, Rex, Lakewood, Foote, Cube, or Oshkosh.
20—7S, capacity 1 bag, with low charging platforms, with gasoline engines.

CARS

20—Western 1-yd., 36-in. Gauge Dump Cars.
20—Koppel, steel, V-shape, 10-36 in. gauge, 10 24-in. gauge; capacity 1½ yd.
15—Flat Cars, 24-in. gauge, platform, 38 in. 72 in.; capacity, 4 tons.

CRANES

3—Byers Auto Cranes on traction wheels, with 30-ft. boom, with ½ or ¾-yd. clam shell buckets.
1—15-ton, 3-wheel O. & S.; 40 ft. boom.
1—O. & S. Full Revolving Crane; traction wheels; steam, ¾-yd. bucket.

DERRICKS

8—Stiff-Leg Derricks, with booms ranging from 50 to 75 ft.; mast legs and sills in proportion, for handling ½, ¾ or 1-yd. buckets.

CLAM SHELL BUCKETS

26—Clam shell buckets. Sizes ½, ¾, 1, 1½, or 2 yd. All makes.

ROAD ROLLERS

3—Erie Tandem, 1-7 ton, 1-3 ton, 1-5 ton.
1—New Huber 10-ton, 3-wheel steam.
2—Kelly-Springfield, 10-ton, 3-wheel; 1 gas; 1 steam.
1—Iroquois, 5-ton, steam Tandem.
5—10-ton, 3-wheel, 3 Buffalo-Pitts, steam, 1 Iroquois, steam, 1 Austin Gas.

TRENCHING MACHINE

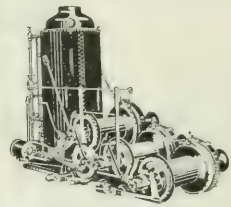
1—Buckeye type, gasoline; size No. 3.

STEAM SHOVELS

1—Type B Erie, on traction wheels, with high lift boom, with ¾ yd. dipper.
1—Bucyrus, 70 ton, on M.C.B. standard gauge trucks, with 2½ yd. dipper.
2—Keystone Excavators. 1—No. 3; 1—No. 6, with clamshell boom.
1—Type O Thew ¾ yd. bucket.
1—Marion No. 31, 1 yd. dipper.

We carry a complete line of Boilers, Compressors, Cars, Engines, Elevators, Hoppers, Steam Hammers, Rollers, Pumps, Spouting and Portable Track.

Write or wire your requirements.



HOISTS

24—Three-drum Hoists, with or without boilers. Sizes 10 x 12, 9 x 10, 8¼ x 10, and 7 x 10 with separate swingers for derrick work. All makes.
30—Two drum Hoist, with or without boilers. Sizes 10 x 12, 9 x 10, 8¼ x 10, 7 x 10, 7½ x 10, 6 x 8, and 5 x 8. Can be equipped with holding drum for bucket work. Several special Cableway Excavator or Drag Scraper Hoists. All makes.
6—Gasoline Hoists, Single and Double Drum, 6, 10, and 15 hp. engines.
6—Swinging Engines.

LOCOMOTIVES

1—Davenport, 18-ton, 36 in. gauge; steam saddle tank.
2—Davenports, 24 in. gauge, steam, 7 tons.
1—Shay, geared, 13-ton, 36-gauge, steam.
5—Whitcomb, gasoline, 36 in. gauge, 2-4 ton, 3-8-ton.

RAIL AND TRACK

3 miles, 24-in. Gauge Portable track with steel ties, made up of 20-lb. rail with switches.
100-Ton, 20-lb. Rail.

EQUIPMENT CORPORATION *of* AMERICA

PITTSBURGH, 855 Empire Bldg.
Phone, Smithfield 1502

CHICAGO: 1455 Lumber Exch.
Phone, Randolph 6586

PHILADELPHIA: 655 Land Title Bldg.
Phone, Spruce 5498

Air Compressors

In Stock, Immediate Delivery

1—22-in. and 44-in. x 25½-in. x 40-in. x 36-in. Ingersoll-Rand, (steam); capacity 2715 cu. ft.

1—18-in. x 20¼-in. x 13¼-in. x 18-in. Ingersoll-Rand (steam); capacity 1115 cu. ft.

1—20-in. x 12½-in. x 16-in. Sullivan (belt); capacity 873 cu. ft.

1—12-in. x 12-in. x 12-in. Chicago Pneumatic (steam); capacity 361 cu. ft.

1—12-in. x 7½-in. x 10-in. Rand (motor); capacity 249 cu. ft.

1—9½ in. x 13-in. x 10-in. Westinghouse Air Brake (steam); capacity 92 cu. ft.

1—8-in. x 7½-in. x 9-in. Westinghouse Air Brake (steam).

Also a large stock of Hoisting Engines, Boilers, Centrifugal Pumps, Rock Crushers, Concrete Mixers, etc.

L. F. Seyfert's Sons, Inc.

437 N. 3d St., Philadelphia, Pa.

FOR SALE

LOCOMOTIVE CRANES

1—McMyler 15-ton, 8-wheel, M.C.B.; single line, 40-ft. boom, low price.
1—15 ton O. & S., 8-wheel, M.C.B.; 70-ft. boom, with 25 ft. removable section; double power driven drums; also dragline attachments, equipped with outriggers.

ASPHALT PLANT

1—Iroquois 800-yd. Road Asphalt Plant; complete.

CRUSHER OUTFIT

1—Gates, 18-K; Gates 60 in. x 20 ft. revolving screens; 42-in. bucket elevator; 80-ft. centers.

NEW TRACTION CRANES

Full Revolving Road Cranes; 7-ton capacity, with ¾-yd. bucket.

LOCOMOTIVE

American 6-wheel Switcher. Cylinders 18 x 24-in., drivers 44 in., wheel base 11 ft. 6 in., weight 60 tons.

ROAD ROLLER

1—Kelly-Springfield 10-ton, 3-wheel, double cylinder, steam road roller.

STEAM SHOVELS

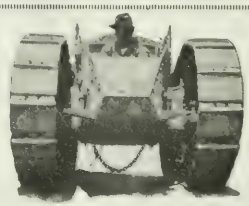
1—Marion, Model 31; 1-yd. dipper; caterpillar traction.
1—Marion, Model 28; ⅝-yd. dipper; Shop No. 3328.

We carry in stock concrete mixers, air compressors, road rollers, hoisting engines, boilers, buckets, pipes, cars and other equipment and machinery.

F. Mayer, 737 Monadnock Bldg., Chicago, Ill.

Powerful Caterpillar Tractor for ¼ value

An exceptional purchase from the Government of a limited number allows us to offer this exceptional value while they last.



Specifications

Weight 6 tons
Length 13 feet
Height 5 feet 6 inches
Four speed transmission
Forty horsepower at 1300 rpm.
Drawbar Pull 6 tons
Width 5 feet 9 inches
Turning Radius 13 feet

The Sales Corporation

1423 New York Ave., Washington, D. C.

CRANES

1—23-ton. 8-wheel McMyler. Double Drum. 50-ft. Boom.
1—15-ton. 8-wheel Industrial Double Drum 45-ft. Boom.
1—15-ton. 8-wheel Brownhoist. Double Drum. 41-ft. Boom.
1—15-ton. 8-wheel Brownhoist. Single Drum. 41-ft. Boom.
1—75-ton. Industrial Wrecking Crane.

STEAM SHOVELS

1—Type B. Erie. Traction Wheels. ¾ yd. Dipper.
1—14-B Bucyrus. Traction Wheels. ¾ yd. Dipper.
2—18-B Bucyrus. Traction Wheels. ¾ yd. Dipper.
1—35-B Revolving Bucyrus. 1¼ yd. Dipper.
1—55-ton. Std. Gauge Bucyrus. 2 yd. Dipper.
1—70-C Bucyrus. 2½ yd. Dipper.

DRAGLINE EXCAVATORS

2—Class 24, late design Bucyrus. 100 ft. Booms. 3½-yd. Buckets.

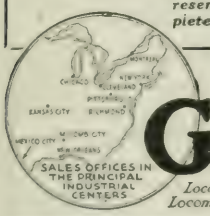
DUMP CARS

16—12 yd. Std. Gauge. Western. 2-way Air Dump Car.
30—4-yd. 36-in. Gauge. Western. Heavy Duty Dump Cars.

CARS

25—10 ton capacity. 36-ft. Wooden Underframe Flat Cars.
16—40 ton capacity. 36-ft. Steel Underframe. Low Side Gondolas.
35—40-ton capacity. All Steel. Self-Clearing. Hopper Cars.
50—50-ton capacity. Standard Gauge Box Cars.

If you don't see what you want in this list, write us. These items represent only a fraction of our complete stock.



GENERAL EQUIPMENT COMPANY, INC.

Locomotives, Dinkies, Dump Cars, Steam Shovels, Draglines, Ditchers, Boilers, Locomotive Cranes, Flat Cars, Gondolas, Box Cars, Air Compressors, Coaches, Rail

This Company is really a sort of Super-Purchasing Agent

for Purchasing Agents. Its exclusive selling contracts with railroads, its relations with contractors who have equipment to dispose of and its widely separated offices are all at the disposal of the man who knows what he wants and wants to know that every dollar of his money is going farthest in getting it. And this applies to the smallest individual contractor as well as the Purchasing Agents of the greatest contracting organizations.

GENERAL EQUIPMENT COMPANY, Inc.
30 Church Street, NEW YORK CITY

CHICAGO, ILL. Peoples Gas Bldg.
CLEVELAND, OHIO Hanna Bldg.
PITTSBURGH, PA Oliver Bldg.
RICHMOND, VA Railways and Power Bldg.
NEW ORLEANS, LA. Maison Blanche Annex
KANSAS CITY, MO Triangle Bldg. Gotham Road
MEXICO CITY MEXICO Edificio La Mutua
MONTREAL CANADA 285 Beaver Hall Hill
McCOMB CITY, MISS.

Exceptional High Grade Equipment at Exceptionally Low Prices

PUMPS

American Well Works Centrifugal Pumps.

4—Size 1 — 25 g.p.m.
5—Size — 50 g.p.m.
3—Size 2 — 70 g.p.m.
2—Size 3 — 350 g.p.m.
1—Size 5 — 750 g.p.m.
3—Size 5 —700 g.p.m., 2-stage, 185-ft. head.
All the above with bases and couplings.
4—Size 5—4 in. with base and couplings.
1—No. 4 Platt, 4 in. suction, 3 in. discharge, single stage, D.S. Centrifugal on base, direct-connected to Terry steam turbine, 420 g.p.m., 40-ft. head.
1—7 in. x 4 in. x 8 in. Advance Duplex Pattern Steam Pump.
2—Keystone Deep Well Pumps, Nos. 33 and 34, double stroke, geared pump head.

MOTORS

3—32 hp. G. E. Form M, 3 ph. 60 cy., 220 v., 720 r.p.m.
1—25 hp. Western Electric 900 r.p.m., 3 ph., 60 cy., 220 v.
1—75 hp. General Electric Form L, 900 r.p.m., 3 ph., 60 cy., 220 v.
5—100 hp. G. E. Form L, 720 r.p.m., 3 ph., 60 cy., 220 v.

NEW CAR WHEELS

700—Car Wheels, "Star Brand," self-oiling, 12 in. diam. tread to tread, 2 in. bore, chilled tread.

HOISTS

1—Flory Single Friction, direct-connected to 35 hp., 3 ph., 60 cy., 220 v. motor.
1—Lidgerwood Steam Hoisting Engine, double cylinder, double drum, with locker and foot brakes.

BOILERS

1—60 hp. Economic, 160 lb.
1—— hp. Kewanee Fire Box, 100 lb.
1—75 hp. Economic, 160 lb.

THE MARKMAN ENGINEERING CO.
111 W. Monroe St., Chicago, Ill.

ROAD ROLLERS

1—10-ton, 3-wheel, Buffalo-Pitts, double cylinder, steam.
1—10-ton, 3-wheel, Kelly Springfield, double cylinder, gasoline.
1—10-ton, 3-wheel, Kelly Springfield, double cylinder, steam.
1—10-ton, 3-wheel, J. I. Case, Steam.
1—8-ton, tandem, Iowa Spring-field, steam.
1—6-ton, tandem, Iowa Spring-field, steam.
1—4-ton, tandem, Iowa Spring-field, steam.

DERRICKS

1—60 ft. guy, 30,000 lb. Stiff Leg Derrick, with 40 ft. boom.

HOISTING ENGINES

1—Nordyke & Marmon Co., 12 in. Cyl., with A.S.M.E. boiler.
1—10 in. by 12 in. Cyl., with boiler.
1—8 in. by 10 in. Cyl., with boiler.
1—Lidgerwood, 10 in. by 12 in. Cyl., with boiler.
1—Lidgerwood, 8 in. by 10 in. Cyl., with boiler.

MISCELLANEOUS

1—No. 70 Thew Steam Shovel, 2 yd. dipper.
1—Broderick Crane, 20 ft. boom, 15 ton capacity.
1—Ingle Derail Frog, 100 lb. rail, 24 in. gauge.
1—Lakewood Bench Cars, 24 in. gauge.
41—Koppel Flat Cars, 24 in. gauge, 5 ton capacity, both.

Midwestern Company
140 South Dearborn St., Chicago, Ill.

MUNDY HOISTING ENGINE

1—8 in. by 10 in. Double Cylinder, Double Drum Hoisting Engine, with A.S.M.E. Boiler, No. 14-30, 100 lb. W.P., 60 in. diam. by 10 ft. long, with 250 ft. 5/8 in. Wire Rope, and Locomotive Type Smoke Stack.

Tavistock Country Club, Tavistock, N. J., Bell 'Phone Haddonfield 1879.

ONE CUBIC YARD
Williams Clamshell Bucket

1—— $[illegible]
TAGE B. CLAVELLINA, Contractor
[illegible]

CRANES

1—15-ton O. & S. Locomotive Crane, 8-wheel, M.C.B., 45-ft. boom, double drums, A.S.M.E. boiler.

1—Brownhoist, 15-ft. gauge, full revolving Crane, 4-wheel, 75-ft. boom, double drums, electrically operated, will handle 1½-yd., 2-yd. bucket. Operator's house mounted 20-ft. over crane.
This is an ideal crane for your dock for handling coal, sand, gravel or any bulk material.

1—30-ton O. & S. Locomotive Crane, 8-wheel, M.C.B., 75-ft. boom, double drums, 1919 Crane.

MISCELLANEOUS

1—Erie Steam Shovel, type B, ¾ yd., Traction wheels.

1—Osgood 18, ¾-yd. dipper, traction wheels.

1—35-hp. Electric Hoist, double drums and attached swinger.

1—75-hp. Electric Hoist, double drums, attached swinger and holding drum.

FORSYTHE BROTHERS
30 Church Street, New York City.

FOR SALE OR RENT

STEAM SHOVELS

1—70-C Bucyrus, Shop No. 1700; 2½-yd. dipper.

1—70-C Bucyrus, Shop No. 1376; 2½-yd. dipper.

1—70 ton Bucyrus, Shop No 939; standard 70-C boom, 2½-yd. dipper.

1—65-ton Bucyrus, Shop No. 394; 2½-yd. dipper.

1—Model 76 Marion, Shop No 2452; 4-yd. dipper.

1—18-B Bucyrus, full revolving steam Shovel, Shop No. 1475, traction wheels, ⅞-yd. dipper.

DUMP CARS

20—16-yd Standard Gauge Western Air Dump Cars, steel underframes, box girder doors.

40—12-yd. Standard Gauge Western Dump Cars, steel underframes, 19-ft. beds, box girder doors.

40—4-yd. 36-in. Gauge Western Dump Cars.

1—Western 36-in. Gauge Spreader Car.

LOCOMOTIVES

2—Standard Gauge, 17 x 24 Cylinder, 6-wheeled Switching Locomotives, with separate tender; weight, 43 tons on drivers.

5—36-in. Gauge, 10 x 16 cylinder, Vulcan 4-wheel saddle tank locomotives, Shop Nos. 1226, 1364, 1453, 1456, 1461; weight 18 tons.

DRAGLINE EXCAVATORS

1—No. 2 Monighan Steam Operated All-Steel Dragline; 60-ft. boom; 2-yd. Page bucket; mounted on skids and rollers.

1—Class 14 Bucyrus Dragline; 60-ft. boom; 2-yd. Page Bucket; skids and rollers.

MISCELLANEOUS

9—2-ton Kelly-Springfield Trucks, standard box bodies with removable sides.

60—Sets Standard Chain Tug Harness, with collars, brand new.

CLAPP, RILEY & HALL EQUIPMENT CO.
(Successors to Clapp, Norstrom & Riley Equipment Co.)
14 SO. CANAL ST., CHICAGO

Equipment For Sale or For Rent

STEAM SHOVELS

1—Erie, Type "B."

1—Bucyrus, 14-B, on caterpillar.

ROAD ROLLERS

2—10-ton Buffalo-Pitts.

2—5-ton Tandem Iroquois.

1—30-ton Browning Locomotive Crane.

1—21-E Foote Paving Mixer.

2—14 Koehring Pavers.

6—Wheel Scrapers.

2—18-ft. Lakewood Finishing Machines.

Crushers, Locomotives and Dump Cars.

Pittsburgh Machinery & Equipment Co.
1302 Fulton Bldg., Pittsburgh, Pa.

ROAD PLANT

QUALITY HFCO SERVICE

Ready for service—at very attractive prices.

21-E Smith Paver, caterpillar, overhauled.
21-E Austin Paver, caterpillar, overhauled.
14-E Austin Paver, on wheels, rebuilt.
10-E Koehring Paver, on wheels, overhauled.
28—Marion Shovel, A.S.M.E. boiler, used very little, excellent for road work.
15-ton O & S Locomotive Crane, Massachusetts boiler, with bucket, ready for work.

Bucket Operating Derrick, 62-ft. boom, 8¾ x 10 Lidgerwood, Three-Drum Hoist, A.S.M.E. boiler, used three months.
Clam shell buckets, ½-yd. to 3-yd. sizes.
10-ton Buffalo-Pitts Macadam Roller, Massachusetts boiler, pressure scarifier.
114-cu. ft. Ingersoll-Rand Portable Compressor, gasoline driven.
Climax Portable Crushing Plant, including bin and power, 150 tons per day, used only few weeks.

Also Forms, Graders, Tractors, Pumps, Finishers—Everything for the Road Builder. Write for complete list.

THE HUBBARD-FLOYD CO., INC.
MAIN OFFICE: Grand Central Palace, New York, N. Y. Vanderbilt 1465.
BOSTON OFFICE: Old South Building, Main 1233.

SACRIFICED ! !

Two 5-Ton Garford Trucks
$875.00 Each

Equipped with Wood Automatic Hoists and Metal Dumper Bodies. All in good running order. These trucks were taken over by a bank and must be sold. Terms can be arranged if secured.

Fredk. Davis, 137 Broadway, New York City
Representing the Owner
Phone Rector 9560

Let George Do It!

FOR SALE OR RENT

Mixers	Saw Tables
Compressors	Hoists
Pumps	Derricks
Bucket	Concrete Chute
Conveyors	Towers

Complete line of Contractors' Equipment and Supplies.

Established 1873

E. GEORGE & CO., INC.
407-409 Broadway, New York City

AT SACRIFICED PRICES

Locomotive Cranes Boilers

1—15-Ton Brown Hoist, 8-wheel, M.C.B. bucket operating, 50-ft. boom, butt strapped boiler in excellent condition throughout.

1—Byers Auto Crane, traction wheels, 30-ft. boom, equipped with ¾ yd clam shell bucket, has seen very little service.

1—20-Ton O. & S. 8-wheel, M.C.B., 50-ft. boom, bucket operating, separate engine and generator for magnet work, butt strapped boiler, in first class condition throughout.

2—72 x 18, 150-hp., Horiz. Return Tubular Boilers, butt strap Mich. Standard, working pressure 120 lb., complete with necessary fittings.

2—66 x 16, 100-hp. Horiz. Return Tubular Boilers, butt strap and Mich. Standard, working pressure 110 lb., complete with necessary fittings.

5—250 hp. Wicker Vertical Water Tube Boilers, butt strap, Mich. Standard, working pressure 150 lb.

1 250 hp. McNaull Water Tube boiler, working pressure 150 lb. Mich. Standard, butt strap, complete with necessary fittings.

All the above equipment is owned by us, located in Detroit, available for immediate shipment. Send us your inquiries for contractors and power plant equipment.

AMERICAN MACHINERY & EQUIP. CO., 6970 W. Jefferson Ave., Detroit, Mich.

REAL EQUIPMENT

FOR SALE OR RENT

ROLLERS

2—Kelly-Springfield 10-ton Road Rollers.
1—Monarch 10-ton Road Roller.
1—Huber 10-ton Road Roller.
1—Monarch 12-ton Road Roller.
1—Erie Tandem Roller.

STEAM SHOVELS

1—Model 28 Marion ⅝ yd. Bucket Traction Steam Shovel.
3—Erie type "B" ¾ yd. Bucket Traction Steam Shovel.

PORTABLE TRACK

5—Miles of 24-in. gauge Koppel Portable Track, 20-lb. rail.

DUMP CARS

20—Koppel 24-in. gauge "V"-shape Dump Cars.

LOCOMOTIVE

1—24-in. gauge Vulcan, 4-driver saddle tank Steam Locomotive.

Send for our Bulletin of used equipment bargains. All equipment offered in stock our warehouse, all overhauled and guaranteed.

PHONE WIRE WRITE

Contractors Machinery & Supply Co.
318-20 Penn Ave., Pittsburgh, Pa.

FOR SALE

One BUCYRUS 18-B
Traction Revolving

Steam Shovel

⅞-yd. Dipper
in Good Condition

F. J. Mann & Sons.
Ashland, Ohio

Caterpillar Steam Shovels

1—30 B Bucyrus Revolving, new June, 1921, 1-yd. dipper, A. S. M. E. boiler, like new.

1—14 B Bucyrus Revolving, built 1920, ¾-yd. dipper, A. S. M. E. boiler, rebuilt like new.

Grey Steel Products Co.
111 Broadway New York City

NEW MARION 61
2½ Yd.—70 Ton

Steam Shovel
Sacrifice Price

Small Revolving Shovels in ¾, 1 and 1½ yd sizes on Caterpillar Traction also Caterpillar Tractors.

Railroad Shovels all sizes and makes.

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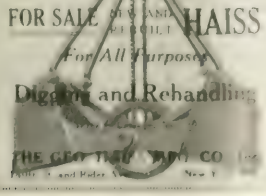
MARION Model 40
1½-yd.

Steam Shovel

Shop Number 2268
Complete with new parts.
Can be seen under steam.

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[illegible] Md

CLAM SHELL BUCKETS



and [illegible] yd. Bucket per day $3.25
Land [illegible] 4.00

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For All Purposes
Digging and Rehandling

THE GEO. HAISS MFG. CO. Inc.
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STEAM SHOVELS

[illegible] Traction Wheel [illegible]

[illegible] and Locomotive Crane

LOCOMOTIVE CRANE

HOISTING ENGINES

Great Lakes Equipment Company
[illegible] Chicago, Ill.

GUARANTEED

Contractors' Equipment

Immediate Delivery

DUMP CARS

150—12-yd. Western & Oliver, all-steel, two-way Dump Cars, standard gauge.
50—1½ yd., 20-in. gauge, wood body, two-way Dump Cars.
[illegible]—36 in. gauge, 8-wheel Flat Cars, 40,000-lb. cap., 7 ft. wide, 20 ft. long, wheels 24-in. diameter.

STEAM SHOVELS

[illegible]—95-ton Bucyrus Railroad Type, 5-yd. dipper; 90 per cent new.
10—70 ton Bucyrus Railroad Type, 2½- to 3-yd. dipper, 90 per cent new.

HOISTING ENGINES

1—7½ x 10-in., double cylinder, single geared drum Hoisting Engine, with reversing throttle valves.
1—6¼ x 8-in., Clyde Double Cylinder, double friction drum steam Hoisting Engine, with two winch heads, drums 14 in. diam., 20 in. between flanges complete with fittings. (No Boiler). Base is made for boiler.

LOCOMOTIVE CRANES

1—15-ton American Hoist & Derrick Company, 8-wheel type Locomotive Crane, 50-ft. boom.
1—10-ton capacity Industrial, 8-wheel type, Locomotive Crane, 25-ft. boom.
1—15-ton Industrial, 8-wheel type, Locomotive Crane, 35-ft. boom.

GENERATORS AND MOTORS

7—Westinghouse 250-hp. Motors, Types C.C.L., 440-v., 60-cy., 3-ph. motors, speed 514 r.p.m., with base and starters. Can be furnished with pulley or flange coupling.
1—60-kw., Triumph Generator, 125 v., D.C., belted.
1—300-kw., G. E. Rotary Converter, 25 cy.

CENTRIFUGAL PUMPS

1—12-in., Worthington Horizontal Centrifugal Pump.
1—24-in., Kingsford Horizontal Centrifugal Pump.

BOILERS

2—150 hp., Triple Riveted Return Tubular Boilers, 66 in. dia., 20 ft. long, 125 lbs. press.
1—125-hp. Triple Riveted Return Tubular Boiler, 72 in. dia., 16 ft. long, 125 lbs. press.
2—125-hp. Triple Riveted Return Tubular Boilers, 66 in. dia., 18 ft. long, 100 lbs. press.
2—100-hp. Triple Riveted Return Tubular Boilers, 60 in. dia., 18 ft. long, 100 lbs. press.
1—50-hp. Locomotive Firebox Boiler, 48 in. dia., 16 ft. 6 in. long, 100 lbs. press.

TANKS

6—Hot Water Feed Tanks, 48 in. dia., 10 ft. long, with one down and one outlet head, manhole in head, about ¼-in. plate.
6—Heavily Constructed Water Tank, about 66 in. dia., 5 ft. 6 in. high, with dished heads, ½-in. plate.
2—Open Top Storage Tanks, 4 ft. 9 in. wide, 4 ft. 8 in. deep, 10 ft. 6 in. long; 7/16-in. plate.
2—Open Top Storage Tanks, 9 ft. 6 in. wide, 5 ft. 3 in. deep, 10 ft. 6 in. long, 7/16-in. plate.
1—Open Top Storage Tank, 9 ft. 6 in. wide, 4 ft. 9 in. deep, 10 ft. 6 in. long, 7/16-in. plate.
1—**Open Top Storage Tank, 10 ft. wide, 6 ft.** 9 in. deep, 10 ft. 3 in. long, 7/16-in. plate.
2—Open Top Storage Tanks, 6 ft. 9 in. wide, 5 ft. deep, 16 ft. 3 in. long; 7/16-in. plate.
Open Top Storage Tanks, 10 ft. wide, 3 ft. 3 in. deep, 16 ft. 3 in. long; 7/16-in. plate.
1—Open Top Storage Tanks, 3 ft. wide, 3 ft. deep, 7 ft. long; 3/16-in. material.
1—[illegible] Open Top [illegible] wide 8 in. deep [illegible] plate.
[illegible] Tanks [illegible] wide 12 in. long, 58 in. deep, ⅝-in. material, capacity [illegible] gal.
[illegible] Tanks [illegible] pressure.
[illegible] Tanks 220 gal.
[illegible] Tanks 150 gal.
[illegible] Tanks 120 gal.
[illegible] Tanks 55 gal.
[illegible] Kettles 100 [illegible]
[illegible] 120 [illegible]
[illegible] 100 lb.

Send for Bulletin No. 205 Describing Our Complete Stocks of Machinery and Tanks

Harris Brothers Co.
35th & Iron Sts., Chicago, Ill.

NEW EXPANDED METAL IN ORIGINAL BUNDLES

500,000 Ft. Slightly Weathered Expanded Metal

Sizes—from 3¾ ft. x 11½ ft. to 6 ft. x 16 ft. and includes sizes 4 ft. x 8 ft., 4 ft. x 10 ft., 4 ft. x 10½ ft., 4 ft. x 11½ ft., 4 ft. x 12 ft., 5 ft. x 10 ft., 5 ft. x 11½ ft., 5 ft. x 12 ft., 5 ft. x 16 ft., and thereabouts.

Average Mesh—2¾ in. x 7 in.

Price—1½c. to 2½c. per square ft. f.o.b. *Norfolk, Va.*

Also 400,000 ft. of ½ in. x 1 in. Diamond Shape Expanded Metal.

Size of Sheets—3 ft. x 8 ft.

Price—2c. per square ft. f.o.b. *Schenectady, N. Y.*

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Syracuse, N. Y.

HOISTING ENGINES

1—9-in. x 10-in., D.C., 3D **Mundy** with **A.S.M.E. Boiler.**
2—9½ in. x 12 in. D.C., D.D. **Lambert** with **A.S.M.E. Boiler.**
1—8½-in. x 10-in., D.C., D.D., **Lambert** with **A.S.M.E. Boiler.**
2—30 hp., D.D., **Lidgerwood Gasoline Engines.**
2—18 hp. **Lidgerwood Single Drum Electric Hoists,** 2 ph., 60 cy., 220 v.
50—Additional Engines in Stock; almost Any Size and Every Make.

CLAM SHELL BUCKETS

1—¾-yd. **Browning.**
1—¾-yd. **Lakewood.**
2—1½-yd. **Williams.**
1—1½-yd. **Blaw-Knox.**

ORANGE PEEL BUCKET

1—¾-yd. **Four Leaf Hayward.**

AUTO CRANE

1—Type C **Byers Auto Crane** with **A.S.M.E. Boiler.**

AIR COMPRESSORS

1—20-in. and 12-in. x 14-in. **Chicago Pneumatic Type "OCB"** Two-Stage Belted **Compressor,** 1145 cu. ft.
1—22-in. and 14-in. x 18-in. **Laidlaw-Dunn-Gordon** Two Stage Belted **Compressor,** 1200 cu. ft.

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Road Oil and Asphalt

Pressure Distributor
On 1919 Packard Chassis

Driven only 3500 miles. Motor in excellent condition; 800-gal. tank capacity. Kinney pump—Pressure provided by truck engine.

Price, $5,000

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Philadelphia

Asphalt Plant Special

We have for sale one rebuilt No. 2 Merriman 1200 yd. One-Car Steam Melting Asphalt Plant. In fine condition, on which we can make good delivery.

Here's an opportunity to get a real plant quickly and at a right price. Better get in touch with us immediately.

The East Iron & Machine Co.
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FOR SALE

Rebuilt Cummer Portable Asphalt Plant

1000-YARD CAPACITY
In first-class condition, thoroughly overhauled in our shops

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PAVERS—ROLLER—EXCAVATOR

1—Koehring Paver, wheel traction, steam power, boom and bucket, 2 bag batch, Michigan, $1000.00.
1—Foote 13-E, steam, wheel Paver, 2 bag size, chute, Wisconsin, $850.00.
1—Austin motor Roller, 10 ton, 3 wheel, good condition, Michigan, $1375.00.
1—Parsons steam oscillating type excavator, good order, Wisconsin, $2600.00.

H. Y. SMITH CO., Milwaukee, Wis.

FOR SALE

Erie Tandem Roller

3½-ton in first class running condition. New flues and gears. Will sell at sacrifice.

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FOR SALE

POWER PLANT

200 hp. Complete

Have tested Central Station Power

200 hp. Vertical Tudor Boiler
16 x 36 Corliss Engine
12-ft. diam. 21-in. face fly wheel
6"x 12" x 7" Worthington Duplex Feed Pump
6-PP Wainwright Feed Water Heater
All necessary piping, gauges, valves, stack, lubricator, etc.

Complete Plant Bargain Price

THE UNITED STATES ROOFING TILE COMPANY
Parkersburg, W. Va.

HOISTS
(with boilers)

1—8¾ x 10 D.C., D.D., National.
1—7¾ x 10 D.C., D.D., and Swinger, National.
1—8¾ x 10 D.C., D.D., and Swinger, National.
1—8¾ x 10 D.C., 3 D., and Swinger, National.
1—8 x 12 D.C., D.D., Mundy.
1—10 x 12 D.C., 3 D., Clyde.

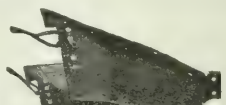
HOISTS
(without boilers)

1—7¾ x 10 D.C., D.D., Mundy.
1—8¾ x 10 D.C., 3 D., and Swinger, National.

BUCKETS

1—½ yd. Lakewood Clamshell.
2—¾ yd. Lakewood Clamshell.
1—1 yd. Lakewood Clamshell.
1—1½ yd. Hayward, Class "E" Clamshell.

T. H. LETSON CO.
50 Church St., New York



Power Drag Scraper, sizes from 1/3 to 5 cu. yd.

1—8¾ x 10 D.D. D.C. Lidgerwood Hoist with boiler.

1—37 hp. American D.D. Electric Hoist Cableway Excavators.

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500 ft. cable span. 100-ft. all steel mast.

Several excavator buckets and steam hoists, various sizes.

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[illegible] Plant, Steam Shovel, Derrick, Dredge, Dragline Excavator, Locomotive Cranes, Tractors, Crushers, Steam and Flat Cars, Dump Cars, Grader, Pitchers, Air Compressors, Rock Drills, Pumps, Boilers, Engines, Etc.

Complete plant.

JOHN M. GREENE
[illegible] Philadelphia, Pa.

FOR SALE

1—10-ton Buffalo-Pitts Roller.
1—10-E Foote Road Paver with chute, 6 hp. Gas Engine.

HICKEY CONTRACTING CO., INC.
79 West High St., Somerville, N. J.

FOR SALE OR RENT

STEAM SHOVELS

1—Type B Erie revolving traction wheels, ¾ yd. dippers.
1—Model 18 Osgood; revolving traction wheels. Combination steam shovel, clamshell and dragline attachments. ¾ yd. dipper, 32 ft. Crane boom, ½ yd. Page bucket.
1—70-ton Bucyrus, railroad type, 2½-yd. dipper.
1—150-B Bucyrus Shovel, 2½ yd.
1—175-B Bucyrus Shovel, 3½ yd.

CARS

20—60,000 lb. capacity Box Cars, 34 ft. 7 in. long.
20—60,000 lb. capacity Refrigerator Cars, 36 ft. long.

TRACTOR AND TRAILERS

1—120 hp. Holt Caterpillar Tractor, completely rebuilt at factory July, 1921.
3—5-ton Troy Trailers.

LOCOMOTIVES

2—6-wheel Switchers; standard gauge, 40-ton.
2—American Passenger; type 4-4-0; stand. gauge; 50-ton.
5—9 x 14 Dinkeys (3 Porter-); 2 Vulcans, 36-in. gauge.
5—14 x 22, 40-ton American Saddle Tank standard gauge.

DRAGLINES

1—Class 14 Bucyrus; skids and rollers; 60-ft. boom; 2-yd. bucket.
1—Class 14 Bucyrus truck mounting, 60 ft. boom, new 2-yd bucket
1—Class 24 Bucyrus; skids and rollers; 100 ft. boom; 3½-yd. bucket.
1—Monighan, A-1, steam; traction wheels; 40 ft. boom; 1 yd bucket.
1—Class 210 P. & H. Gasoline driven, 76 hp., Twin-City motor, caterpillars, 48 ft. boom; 1-yd. Page bucket.

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ONE SAUERMAN

DRAGLINE CABLEWAY EXCAVATOR OUTFIT

Complete with fabricated steel mast, cables, 1-yard capacity bucket, boiler and hoisting engine. All in first-class condition. Will make an interesting price. THIS IS A BARGAIN. Full details promptly furnished.

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7½ ton Tandem Universal Steam Roller. Excellent condition throughout. Completely overhauled. $750. F.O.B. Newark, N. J.

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Nos. 3, 4, 4½ and 5 Champion Crushers, elevators, bins and screens, portable and stationary.
60 hp. locomotive type Farquhar Boiler, mounted, $600.
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Gasoline and Electric Loaders.
Rex 14E Paver, Boom and Bucket, $2500.
Specialty 18-ft. belt Loader, 15-in. belt, portable, $350.
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Peerless Crane 8½ x 13 Engine, Butt Strap Boiler, 40-ft. Boom and Bucket, $2500.

Rollers, Pumps, Hoists, Crushers, etc.
Send us your inquiries.

The Cable Excavator Co.
Fernwood, Del. Co., Pa.

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A Koehring No. 14 Paver with 20-ft. Boom and Bucket in good working condition.
Price $1500.00 F. O. B.
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Consisting of Concrete Mixer, Finisher and Forms, Road Rollers and Water Pump.

FIRST NATIONAL BANK, Weatherly, Pa.
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Road Building Equipment

18,000 ft. 24 in. Ropeed 20-lb. track.
1—5 ton Kelly Springfield Tandem Roller.
68 Batch Boxes, 2 ton Cap.
Will sell cheap for quick removal.

CHAS. ECKBOLD
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One Cement Chute

FOR SALE

Complete, in good condition. Includes 3 chutes, 21 ft. each; 3 chutes, 11 ft. each; 3 hoppers, 1 elevator hoist hopper, 29 ft. pole, 4 cement carts.

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Realizing the advantages at times of purchasing good used equipment, I have personally inspected and now offer for sale the following:

Road Pavers
Steam Shovels
Dinkeys
Concrete Mixers
Cranes
Dump Cars
Gasoline Locomotives
Trenching Machines
Wagon Loaders

All of the above for sale and then some. Send us your inquiries.

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Real Estate Trust Bldg., Philadelphia, Pa.

1—Hayes Path Builder Wagon Loader
1—Hayes Self Propelled Loader, $1
1—1 yd. Mead Morrison Crab Steel Bucket.
1—Hayes 1½ yd. Steel Power Bucket.
2—¾ yd. Hayes Elevated Buckets.

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1—Gyratory No. 6-F with [illegible]

Holbrook, Cabot & Rollins Corp.
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Koehring Paver

HALF CATERPILLAR TRACTION

[illegible] 14E on half caterpillar traction and Koehring No. 1618 good operating condition. Can be seen operating now. Location, Erie, Pa.

E. H. WILSON & COMPANY
[illegible]
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[illegible]

E. F. Conway, 29 Cortlandt St., N. Y.

IMMEDIATE DELIVERY

Send us your Steam Shovel Inquiries

15" x 36" to 7½ x 30" TRAYLOR JAW CRUSHER.
No. 7½K GATES CRUSHER.
50-75 H.P. Single Drum HOISTS, 25 cy. motors, 220-440 v., 3 ph.
30-40-50 H.P., D.D. HOISTS, 60 cy., 220-440 v., 3 ph.
Nos. 5, 5A, 6, 7½ and 8K CRUSHERS.
6 and 12 ton 65 ohm LOCOMOTIVES.
10 in. x 12 in Steam HOIST, 2 drum.
2—Type 4 CRUSHERS, 24 in Symons.
2—50 ft. Barber Greene, 18 in. Belt CONVEYORS
100 Cu. 2½ yd. Electric SHOVEL.
50 to 5000 ft. Steam, Belt and Electric COMPRESSORS.
Jaw and Roll CRUSHERS.
10, 15 and 20 ton Locomotive CRANES.
15 x 30, 20 x 20, 20 x 11 in., and other Jaw CRUSHERS.
24 x 54 McLANAHAN Roll CRUSHER.
Send us your inquiries for Steam Engine, Centrifugal Pumps, Quarry and Contractors' Equipment, etc.

ROSS POWER EQUIP. CO.
Indianapolis, Ind.

ARCHER ARMSTRONG & CO.
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COMPRESSORS — GENERATORS
DERRICKS — HOISTS
BOILERS — CRANES
SHOVELS — MOTORS
CONCRETE MIXERS — PUMPS

Vanderbilt 10408

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We make a Specialty of Renting Contractors' Outfits

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Model 60 Marion
Erie ¾ yd. revolving
Marion ⅝ yd. revolving

CARS
12-yd. Western Std. gauge
4-yd. Western 36 in. Std. gauge

LOCOMOTIVES
36-ton Std. gauge saddle tank
60-ton Std. gauge switchers
18-ton 36 in. gauge Porters
12-ton 36 in. gauge Porters
10-ton 36 in. gauge Davenports

Railroad Ditchers, Locomotive Cranes, Other Heavy Equipment

H. KLEINHANS COMPANY
Union Arcade Building, Pittsburgh, Pa.

Air Compressors

2—710 C.F.M. Class WJ3 Sullivan Angle-Compound Belt Driven Air Compressors. Practically good as new. Immediate shipment.

A. McMILLAN
628 Monadnock Block, CHICAGO, ILL.

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Concrete Mixers, Lakewood Concrete Towers, Hoisting Engines, Derricks, Pumps, Gasoline Tractors, Steam Hammers, Buckets and Compressor outfits.

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PUMP
FOR SALE

1—Brand new motor-driven De Laval Pump, 2-stage series type, with pressure regulator and self-starter. Will deliver 750 gallons water per minute at 1800 revolutions, attached to 75 hp. G. E. motor.

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NEW 1730-ft. Chicago-Syn. Electric.
1691-709-ft. WJ-3 Sullivan Angle, two stage belt.
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741-ft. O-CB Chicago, two-stage belt.
NEW 592 ft. XB 2 Ingersoll, two stage belt
NEW 209-116-ft. Cayton, single-stage belt.
2066 ft. WC Sullivan, steam.
NEW 1955-1266 XPV 3 Ingersoll, steam.
1190-ft. X 3 Ingersoll, steam.
888-599 ft. X 2 Ingersoll, steam.
296-ft. WB 2 Sullivan, steam.
179-ft. NF-1 Ingersoll, steam.
100 hp. NEW 220-440-550-2200-v. motors.

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Second-Hand
MACHINERY
Contractors' Equipment

Stacks, Tanks, Pipe, Etc.

What are your requirements?

Henry A. Hitner's Sons Co
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A REAL OPPORTUNITY

New Structural Steel

Slightly Rusted—Not Pitted.

275 tons 6-in. I—15 ft. 0 in. long
250 tons 5-in. I— 9 ft. 0 in. long
350 tons 4-in. I—12 ft. 0 in. long

Exceptionally low price before removal. Located New Cumberland, Pa.

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2 AIR—COMPRESSORS—NEW
Direct Connected to Motors

1700 cu.ft., 22—14 x 18 Bury, 225 r.p.m., 100 lb.
350 hp. G. E., 440 v., 3 ph., 60 cy., 225 r.p.m. Syn. Motor.
Controlling Panels—Never Used, Low Price.

H. R. WILSON MACHINERY CO.
417 Pine St., St. Louis, Mo.

COMPRESSOR

12 x 12 Chicago Pneumatic Duplex Compressor, 50-lb. pressure, good condition throughout. Arranged for belt drive. Price $850 f.o.b. Jersey City, N. J.

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50 Church Street, N. Y. C.

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Murphy Tripod Drills, NEW, from 2½ in. to 3⅝ in. ready for immediate shipment.

Also quantity of drill steel in various lengths (NEW).

Send for our July list of the largest stock in the United States of slightly used or thoroughly overhauled **Machine Tools, Power, Electrical and Contractors' Equipment.**

WICKES MACHINERY CO.
Jersey City, N. J.
Established 1900.

FOR SALE OR RENT

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1—Ledgerwood 5¼ x 10, D.C., D.D.
1—Mundy 7 x 10, D.C., D.D.
1—Atlas 8 x 10 x 12, D.C., D.D.
2—Meade Morrison 7 x 10, D.C., D.D.
8—Nose double drum, 12 hp., 2 cyl.
1—Ideal 8 x 10, D.C., D.D.
1—Ledgerwood 7½ x 8, D.C., D.D.
10—Others various, in sizes from 10 to 100 hp.

DERRICKS

1—All-steel 75-ft. boom, cap. 10 ton.
1—All-steel 60-ft. to 110-ft. boom, cap. 20 tons.
1—Steel Guy, 85-ft. boom, cap. 15 tons.
1—All-steel Stiffleg, 110-ft. boom, cap. 30 tons.
3—Derrick cars.

ROAD EQUIPMENT

1—5-ton tandem Lorenda, steam.
1—10-ton, 3-wheel Austin, gas.
1—Kelly 12-ton, 3-wheel, steam.
1—Erie 5-ton, tandem, steam.
1—Adams grader with scarifier attachment.
2—Austin standard blade scarifiers.
2—Lakewood finishing machines.
320—24-gauge Western flat cars.
220—5-ft. wood batch boxes.
200—30-ft. wood batch boxes.

CONCRETE MIXERS AND PAVERS

1—No. 12-E Koehring Paver.
1—No. 17-E Milwaukee Paver.
2—Koehring 18-E caterpillar pavers.
1—14-S Koehring batching type elec. 1-bag.
1—14-S Stand. Gasoline type.
1—No. 14 S Koehring side loader, 1 cy. capacity.
2—1 cub. Rex low charging.
20—Others of various makes and sizes.

STEAM SHOVELS AND CRANES

1—Type B Erie traction wheels, ¾-yd. dipper.
1—Type O Thew traction wheel.
1—Type B Erie crane.
1—Byers Auto Crane traction wheel.
1—No. 1 Keystone excavator.
1—Osgood No. 18 combination shovel and crane.
1—Model 28 Marion traction wheel.
1—Bucyrus 18 B traction wheel.

LOCOMOTIVES, CARS AND TRACK

1—Plymouth, gas, 3-ton, 24-in. gauge.
2—Whitcomb, 6-ton, 24-in. gauge.
1—Vulcan, steam, 24-in. gauge.
1—27-cu. yd. standard gauge saddle tank.
12—Western, 36-in. gauge, 1 yard cars.
15—Mcsteel Western, 24-in. gauge, 1½-yd. cars.
100—Koppel "V"-shape, 24-in. gauge, 1 yd. cars.

MISCELLANEOUS

1—Erie Cent. Pump, 8-in. suction steam engine.
1—No. 6 Morris Cent. steam engine.
1—No. 2 Vulcan steam hammer.
1—No. 8 Austin gyratory crusher.
2—Jaw crushers.
1—Insley 110-ft. steel tower with spouting.
1—Insley 240 ft. steel tower with spouting.
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1—4 brag Compressor 8 x 12, belt drive.
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1—Lakewood ¾ yd.
1—21-ft. Hayward orange peel, new.
2—15-ft. Hayward orange peel, new.
Also cableway, dragelines, pumps and miscellaneous construction equipment.

We carry a complete line of construction and road equipment.

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TEN LOCOMOTIVE CRANES

2—Ohios, 30-ton cap. D.D. 8-wheel M.C.B., 30-ft. boom
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5—Osgoods "29" 4-wheel standard gauge, 40-ft. boom

These Cranes all equipped with A.S.M.E. boilers and are ready for work. If you wish to inspect wire OWNER.

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2—25 ton, 8 wheel, Industrial, built 1918, A.S.M.E. boilers, 50-ft. booms.
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3—20 ton, 8 wheel, Browning, built 1920, A.S.M.E. boilers, 50-ft. booms, 15-ft. extensions.

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About [illegible] ft. practically new, Van Stone Flanges.

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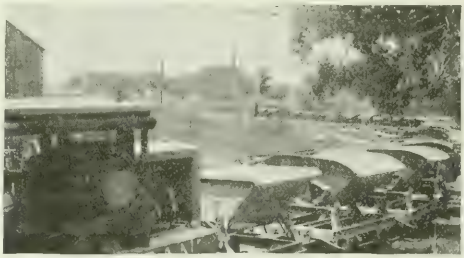
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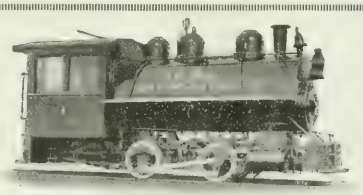
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All sizes and types of light steam
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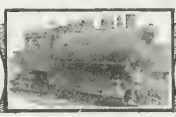
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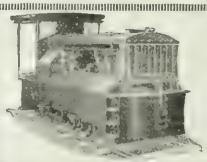
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There is great satisfaction in good equipment. Experience, the Best of Material, Careful Workmanship, and Rigid Inspection warrant your confidence in our Equipment.
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Manufacturers of Locomotives
Gasoline-Storage Battery-Trolley-Combination
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See our ad. in the first issue of each month

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We are just laughing at you and trying to save your bacon for you.

We used to write those violet water, turtle dove kind of advertisements.

But neither you nor anyone else ever read them any more than you now read the hundreds of other such gentle advertisements in this paper.

Say, why did you turn to this card to read "Ridgway's Sass an' Impudence?"

Did we ever tell you this:—

Mr. Bullard who owned the Bullard Machine Tool Co. of Bridgeport, Conn., used to get indignant at our weekly preachment.

"Rot, arrant rot," he would cry, "disgrace to the pages of a dignified trade paper. The fellow's a fool."

But he read the "Rot" every week just the same.

Then in course of time Bullard would build a new factory. That's it you see from the cars as you pass through Bridgeport.

One day we got a letter saying if we had a representative in New England the Bullard Co. would be glad to have him call.

Old Hook 'er put on a biled shirt, grabbed his blue prints and pulled for Bridgeport.

"Well, you're not the kind of a man I expected to see," said Mr. Bullard.

And right then and there in that interview Mr. Bullard like all the others who meet us personally became one of our best friends until he went home.

Oh yes, we equipped the new factory and his sons who own the splendid big plant today will say to you, if you ask them

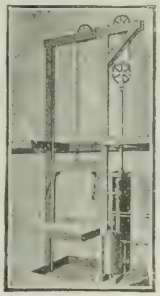
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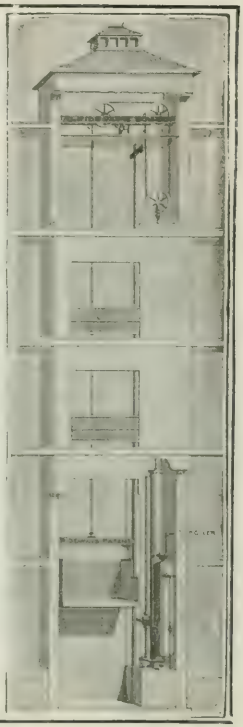


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BAKER MANEY Self-Loading SCRAPERS

[illegible] did results and low operating [illegible]

Send for Catalog No. 96

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367 Stanford Ave.,
Springfield, Ill.

The AGGREMETER



For Any Type of Truck

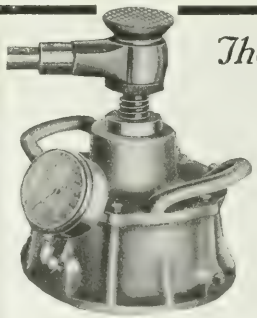
proportions and loads any truck

Holds 85 tons of stone and gravel. Under *one-man* control, perfectly and rapidly proportions and loads material for any batch—into any type of truck body (single batch, dual or 2-3-4-5 compartment). The AggreMeter is all steel. Can be erected in one day using load-crane and 4 men.

Will last for years—not built for just one or two jobs. Enables contractor so to speed up trucks that fewer trucks do the same work and he gets about 10% more yardage finished road. Write us. Let us *point out in detail* why you cannot afford NOT to use the AggreMeter.

This plant proportioned and loaded into trucks 24 Batches in 11 min.—36 tons aggregate—enough to keep a 21 E Paver going 42 minutes.

Erie Steel Construction Co.
Erie, Pa., U. S. A.



The LOADOMETER

THE LOADOMETER is a portable weighing instrument, designed primarily for use by state and county officials for conveniently weighing trucks that are suspected of overload.

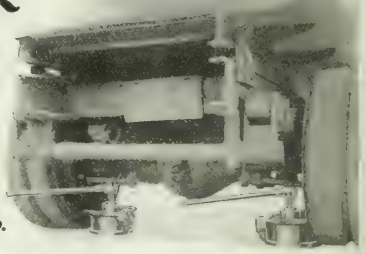
These instruments repay their original cost in a short time and are the means of saving thousands of dollars in road repairs

Loadometers are now being used in the majority of the states in the Union.

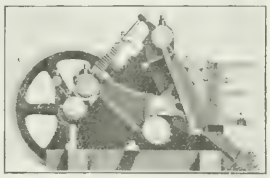
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We manufacture a complete line including *Crushers, Elevators, Screens, Bins, Sweepers, Car-Unloaders,* etc. Write for Catalogue.

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Kingston, N. Y.
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"RELIANCE" LABOR SAVING MACHINERY

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15 West 44th St.
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Hoists and Dump Bodys complete ready to mount
1 and 1½-ton cap., 35 cu. ft. List.....$290
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F.O.B. Factory
Immediate Shipment

Hydraulic Hoists and Steel Bodies

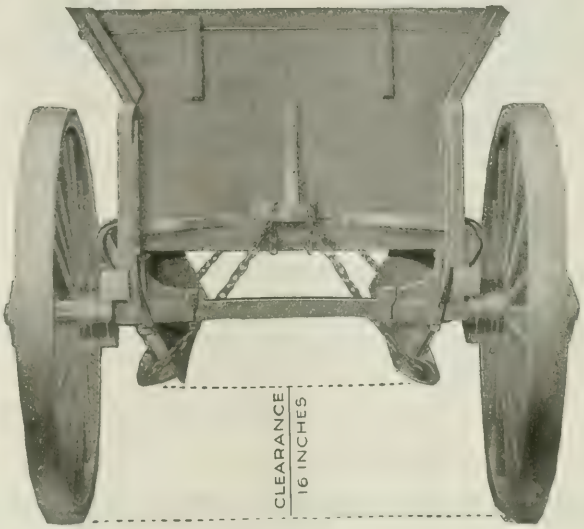
Wood-Detroit equipment in use exceeds all other makes combined. Installed on any chassis. See page advertisement in June 22nd issue.

Wood Hydraulic Hoist & Body Co.
4196 Bellevue Avenue, Detroit, Mich.

"If ever you see a Watson stalled on the dump go to an Oculist. Yer eyesight ain't right!"

Jim Fellowes

Look at that big 16 inch clearance
J.F.



SIXTEEN inch clearance with the bottom down! That's another reason I'm so darn strong for the Watson Wagon.

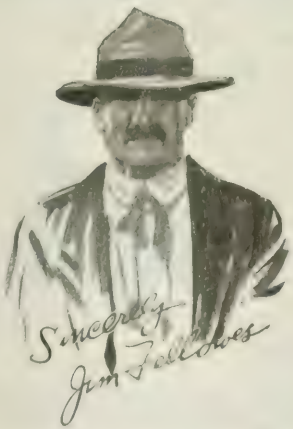
Some dump wagon makers kick up a lot o' dust about havin' arched axles. Don't be deceived. It's nawthing but a smoke screen.

Their wagons has got such goldarn little clearance they have to make the axles arched. If they didn't they'd never get away from a load!

But don' ever let anyone tell you an arched axle's strong as a straight one. An ol' hoss could tell you better'n that.

Watsons have got straight axles straight as a die. They're the strongest axles made. And Watsons have got a big 16 inch clearance even with the bottoms down. Don't need no hump backed axle to let 'em make a getaway.

If ever you see a Watson stalled on the dump go to the oculist. Yer eyesight ain't right.



WATSON DEPENDABLE DUMP WAGONS

Watson Products Corporation, Canastota, N. Y.

Stanolind Paving Asphalt



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Think of the Future

IT IS reasonable to expect that repairs will be necessary on any road that is in constant use for seven years.

The road illustrated above was built of

STANOLIND PAVING ASPHALT "C"

(Penetration Method)

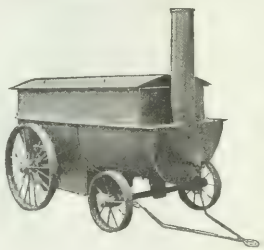
during 1915, it has been in constant use ever since—but not one cent has been required for repairs. Consider that when you are thinking about a new road.

Send for our booklet Stanolind Paving Asphalt. It tells all about the proper construction of asphalt roadways.

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250, 350, 500, 700, 900 Gallon Capacities

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The major portion of the 90-mile park drive and boulevard system of Kansas City, Mo., is Texaco paved.

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THE TEXAS COMPANY
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For fast work—the MACON CONCRETE ROLLER



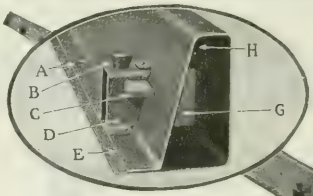
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Macon Concrete Roller Co.
Macon, Ga.
Patentees



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Note the Features of its Construction

A Numerous auxiliary stake-holes.
B 18-inch, mushroom-head stakes, ⅞-inch diameter.
C Instant-gripping stake-wedge, fastened to box.
D Heavy stake-box, riveted to flanges of rail.
E Web lapped, electrically welded, solidly riveted.
F 5¾-inch base flange—over 200 sq. in. greater bearing surface per rail.
G Stake-box riveted to face flange and base flange, adding strength and rigidity.
H Extra flange of continuous web; 11-guage steel—which gives tubular strength to rail, and unyielding support under battering of finisher and sub-grader.

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STANDARD *Asphalt Products*

Standard Asphalt Binder A *for surface treatment.*
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Standard Asphalt Binder C *for the mixing method.*
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Standard Asphalt Joint Fillers *for brick or block pavements.*
Standard Paving Flux, Standard Bridge Asphalt and Preserving Oils.

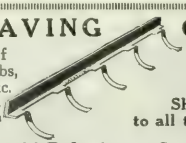
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SEWER JOINT COMPOUND

FOR WATER-TIGHT SEWERS

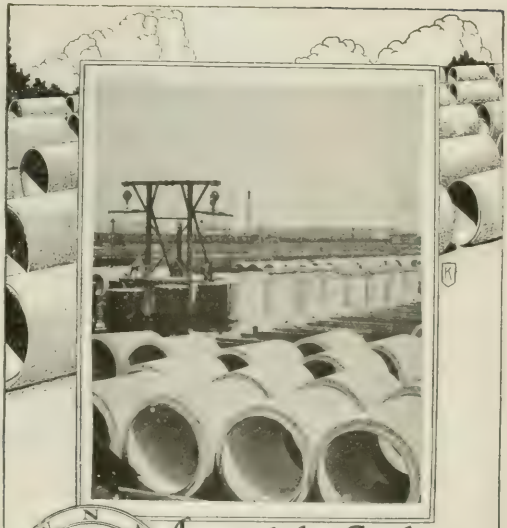
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of Genuine Open Hearth Iron with [illegible] of Copper and [illegible] of Steel, [illegible] and [illegible] and [illegible] for [illegible] and durability.

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No. 5: South:

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Some of these lines are sewers, some pressure lines, all of them giving perfect satisfaction.

Lock Joint Pipe Co.

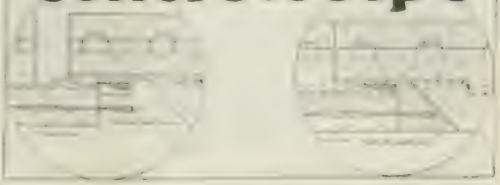
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Reinforced

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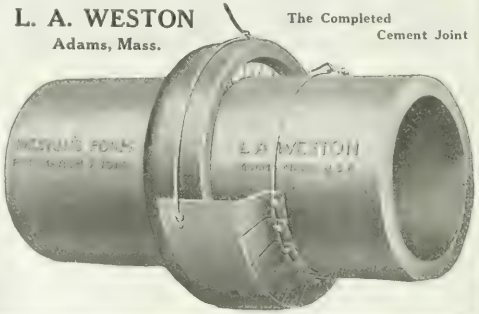
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"The only dump wagon for steamshovel work is the Western." This is the verdict of steam-shovel men everywhere. Ask them.

The Western Dump Wagon will stand up in hard running; a boy can operate it.

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INCORPORATED
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Creosoted cross ties, lumber, piles, poles, Fence Posts and Ties
Pressure treated by Lowry process in Long Cylinders.
Capacity [illegible] per month.

Plants at New Orleans, La., Long [illegible], and Winnfield, La.

Untreated Material	Years
LUMBER:	
Chestnut	12
White Oak	8
Elm	7
Ash	5
Maple	4
Birch	4
Poplar	4
Cottonwood	4
Tupelo	4
Basswood	4
White-heart Beech	4
Red Gum	4
Sycamore	3

Untreated Material	Years
POSTS:	
Locust	25
Osage Orange	40
Mulberry	20
Catalpa	14
Chestnut	10
White Oak	8
Red Oak	5
Ash	5
Aspen	5
Gum	3

Untreated Material	Years
TIES:	
Black Locust	20
White Oak	8
Chestnut	7
White-heart Beech	4
Birch	4
Maple	4
Red Oak	4
Gum	3

The estimates here presented are based on experience and actual inspection by the Forest Products Laboratory.

Here is the life of Untreated Wood
—placed subject to decay

The question is—what is the life of *properly treated wood?*

Well—the Clinton Woolen Mfg. Co., of Clinton, Michigan, increased the life of timbers on their dye house from five years to ten, with a brush treatment. The Consolidated Coal Co., Saginaw, Michigan, report that untreated mine timbers decayed in from one to two years.—while treated timbers "never showed any signs of rot." Messrs. C. Deutermann & Son, White Plains, N. Y., made sills for their ice house last twenty years instead of the usual five. In the Bellevue Mine specimens fourteen years old were still perfect (average life, two years). The Northwest Paper Co. of Cloquet, Minn., increased the life of ceiling boards from one and one-half to ten years. A user of oak posts increased their life from five to eighteen years. A user of spruce wharf planking in Rhode Island, from one to ten years. The Cleveland Marine Ry., (Fla.,) made barge sheathing last nineteen years instead of the usual two! They used simple methods of application and chose the best preservative—Protexol.

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Successor to Carbolineum Wood Preserving Co.

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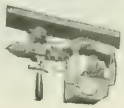
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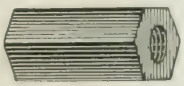


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Over 15,000,000 Pounds used

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MISSISSIPPI WIRE GLASS

For protection against Fire and Breakage

Mississippi Wire Glass Co.
218 Fifth Ave.,
New York

Chicago St. Louis

"ANTI-PLUVIUS"

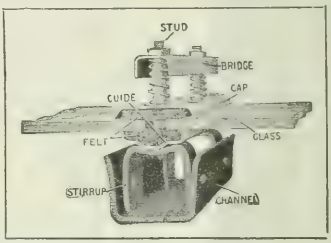
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Stops excessive glass breakage. No glass comes in contact with metal. Always tight and weather proof.

Built with a supporting frame of hot rolled, high carbon structural steel.

No maintenance expense.

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Millions of square feet now in use on all types of buildings in all parts of the world.

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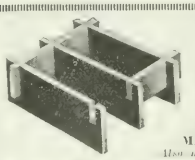
The FIRST COST is the LAST

AMERICAN CEMENT TILE MANUFACTURING CO.
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PITTSBURGH, PA.

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for every purpose. Bridge Paints and Metal Preservative Paints of all kinds. Fume Resisting, Acid Resisting, Heat Resisting, Mill White, Concrete Paints, etc.

CHEESMAN-ELLIOT CO., INC., *Paint Makers*
Established 1876
23 Flatbush Ave., Brooklyn, N. Y.
Works: Williamsport, Pa., and Brooklyn.



"MITCO" INTERLOCKED GRATINGS

No bolts. No rivets. No bent metal. Every joint locked by metal thread in dovetail. No clogging. Write for data. See half page advertisements.



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Also makers of "S.M.C." Standardized Metal Cages

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A Rust and Corrosion-Proof Building Material for

Permanent Roofs, Siding and Trim

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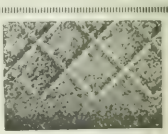
All types for factory, power house and office. Continuous steel sash for monitors and sawtooth construction. Operating devices for all types of movable sash and doors. Steel skylight and ventilators, steel office partitions, hinged steel doors, sliding steel doors.

STEEL CONSTRUCTION FOR LIGHT AND VENTILATION IN BUILDINGS

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FERALUN Anti-Slip Treads

Stair Treads
Floor Plates
Door Saddles
Manhole Covers
Etc., Etc.



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It's Iron and Emery Cast Together

KERLOW

50 CHURCH STREET NEW YORK

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100% Efficient (for traction) 78% Open (for ventilation)
100% Steel (for strength) 22% Surface contact (for comfort)
Two work Surfaces (for longevity)

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American Bessemer—Open Hearth—Keystone Copper Steel
Black Sheets, Galvanized Sheets, Special Sheets, Corrugated Sheets, Formed Roofing Products, Tin and Terne Plates, Etc.

AMERICAN SHEET AND TIN PLATE COMPANY, PITTSBURGH, PA.

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CENTURIES OF SERVICE
PYRAMID NATURAL SLATE STRUCTURAL
Proof against Time - Wear - Water - Fire

for all Industrial purposes

Our service does not consist only of the prompt delivery of the slate. Through a complete and fully illustrated series of publications we provide basic specifications and detailed drawings to assist in securing the most satisfactory installation of:

Toilet Enclosures, Stairs, Urinals, Shower Stalls, Laundry Tubs, Sinks and Sink Tops, Switchboards, Fuse Blocks, Bus Bar Supports and Panel Boards.

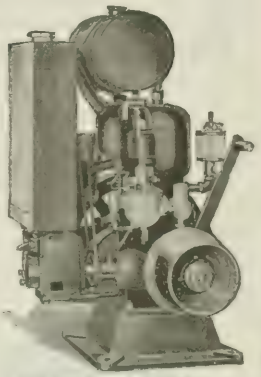
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Your Machine Will Deliver Better Service with a

CUSHMAN

Light Weight Heavy Duty Engine

Over 50,000 in successful service. Sizes 1½ to 20 H.P. Let our engineers work with you. Write us your power problem.



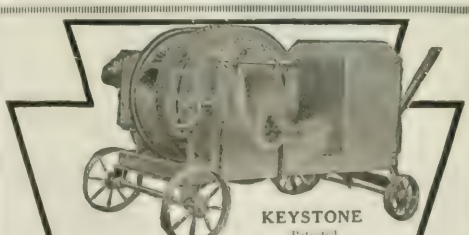
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Weight, complete, 230 lbs.

Cushman Motor Works
801 N. 21st St.
Lincoln, Nebr.

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PATENTED
THE FIREPROOF VENTILATING FLOORING

IRVING IRON WORKS CO.
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IRVING SAFSTEP
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PATENTED
ABSOLUTELY NON-SLIPPING ALWAYS



KEYSTONE
Patented
Stop! Look!! READ!!!
Gray Iron Foundry Co.
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UNIVERSAL FORM CLAMPS

UNIVERSAL CLAMP CO.

SONNEBORN PRODUCTS

Not the cheapest in Price but the cheapest in Service. Standard for twenty years.

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Makes Concrete Floors

Dustproof and Wearproof
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SONNEBORN

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FOR CORRECT METHODS OF USING CONCRETE

VULCANITE PORTLAND CEMENT CO

PHILADELPHIA BOSTON NEW YORK

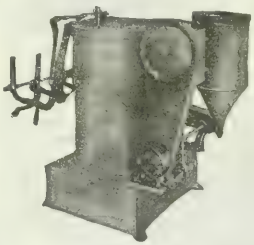
Soon Pays for Itself
The Rest Is Profit

The Century Bag Cleaner

beats the inside of the bag with the opening down.

ALL the cement is dislodged from the corners, seams and cloth, and readily drops out.

The quickness, ease and thoroness of this method gives the greatest possible saving in cement, time and labor.



Style B Power Driven

You also save the freight paid in sending your own cement back to the mill.

We supply hand or power machines. The power machine operates from a light-socket.

Well-known engineering firms use The CENTURY BAG CLEANER as standard equipment for each contract.

A descriptive circular giving prices and further information will be mailed you on request.

The Willsea Works

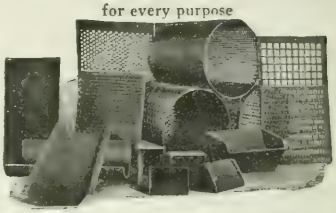
Successor to The Century Cement Machine Co.

Manufacturers of special machinery and machines for making concrete blocks and trimming stones.

60 Brown's Race, Rochester, N. Y.

HENDRICK SCREENS

for every purpose



ELEVATOR BUCKETS (plain and perforated) STACKS AND TANKS
GENERAL SHEET AND LIGHT STRUCTURAL WORK
LIGHT AND HEAVY STEEL PLATE CONSTRUCTION

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PORTLAND CEMENT

Highest Quality

Manufactured by

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Business Established 1832

The Lawrence Cement Co.

No. 302 Broadway New York, N. Y.

Selling Agents for

Dragon
PORTLAND CEMENT

In Successful Use a Third-Century

CEMENT-GUN Trade Mark

And the Traylor Portable Compressor

See our full page ad in the last issue and in the next issue.

Cement-Gun Co., Inc., Allentown, Pa.

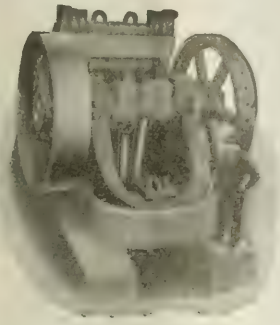
ANTI-HYDRO FOR PERMANENT CONCRETE HARDENS WATERPROOFS

FOR HARDENING & WATERPROOFING CONCRETE

A liquid integral hardener makes concrete dustless and waterproof. Used successfully for eighteen years. Write for details.

ANTI-HYDRO WATERPROOFING COMPANY, Newark, N. J.

ENDURINGLY EFFICIENT



TRAYLOR
Bulldog Jaw Crusher

Exclusive, patented features; Simple, strong pitman, Frictionless toggle system, Self-aligning bearings, Scientifically reinforced frame, General accessibility of all parts.

Used and Approved the World Over

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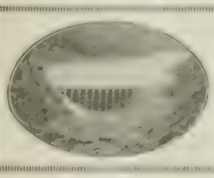
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CARBIDE LIGHTS
FOR CONSTRUCTION WORK

Burn carbide, obtainable everywhere.

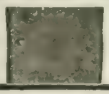
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The Alexander Milburn Co.
1420-1428 W. Baltimore St., Baltimore, Md.
STOCKS IN ALL LARGE CITIES.

New England Foundation Co., Inc.
120 Tremont Street, Boston, Mass.
SIMPLEX CONCRETE PILING
Open Caissons—Difficult Foundations
Engineering and Construction



AMBURSEN DAMS
Foundation Problems
Built, 6 feet
Built, 15 feet
Ambursen Construction Co.,



Because it's compressed concrete —

—the MacArthur Pedestal Pile is not only dense, but in the form of its pedestal it conforms to the soil around it, besides compacting that soil itself to a high degree. Moreover, there is the gripping action of the ROUGH concrete surface of the shaft —16 in. in diameter over its entire length.

Have you written for a copy of the "MACARTHUR FACTS"?

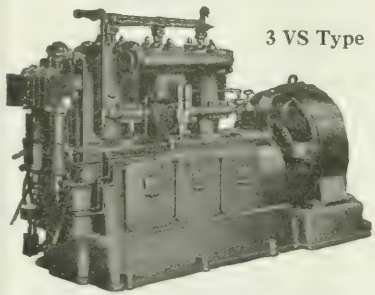


MacARTHUR
CONCRETE PILE & FOUNDATION CO.
42 John Street, New York City
Canadian MacArthur Concrete Pile Co., No. 10 Cathcart Street, Montreal, P. Q.

WESTINGHOUSE — NATIONAL
AIR COMPRESSORS

Compact-ness!

COMPACTNESS is a desirable feature of design peculiar to all types of Westinghouse-National Air Compressors. They occupy less floor space in proportion to air output than any other machine. If space is an important consideration you will find your interests best served by a WESTINGHOUSE-NATIONAL.



3 VS Type

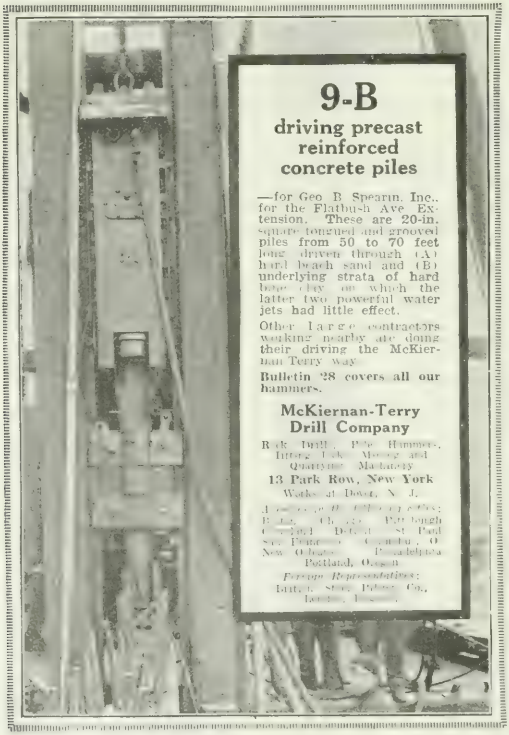
Westinghouse-National Air Compressors are furnished in all sizes from 11 to 550 cu. ft. piston displacement; stationary and portable types; A.C. or D.C., motor. Especially adapted for factories, foundries, garages, office buildings, railway shops and yards, printing plants, etc. Literature on request.

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9-B
driving precast reinforced concrete piles

—for Geo. B. Spearin, Inc., for the Flatbush Ave. Extension. These are 20-in. square tongued and grooved piles from 50 to 70 feet long driven through (A) hard beach sand and (B) underlying strata of hard beach clay on which the latter two powerful water jets had little effect.

Other large contractors working nearby are doing their driving the McKiernan Terry way.

Bulletin '28 covers all our hammers.

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Rock Drills, Pile Hammers, Hoisting Jacks, Mining and Quarrying Machinery

13 Park Row, New York

Works at Dover, N. J.

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CONTRACTORS
18 East 41st Street, New York, N. Y.
Aqueducts, Subways, Dams, Railroad Work, Docks and Piers, Shafts and Tunnels.

Spencer, White & Prentis
100 West 41st St., N. Y. C.
Foundation Specialists
Steel Tubes to Rock ***"Pretest" System***

The Underpinning & Foundation Co. 342 Madison Ave. New York City
Difficult Foundations
Pneumatic, Steel, Concrete and Wooden Pile Foundations. Bridge Piers; Underpinning Heavy Buildings
"HERCULES" STEEL PILES

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84 Pine St., New York **Hanna Bldg., Cleveland**
WM. BARCLAY PARSONS
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Engineers—Constructors—Managers
Design, Estimates, Supervision, Operation and Management, Examination and Reports



OUR small size excavators are making money for the pit owner with a 100-ton per day market, just as our larger installations are for the car-load gravel shipper. **Write for booklet.**

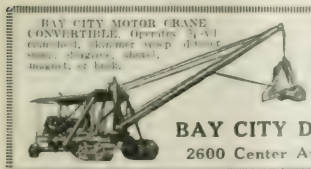
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53 Jackson Blvd., Chicago

SAUERMAN DRAGLINE CABLEWAY EXCAVATORS
dig, convey, elevate and dump in one operation



Here's Your Copy
a Catalog on
Pile Driving
Latest Suggestions for
Pile Driving, Steel Sheeting, Bearing Piles, Etc.
Send for Your Copy Now

National Hoisting Engine Co.
Office and Works: **Harrison, New Jersey**



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CONVERTIBLE. Operates [illegible] equipped, [illegible] scrap, dragline, shovel, magnet, or hook.

CRANES
EXCAVATORS
LAND DREDGES
Walking, Track Crawler and Floating Type

BAY CITY DREDGE WORKS
2600 Center Ave., Bay City, Mich.

THE UNION LINE
Consists of pile driving, excavating machinery, road builders, and contractors' equipment
See larger advertisement second issue of each month.
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GRAY STRAND WIRE ROPE
ELECTRICALLY WELDED WIRE
Wickwire Spencer Steel Corporation
Worcester, Mass. **Buffalo, N. Y.**
District Offices and Warehouses
New York Philadelphia [illegible] Chicago **Boston**
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VULCAN IRON WORKS
THE WARRINGTON (VULCAN)
STEAM PILE HAMMERS
PILE DRIVERS AND PILE DRIVING MACHINERY
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Mobility—*counts big in drainage work*

ON CLEANOUT jobs, where ability to move quickly and easily from job to job is as important as the actual work done, the Northwest Crawler Dragline puts money in the contractor's pocket.

Whatever the job, the Northwest makes every moment count from beginning to end. It loads itself on a flat car—no dismantling necessary. It then unloads itself and goes directly to the job over bad land. It gets right down to its task quickly, handling a $\frac{3}{4}$ or 1-yard bucket on a 35 or 40-foot boom. One man, assisted by the sturdy Northwest, does the work from start to finish. Let us show you how you can make the smallest job produce a bigger margin of profit by doing it the Northwest way.

Northwest Engineering Company
Works: Green Bay, Wisconsin
General Sales Offices: 28 E. Jackson Blvd., Chicago
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NORTHWEST
crawler crane — dragline — pile driver



Ready for a twelve-mile jaunt—

The above photograph shows the Monighan Excavator walking right off the car under its own power—no Cables or Ropes.

It's ready now for a twelve-mile jaunt to the job—twelve miles over rough roads and mud holes, but the Monighan can be depended upon to steadily step right along until it gets there.

And when it gets on the job it will move a bigger yardage because there are **no delays due to traction**—no matter what the condition of the ground.

The Monighan will save you labor, save you planks—it will minimize delay—and save you trouble (lots of it).

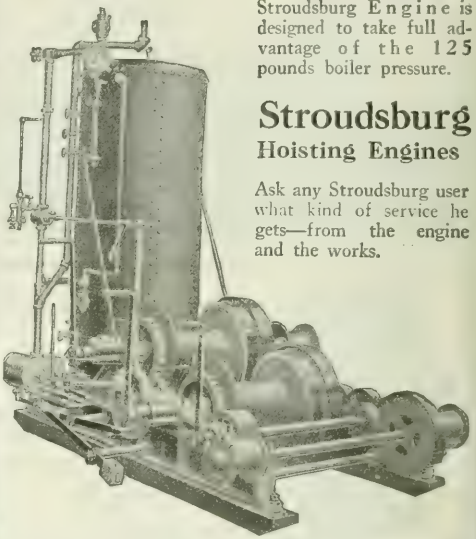
It walks—it's easy to handle.

You should investigate.

Monighan Machine Co.
2024 Carroll Ave., Chicago, Ill.

Proportioned for Fast Work

Every detail of the Stroudsburg Engine is designed to take full advantage of the 125 pounds boiler pressure.



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Hoisting Engines

Ask any Stroudsburg user what kind of service he gets—from the engine and the works.

STROUDSBURG ENGINE WORKS
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Filling, Land Reclamation, Canals and Port Works

River and Harbor Improvements, Deep Waterways and Ship Channels

We are equipped to execute all kinds of dredging, reclamation and port works anywhere in the United States.

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Correspondence Invited from Southern Officials and Corporate and Private Interests Everywhere.

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P&H TRENCH & DRAGLINE EXCAVATORS
PORTABLE CRANES
PAWLING & HARNISCHFEGER CO.
MILWAUKEE, WIS.



LIDGERWOOD TWO-SPEED HOISTS

STEAM—ELECTRIC—BELT DRIVEN

For Operating Slack Line Drag Bucket Excavators

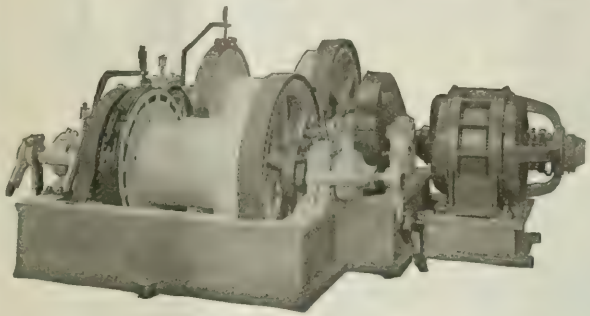


Illustration shows our two-speed electric hoist built in sizes up to 200 H.P. for operating slack line drag line buckets up to and exceeding two yards capacity.

Bucket work is hard on the engine.

The general design of the Lidgerwood Bucket Hoist and the design of each individual part has the strength to meet the severe service of Slack Line Drag Bucket Work.

HOISTS **CABLEWAYS** **DERRICKS**

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London, England Sao Paulo, Brazil Apartado 812, Mexico, D. F.

FLORY HOISTS

S. FLORY MFG. CO., BANGOR, PA.

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For Electric Welding
For Oxy Acetylene Welding

John A. Roebling's Sons Company
Trenton, N. J.



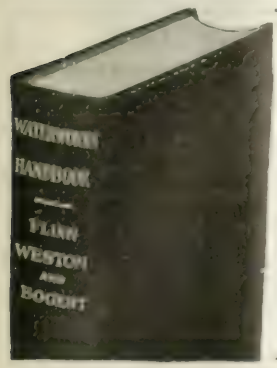
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The [illegible] engineer, superintendent and designer will find in this standard guide all the facts, tables, and methods that will help answer any water system question.

The book covers sources of water supply, collection of water, transportation and delivery of water, distribution of water and character and treatment of water.

Flint, Weston and Bogert's WATERWORKS HANDBOOK. $6.00

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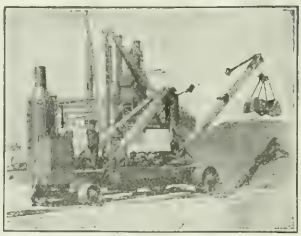
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Builders of the highest type

DERRICKS *and* CRANES

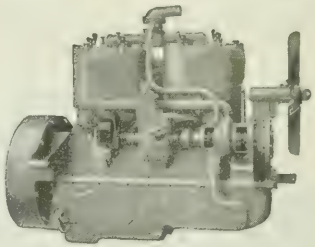




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Plant—Kearny, Newark, N. J.

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No User of Climax Engines Has Ever changed to Any Other Make

Moderate Speed—Heavy Duty—30 to 70 H.P.
Kerosene or Gasoline

CLIMAX

"The Trustworthy Engine"

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Climax Engineering Co.

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Manufacturers of Internal Combustion Engines for Automotive and Industrial Power Purposes

IMPROVED CRANES *and* DERRICKS

Setting entirely new standards of value in material-handling equipment.

Standard and special types for all purposes incorporating exclusive features.

Design and workmanship backed by 50 years' engineering and manufacturing experience.

Lowest initial and operating cost.

Penn Bridge Company, 101 Park Ave., New York
Shops: Beaver Falls and Claysville, Pa.

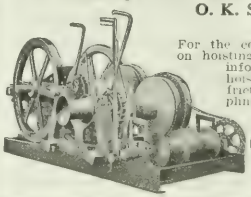
If they're O.K. they're HOISTS

O. K. GASOLINE HOISTS

Do the work of much larger steam outfits—save labor—save operators' wages—save hauling coal and ashes and extra work required to move these big outfits.

O. K. Single and Double Drum Electric Hoists

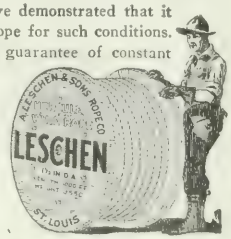
For the contractor who wants real facts on hoisting economies we have ready the information that will help him cut hoisting costs. We also produce friction clutches and cut-off couplings.



O.K. CLUTCH & MACHINERY CO.
Columbia, Pa.

A Service Tested Wire Rope

The use of HERCULES (Red-Strand) Wire Rope on heavy duty equipment is not an experiment, for its many years of actual service have demonstrated that it is a safe and economical rope for such conditions. Its one red strand is our guarantee of constant quality.



Established 1857

A. LESCHEN & SONS ROPE CO.

St. Louis, Mo.

New York, Chicago, Denver, San Francisco

The WILEY WHIRLEY



Derrick—Crane—Dragline

See large advertisement last week and next week.

Glen M. Wiley, Dayton, O.

PARSONS

TRENCH EXCAVATORS—BACKFILLERS

THE PARSONS COMPANY
NEWTON, IOWA

The W-S-M Engine

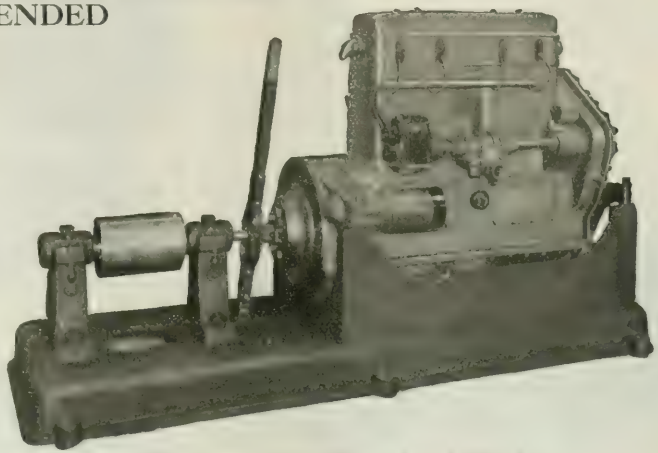
An engine developed by the foremost experts in this field with long life, simplicity, ruggedness, and accessibility as major considerations.

REBORING OF CYLINDERS ELIMINATED. REPLACEABLE CYLINDER LINERS AT MINIMUM COST. NO EXTENDED SHUT DOWN.

Many superior features of design.

Illustration shows full-power take-off for belt drive.

Bulletin on Request.



The Wellman-Seaver-Morgan Co., Cleveland, Ohio

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CLAM SHELL BUCKETS · STIFF LEG BUILDING CRANES
CAR DUMPERS · PILE DRIVERS
THE McMYLER INTERSTATE CO
CLEVELAND OHIO

CRANES All Types All Sizes

CAR DUMPERS

Pile Drivers—Clam Shell Buckets

The McMyler Interstate Co.
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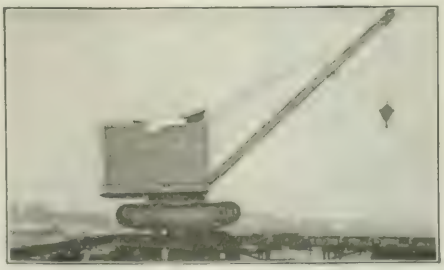
BRANCH OFFICES

Byers Model "10" Full Circle Crane

The Byers Machine Co.
250 Sycamore St., Ravenna, Ohio



BYERS



GOES ANYWHERE

INDUSTRIAL WORKS
BAY CITY MICH U.S.A.

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Prompt deliveries can be made on any type of crane

O. S. DEPENDABLE

7-Ton and 12-Ton Crawling Tread Cranes

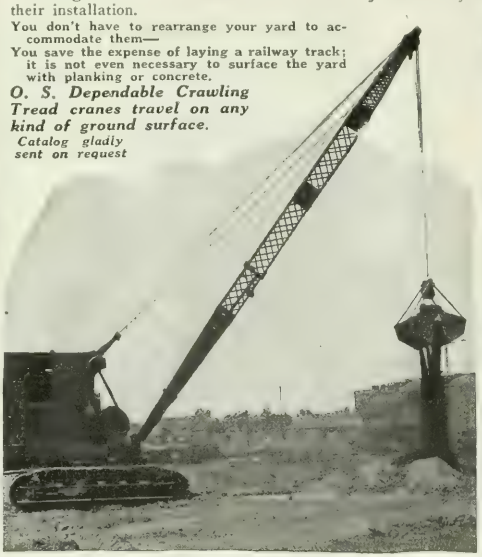
One of the Outstanding Features of the O. S. Dependable Crawling Tread Cranes is the *Initial Economy* effected by their installation.

You don't have to rearrange your yard to accommodate them—

You save the expense of laying a railway track; it is not even necessary to surface the yard with planking or concrete.

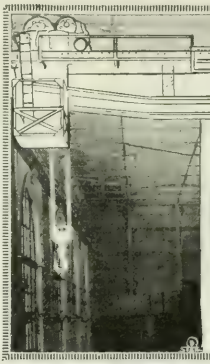
O. S. Dependable Crawling Tread cranes travel on any kind of ground surface.

Catalog gladly sent on request



ORTON & STEINBRENNER COMPANY

Main Office: Chicago, Ill. Factory: Huntington, Ind.



250 Lbs to 500 Tons

CLEVELAND CRANES

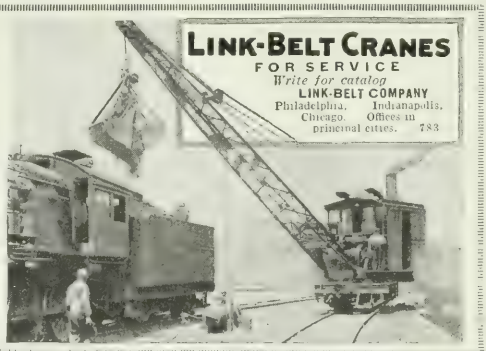
For everlasting crane satisfaction. Your address?

The Cleveland Crane and Engineering Co.
Wickliffe, Ohio

50 Church St. New York City

Farmers Bank Bldg. Pittsburgh, Pa.





LINK-BELT CRANES

FOR SERVICE

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LINK-BELT COMPANY

Philadelphia, Chicago, Indianapolis. Offices in principal cities. 783

ELESCO SUPERHEATERS

save fuel and increase capacity on Steam Shovels and Small Locomotives.

Ask for full information and H-Series Bulletins.

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General Offices: 17 E. 42nd St., New York

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BROWNING LOCOMOTIVE CRANES



A Giant's Strength With a Wizard's Deftness

THE BROWNING COMPANY
East 162nd St. & Waterloo Rd
Cleveland, Ohio



Ask for

NEW BEDFORD

"Good Rope Since 1842"

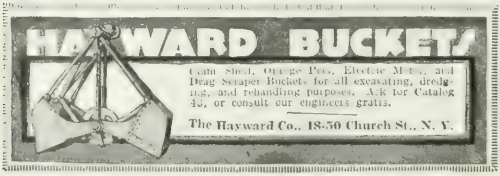
We do not claim it is "the best in the world." But certainly you can depend upon it—ABSOLUTELY—to return full value from every foot for every dollar invested. Interesting rope data on request.

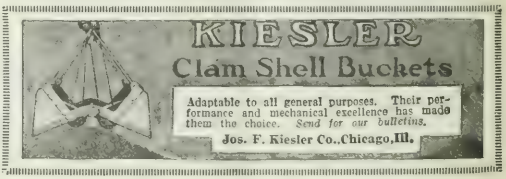
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120 Broadway, New York, N. Y.
Mills: New Bedford, Mass. Established 1842

"TOLEDO CRANES"

Fulfill Every Requirement
Save Time, Labor and Space

THE TOLEDO CRANE CO.
BUCYRUS, OHIO







"Have used a number of WILLIAMS Clamshells, we are working several now, and

"Have *always* received 100% service from WILLIAMS Buckets"

writes Vang Construction Co., Cumberland, Md.

Contractors have learned to depend on any WILLIAMS Bucket as a good bucket—properly designed and well constructed.

Plenty of strength for continuous service under hard conditions.

WILLIAMS principles of construction have been worked out in 25 years of bucket-building experience. These principles are sound, as proved by many remarkable WILLIAMS records. **Many WILLIAMS buckets are still doing good work after 10, 15 and 20 years of continuous use.**

Why take chances—why experiment—when you can be sure of 100% service from your bucket equipment? Profit by the experience of the many successful contractors who have made careful tests and comparisons—and now use WILLIAMS Buckets exclusively.

Write for the WILLIAMS Catalog. It shows many photos of WILLIAMS Buckets doing every kind of clamshell work—some of them doing work you never thought any clamshell could do! It also gives blue-prints and specifications of every bucket in the complete WILLIAMS line. **Ask for Catalog N.**

G. H. WILLIAMS CO., Erie, Pa., U. S. A.

If your crane has only one bucket drum, the WILLIAMS Single Line Bucket is the one you need. Like other WILLIAMS Buckets it has:

The large one-piece hinge bearing which takes the place of 5 moving parts found on most clamshells.

The closing action is quick and powerful because of the tandem arrangement of the sheaves on the Power Arm—makes the cable overhaul much shorter, and speeds up the opening and closing of the scoops.

WILLIAMS

QUICK-ACTING CLAMSHELLS

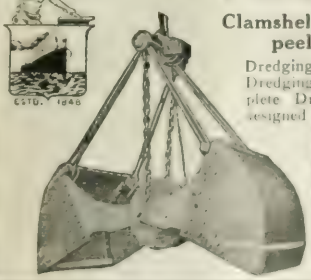
All Parts Guaranteed Against Breakage

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Clamshell and Orange-peel Buckets

Dredging Buckets. Hydraulic Dredging Equipment. Complete Dredges. All work designed and finished in our own plant. Backed by [illegible] years' experience. Repairs to all types of Buckets and Dredges.

Write for our catalog—just published



VULCAN
Iron Works, Inc.
Jersey City, N. J.

LAKEWOOD CLAM SHELLS

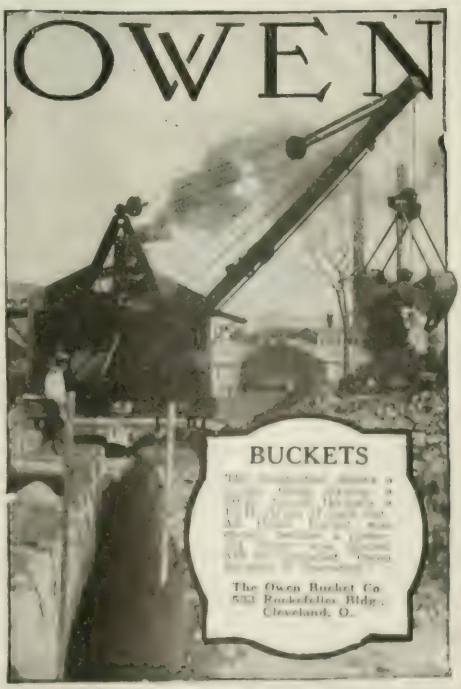
for digging, dredging and handling - send for descriptive bulletin



The Lakewood Engineering Company
Cleveland U. S. A.

Complete Paving Plant — Construction Plant

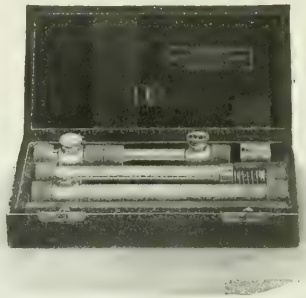
OWEN



BUCKETS

The Owen Bucket Co.
[illegible] Rockefeller Bldg.
Cleveland, O.

BUILDERS VENTURI IRON FOUNDRY



Color and Turbidity of Water Determined with Accuracy

Water is often "colored" by vegetable matter or "turbid" from mud and silt carried in suspension. When water is used for a municipal supply, color and turbidity are always objectionable; when furnished to industries either quality is usually harmful to the products.

The U. S. Geological Survey Design Color and Turbidity Determining Instruments based on the Platinum-Cobalt methods of color measurement devised by Allen Hazen, C. E., make possible at small cost the scientific determination of color and turbidity of water.

We are prepared to furnish complete sets of these Instruments packed in neat, pocket-size cases ready for immediate use in the field.

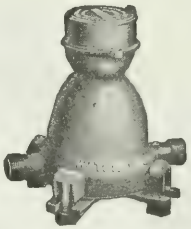
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Builders Iron Foundry, Providence, R. I.

NEW YORK CHICAGO PITTSBURGH ATLANTA DALLAS
SAN FRANCISCO LOS ANGELES PORTLAND, ORE.
TORONTO OTTAWA

86

"WATCH DOG"



WATER METERS

Accurate
Durable
Efficient

GAMON METER COMPANY
Main Office and Works:
NEWARK, NEW JERSEY

SIMPLEX Venturi Tube METERS

For checking up reciprocating pump performance and determining slippage due to imperfection or wear in valves; for measuring delivery of centrifugal pumps and figuring pumping station efficiency; for distributing proportionately the cost of water supplied to several districts; for checking up the performance of filter beds; for detecting waste; for recording daily amounts of sewage handled, and planning future extensions, etc., etc.

SIMPLEX VALVE & METER CO.
5722 Race St., Philadelphia, Pa.

In These Abnormal Times

Information in respect to Commercial Credits and Investment Securities is most essential.

A highly developed Credit Department and an Investment Securities Department are only two of the useful features of the service which we render to customers.

The Coal and Iron National Bank
of the
CITY OF NEW YORK
Capital, Surplus and Profits, $3,000,000

Member N. Y. Clearing House Assn.
Member Federal Reserve System

NEPTUNE
The Pioneer of Progress

Originators
of the
Oil Enclosed Gear Train

ORIGINATORS
of the Frost-Proof Meter

ORIGINATORS
of Anti-Friction Disk Thrust Roller Construction

ORIGINATORS
of Snap Joint Disk Chamber Construction



ORIGINATORS
of the Compound Meter

ORIGINATORS
of Renewable and Heat-Proof Rubber Bushings on All Bearings

ORIGINATORS
of the Portable Test Meter

It is Interchangeable

The Trident Oil Enclosed Gear Train Eliminates Corrosion.

The oil around the gears does not freeze in the Trident Oil Enclosed Gear Train.

Greater accuracy—longer life—increased revenue are assured by the Trident Oil Enclosed Gear Train.

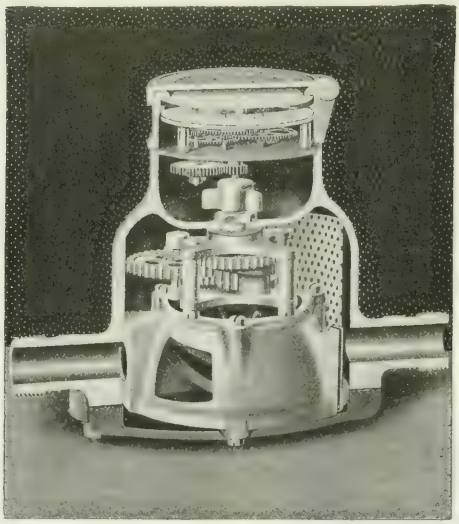
Foreign Matter cannot lodge in the protected Trident Oil Enclosed Gear Train.

Wear is eliminated by correct lubrication in the Trident Oil Enclosed Gear Train.

Neptune Meter Company
Pioneers in Meter Progress
New York City

Boston Chicago San Francisco Atlanta Los Angeles Seattle Portland Cincinnati

Trident Interchangeability applies to every part of every Trident Meter



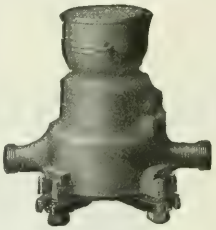
HERSEY DISC METER, MODEL HF which is the Highest type of Frost protected Meter and HERSEY DISC METER, MODEL HD which is the Highest type of Divided or split-case Meter, are the product of thirty-five years' experience and refinement in the manufacture of Water Meters. These Models excel all Meters of all makes in all those essentials which go toward making exceptionally desirable Meters.

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WATER METERS

KEYSTONE
KEYSTONE TYPE "W"
ARCTIC FROST BOTTOM
EUREKA
KEYSTONE COMPOUND



If it is a **Water Meter** service these meters will handle it satisfactorily.

Pittsburgh Meter Company
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Columbia, S. C.: 1433 Main St.
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Stevens Water Level Recorders and Indicators

for water power plants, tides, irrigation, city water supply, sewers and drains.

Let Stevens Recorders plot your Hydrographs

Direct Acting, Long Distance, Duplex and Differential Recorders and Indicators, Transits and Levels.



Bulletins on request

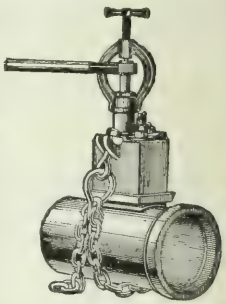
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109 East 70th St., N., Portland, Ore.
Hydrographic and Surveying Instruments

Easily Carried By One Man

This light, durable machine will be sent on approval for 30 days trial. If not as represented, send it back.

Corporation Tapping Machine

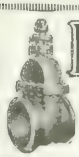
Write for latest bulletins of this and other waterworks appliances.



The A. P. Smith Mfg. Co.
East Orange, N. J.

SLUICE GATES
Shear, Flap and Butterfly Valves
FLEXIBLE JOINTS
COLDWELL-WILCOX CO
NEW WINDSOR NEWBURGH N.Y.

Nicholas Engel
JOHN FOX & CO.
Cast-Iron Water, Gas and Flange Pipe, Special Castings, Fire Hydrants, Valves, General Foundry and Machine Work.
Woolworth Building, 233 Broadway NEW YORK CITY



KENNEDY
Water Gates, Fire Hydrants, Gate Valves
have demonstrated their efficiency, reliability and low maintenance cost in installations throughout the country. 500 different sizes and types. Send for Catalog.
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New York Boston Chicago San Francisco 211

1803 **R. D. Wood & Co.** **1921**
400 Chestnut St., Philadelphia

Cast Iron Pipe
Special Castings
For water, Gas and High Service

Mathews Fire Hydrants
Gate, Foot and Check Valves
Loam Castings
Hydraulic Tools
Gas Producers

JENKINS TRADE MARK

Go into service—
and STAY

Because Jenkins Valves are designed, made, and tested for the maximum service, not merely for the average, they go into service and *stay*. For boiler blow-off service or for handling heavy fluids.

Know genuine Jenkins Valves by the signature and Jenkins "Diamond" cast on the body — at supply houses everywhere.

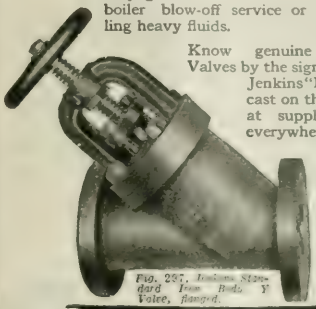


Fig. 237. Jenkins Standard Iron Body Y Valve, flanged.

JENKINS BROS.
New York
London
Boston
Philadelphia
Chicago
Montreal

Jenkins Valves
SINCE 1864 2429-J

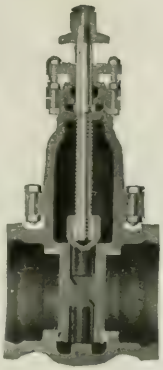


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Valves—Sluice Gates
Floor Stands—Hydrants
Standard and Special Equipment that is backed by 50 years' experience.
Send for Bulletin 38
The Chapman Valve Mfg. Co.,
Indian Orchard, Mass.
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VALVES
72-Inch and Smaller
RENSSELAER VALVE CO.
TROY, N. Y.

POWELL VALVES
THE WHITE STAR VALVE
The Wm. Powell Co., Cincinnati, O.

LUDLOW
Double Gate Valve



FEATURES
of Ludlow Double Gate Valves, one of our best known products:
1—Simple in construction—few parts.
2—No locking or wedging of gates till directly opposite port of valve opening.
3—No grinding or dragging faces of gates on seats.
4—No binding of stem in wedge.
5—No stripping thread from stems.
6—Less wear of faces and gates.
7—Work equally well with pressure on either side of gate.

The question is—

how long will the valve stay watertight?

The answer is—almost forever—if it's a Ludlow. Add together points 2, 3 and 6 of the above seven reasons and you have the reason why. Little wonder then that Ludlow Valves are used so widely and satisfactorily all over the country!

Have you secured your copy of the NEW Ludlow Catalog?

The Ludlow Valve Mfg. Co.
Troy LUDLOW New York

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New York—[illegible] Gold Street
Boston—[illegible] Water Street
Philadelphia—Harrison Building
Pittsburgh—First National Bank Building
Chicago—[illegible] The Rookery
Kansas City Office—R. A. Long Building

Southern Representative:
W. F. Wilcox, American Trust Building, Birmingham, Ala.

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FILTERS

DRY FEED CHEMICAL MACHINES

Write for Bulletins 19-2-3

The total daily capacity
of municipal filtration plants
installed by us is
ONE BILLION GALLONS
Supplying 500 communities

THE NEW YORK CONTINENTAL
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111 W. Monroe St., Chicago, Ill.
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Originators of Mechanical Filtration

Member Associated Manufacturers of Water Purifying Equipment.



Water for New York City leaving the Kensico Reservoir is treated with Liquid Chlorine and W & T Equipment

W & T Equipment

has made Chlorination standard practice in water purification. We publish an interesting series of Technical Bulletins that will be sent on request to anyone interested in Water Purification.

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COMPANY, INCORPORATED
Manufacturers of Chlorine Control Apparatus
NEWARK NEW JERSEY

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WATER-*fit for use*
Filtration and Water
Softening Plants
ROBERTS FILTER MFG. CO.
DARBY PA. *New York Office Flat Iron Bldg*

WATER SOFTENING AND FILTRATION PLANTS
INTERNATIONAL FILTER CO.
333 West 25th Place, Chicago
New York Office: Woolworth Bldg.

GRAVER
Steel
Tank and Plate Work
HEADQUARTERS
Steel Tanks and Steel Plate Work

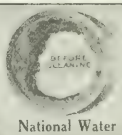
Water Softeners, Filters and Heaters
Water Softeners for Boiler Feed Water Hot Process, Cold Compounds and Zeolite Softeners Pressure and Gravity Filters Water Heaters We make all successful types
GRAVER *Corporation*
East Chicago, Indiana

WATER SOFTENING AND FILTRATION PLANTS
AMERICAN WATER SOFTENER COMPANY
4th and LEHIGH AVES. PHILADELPHIA, PA.
No affiliation or working agreement with any of our competitors

EBG

Liquid Chlorine
Electro Bleaching Gas Co.
PIONEER MANUFACTURERS of LIQUID CHLORINE
Plant NIAGARA FALLS, NY
Main office 18 East 41st Street New York Chicago office 11 So. La Salle St.

Clean Water Mains
Deliver Full Capacity



We are glad to confer with municipal officials or Water Companies
National Methods are patented



National Water Main Cleaning Company, 54 Church Street New York

CHLORIDE OF LIME

For Purifying Water

Pennsylvania Salt Mfg. Company, Philadelphia, Pa., U. S. A.

MICHIGAN PIPE



Joint Simplicity means Low Cost in Handling Low Cost of Installation No Cost for Maintenance

Shipped immediately from stock.

The Michigan Pipe Co.
Dept. 17, Bay City, Michigan

Oklahoma City, Okla., 105 W. 16th St.; New York City, N. Y., 17 E. 42nd St.; Chicago, Ill., Lester Bldg., 15 E. Van Buren; Boston, Mass., Room 737, Oliver Bldg.; Cleveland, Ohio, 919 Union Bldg.; Chattanooga, Tenn., 702 James Bldg.; Philadelphia, Pa., 318 Widener Bldg.; Pittsburgh, Pa., 325 Fulton Bldg.

AMERICAN WOOD PIPE

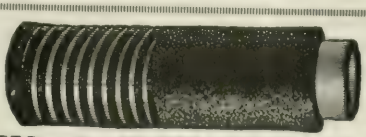
Wire wound and continuous stave wood pipe for—

Irrigation
Water Works
Railroads
Mines, Etc.

Water Pipe—made of Clear Washington Yellow Fir. Steam Pipe—Heart of Washington Cedar, as-[illegible] for [illegible]

Write for Catalog.

AMERICAN WOOD PIPE CO., TACOMA, WASH
Eastern Office: 30 Church St., New York City



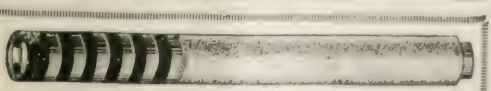
Wyckoff Wood Pipe

Carries 14 to 20% more water than iron or steel and lasts longer.

Frost and corrosion proof. Send for our Catalog for full details.

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H. H. White, 1502 Fourth Nat'l Bank Bldg., Atlanta, Ga.; Johnson-Peters Co., Pittsburgh Terminal Warehouse, Pittsburgh, Pa.; Valley Supply Co., Coal Exchange Bldg., Scranton, Pa.



"STANDARD" WOOD PIPE

Will furnish Pipe to suit Conditions.

Standard Wood Pipe Company, Williamsport, Pa.



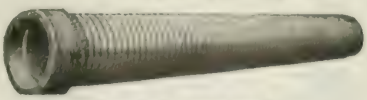
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Are Standard

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Boston & Lockport Block Co.
100 Condor St., East Boston, Mass.
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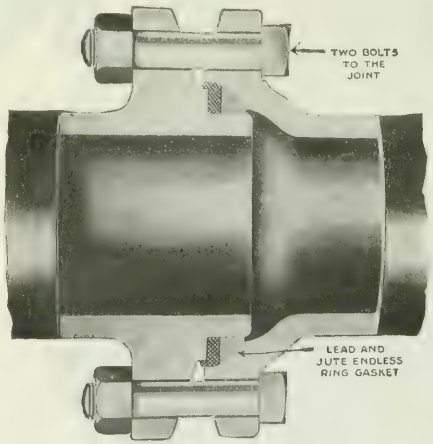
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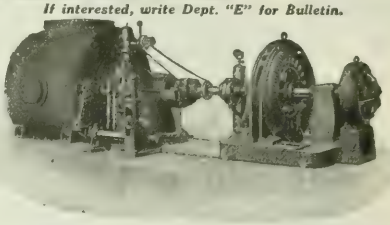
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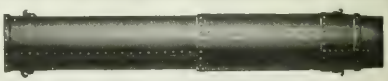
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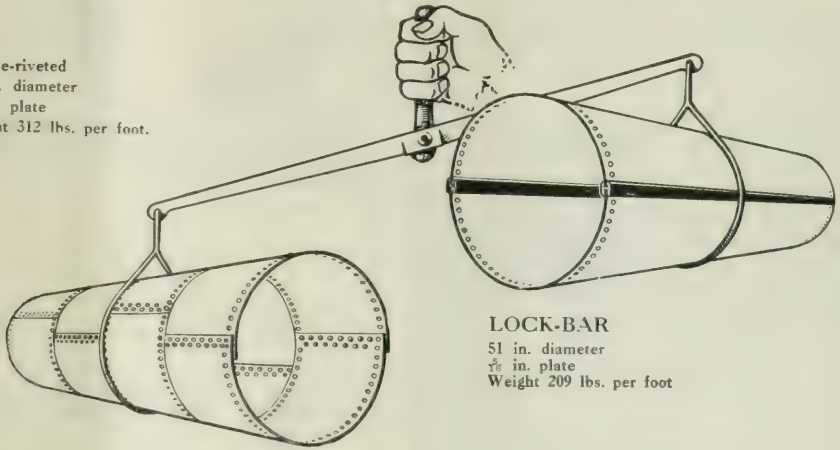
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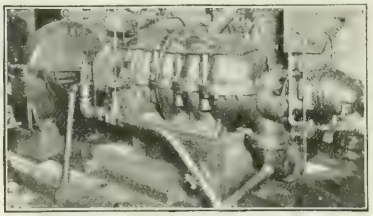
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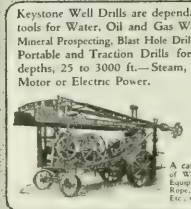
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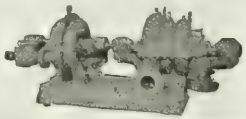


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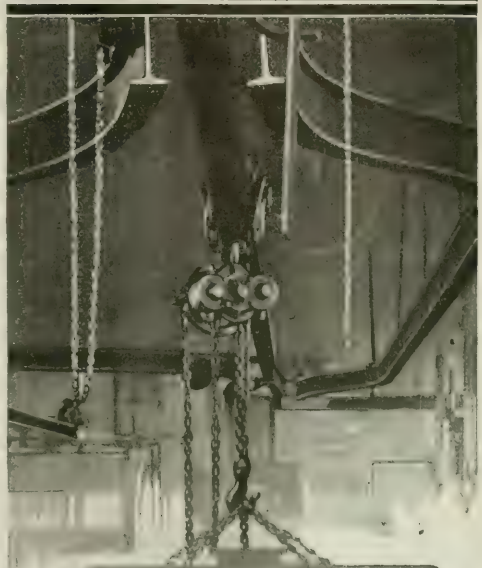
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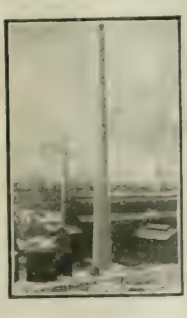
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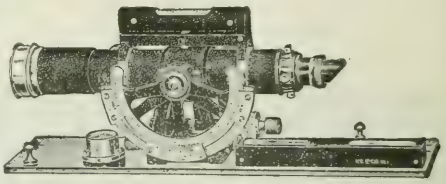
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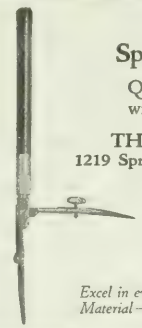
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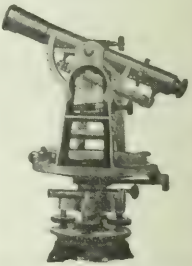
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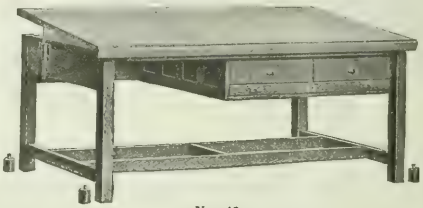
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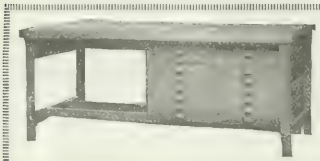
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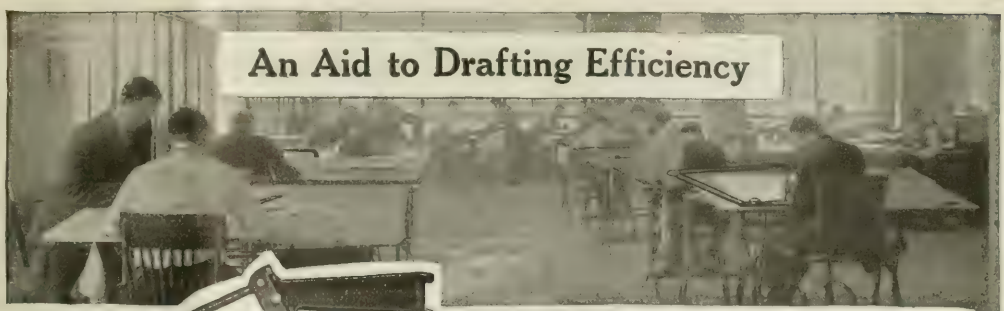
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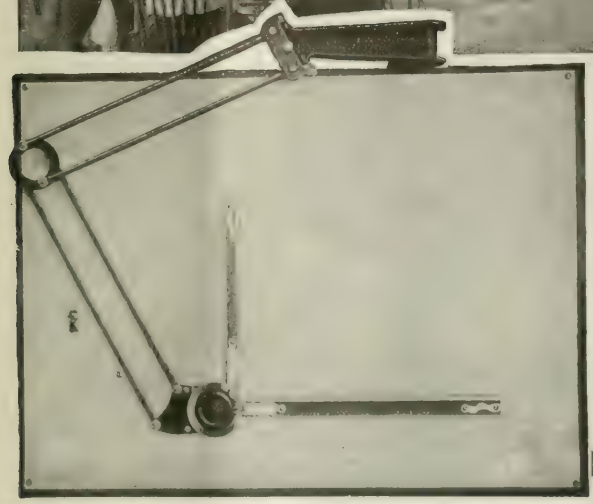
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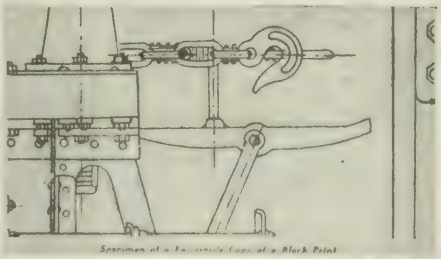
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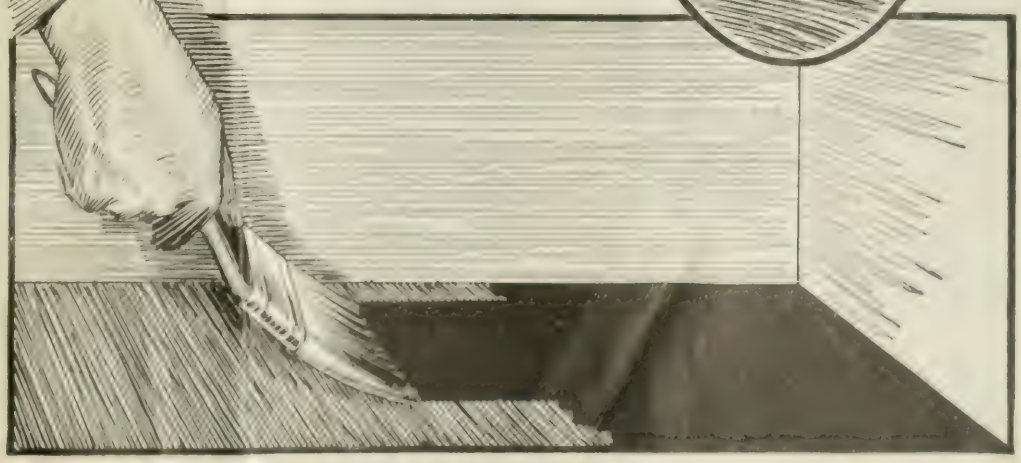
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